CS10/17-T23 & RS10/17-T23
CONDUCTIVITY and RESISTIVITY SENSORS

INSTALLATION and MAINTENANCE MANUAL
for use with
Model T23/C22/T28 Transmitters

YORBA LINDA * CALIFORNIA * 92887 * USA
Your decision to purchase from Electro-Chemical Devices, Inc. has provided you with the finest analytical instrument available. Before you install and commission this product, we highly recommend that you read this instruction manual. If this is your first purchase from ECD, we suggest that you obtain factory-authorized training for those products purchased. At ECD, we believe our most knowledgeable customers are our most valuable customers.

Trademark references:
CV75 is a fluoroelastomer compound developed by E.I. Du Pont De Nemours and International Seal Company, Inc.
Hastelloy C22 is a registered trademark of Haynes International.
Kalrez is a registered trademark for E.I. Du Pont De Nemours Co's perfluoroelastomer.
Kynar is a registered trademark for Penwalt's PVDF.
Ryton is a registered trademark for Phillips 66's polyphenylene sulfide resin.
Teflon is a registered trademark for E.I. Du Pont De Nemours Co's fluorocarbon resin.
Viton is a registered trademark for E.I. Du Pont De Nemours Co's fluoroelastomer.
Scotch-Brite is a registered trademark of the 3M Company.

Abbreviations used in this manual:
CPVC is an abbreviation for chlorinated polyvinyl chloride.
EPR is an abbreviation for an ethylene propylene elastomer.
NEMA is an abbreviation for the National Electrical Manufacturers Association.
Nylon is a generic name for a polyamide polymer.
PES is an abbreviation for polyethersulfone.
PPS is an abbreviation for polyphenylene sulfide thermoplastic.
PVDF is and abbreviation for polyvinyl difluoride.
TFE is an abbreviation for Du Pont's Teflon.
316ss is an abbreviation for 316 grade stainless steel.
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WARRANTY

Electro-Chemical Devices, Inc. (ECD) warrants all products it manufactures to be free from defect in materials and factory workmanship, and agrees to repair or replace any product that fails to perform, as specified, within one (1) year after date of shipment. This warranty shall not apply to any product that has been:

1. Subjected to misuse, negligence or accident;
2. Connected installed, adjusted or otherwise used not in accordance with the instructions furnished by ECD;
3. Repaired, modified or altered by persons not authorized by ECD, resulting in injury to the performance, stability or reliability of the product.

This warranty is in lieu of any other warranty, expressed or implied. ECD reserves the right to make changes in the design or construction of its products at any time, without prior notification, and without incurring any obligation to make any changes in previously delivered products.

Seller's sole liabilities and the buyer's sole remedies under this agreement shall be limited to a refund in the purchase price, or at ECD's discretion, to the repair or replacement of any product that proves, upon ECD's examination, to be defective, when returned to the factory, transportation prepaid by the buyer, within one (1) year of the product's original shipment date. Seller shall not be liable for damages consequential or incidental to defects in any product, for failure of delivery in whole or in part, for injuries resulting from its use, or for any other cause.

This warranty and the writing attached constitute the full understanding of seller and the buyer, and no terms, conditions, understanding, or agreement purporting to modify or vary the terms hereof shall be binding unless hereafter made in writing and signed by an authorized official of Electro-Chemical Devices, Inc.

This warranty does not cover pH, ORP or Specific Ion measurement, reference or combination cartridges or cartridge that have been commissioned in service.

IMPORTANT SERVICE INFORMATION

Use only factory authorized components for repair. Tampering or unauthorized substitution of components may adversely affect the operation of this product and may void the warranty.

If service or repair is required please obtain the serial number(s) or sales order number of the product(s) in question and call ECD's Service Department at:

(800) 729-1333 or (714) 692-1333
or through the ECD web page and email service@ecdi.com

A Return Material Authorization (RMA) number must be obtained from the service department before returning any material to ECD. All material returned to ECD shall be shipped prepaid to the factory.
UNPACKING THE SENSOR

Your Electro-Chemical Devices sensor has been carefully packaged to protect it from damage during shipment and dry storage. Upon receipt please follow the procedure outlined below.

1. Before unpacking, inspect the condition of the shipping container to verify proper handling by the carrier. If damage is noted, save the shipping container as proof of mishandling for the carrier.
2. Check the contents of the shipping container with the items and quantities shown on the packing list. Immediately report any discrepancies to ECD.
3. Save the original packing material until you are satisfied with the contents. In the event the sensor must be returned to ECD, the packing material will allow you to properly ship it to ECD.
4. Familiarize yourself with the sensor before installation, and follow proper installation and wiring procedures.

CONVENTIONS AND TERMS USED IN THIS MANUAL

Throughout this Conductivity and Resistivity sensor manual, several scientific symbols and terms are used and warrant an explanation for a full understanding. Conductivity and Resistivity are two different expressions of virtually the same measurement. Where Resistivity measures the electrical resistance of a solution, Conductivity measures the reciprocal of the resistance, or specific conductance, of a solution. Conductivity can also be defined as the ability of a substance to conduct electric current.

Resistivity is expressed in units of ohms, named after George Simon Ohm, the developer of Ohm's Law (1828). The symbol used for the ohm is the Greek symbol omega (Ω). As the reciprocal of resistance, Conductivity uses the mho as an accepted unit of measurement, which is ohm spelled backward. However, ECD uses the SI unit¹ of measurement, the siemen, named after the European inventor Ernst von Siemens. The siemen is expressed with the capital letter S.

Conductivity measurements are typically used in conductance ranges from 1 microsiemen (µS) to 1 siemen (S). In less conductive environments, typically lower than 1 µS, Resistivity is used. At 1 µS conductance, the resistance is 1 Megohm (MΩ). This is easily calculated by taking the reciprocal of the conductance value. As the reciprocal of conductance, Resistivity values will increase as Conductivity values decrease. The following common Resistivity values list the corresponding Conductivity value.

<table>
<thead>
<tr>
<th>Resistivity (MΩ)</th>
<th>Conductivity (µS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 microsiemen</td>
</tr>
<tr>
<td>4</td>
<td>0.25 microsiemen</td>
</tr>
<tr>
<td>18</td>
<td>0.055 microsiemen</td>
</tr>
<tr>
<td>50</td>
<td>0.02 microsiemen</td>
</tr>
</tbody>
</table>

Please note the use of megohms (MΩ) and microsiemens (µS). These terms are used to express multiples of ohms and fractions of a siemen, based on the metric system. The following list defines the units of measurements used in this manual:

- siemen (S): The basic unit of measurement for conductance.
- millisiemen (mS): 1/1,000th of a siemen. 1 mS = .001 S.
- microsiemen (µS): 1/100,000th of a siemen. 1 µS = .000001 S.
- ohm (Ω): The basic unit of measurement for resistance.
- megohm (MΩ): 1,000,000 ohms. 1 MΩ = 1,000,000 Ω.

Other helpful conversions:

- 1,000,000 µS = 1 S
- 1,000 mS = 1 S
- 1,000 µS = 1 Ms

¹SI units are those units of measurement defined by the International System of Units, a modernized version of the metric system. The system was established by international agreement to provide a logical and interconnected framework for all measurements in science, industry and commerce.
1.0 GENERAL DESCRIPTION
The CS10-T23, CS17-T23, RS10-T23 and RS17-T23 model sensors are a contacting type, modular process sensor for use in process environments where Conductivity and Resistivity are being measured. For use with T23, C22, & T28 transmitters, these sensors incorporate a sensing element, universal housing with signal conditioning and temperature compensation. The modular design allows the sensors to be easily configured, with some limitations, for specific applications using different materials of construction and guard configurations.

The S10 and S17 sensors are available for various environments including ultrapure water, highly corrosive processes, high temperature, sanitary service and more.

Wetted material selections include 316 Stainless Steel, Titanium, Hastelloy C and Kynar; with seal selections of Viton, EPR, Teflon, Kalrez, CV75, and VIT75. A cartridge style Conductivity and Resistivity cartridge allows the element to be replaced if a range change is desired.

S10 and S17 sensors are configured for different service requirements: insertion, submersion, flow-through and valve-retraction applications.

1.1 Model S10
The S10 sensor is configured for insertion or submersion service (refer to application drawing 4034035). Approximately 10" long and 0.750" diameter, the S10 can be inserted into a standard 3/4" pipe fitting using the gland fitting option with the sensor. The sensor can also be inserted into ECD’s flow body for flow-through service. For submersion service, the gland fitting option can be reversed and have a cable seal/extension assembly or standpipe attached.

1.2 Model S17
The S17 is configured for valve-retraction service (refer to application drawing 4034026). The valve-retraction configuration allows removal of the sensor from the process without process shutdown or removal from a tank without draining the tank. This is accomplished by a unique dual o-ring seal gland fitting used in conjunction with a 1” full-port ball valve. The standard 17” long sensor provides sufficient insertion depth in most applications. A high-pressure valve stop at the front of the sensor housing provides blowout protection, as do the redundant stainless steel safety lanyards.

1.3 Identification
Sensors are electro-etched with identifying information on the housing. The information contains the base model number (example: CS10-T23 or RS17-T23), the range of the sensor (example: 10Ms or 20 megohm), and special designators to identify special housing or o-ring materials. Special o-ring and guard materials are branded on the guard, between the two external o-rings.

The serial number is also branded on the sensor housing and helps ECD customer service personnel identify the original order if assistance is required.

The full model number, as found on the packslip, is a list of alphanumeric characters used to designate certain features of the sensor. It is advisable to note the full model numbers and serial numbers of the sensors in this manual. Table 1 in APPENDIX B lists the designators used for the CS10/17-T23 and RS10/17-T23 sensors.

2.0 FAMILIARIZATION
The CS10/17-T23 and RS10/17-T23 sensors are modularly constructed and consist of an external housing, temperature compensation module, connector module, signal conditioner, cartridge and cartridge seal guard (refer to application drawing 4035058). The following sections describe each sensor component.

2.1 Housings
Unless otherwise specified, sensors are supplied with 316 stainless steel housings. Other standard housing materials available are Titanium (grade 2) and Hastelloy C22. Metallic housings are .750” OD.

2.2 Temperature Compensation Modules
The temperature compensation module (TC module) is an internal sensor component with the sensing element located approximately 1.25” from the front of the housing. In the front, the TC module is threaded with Acme threads to receive the cartridge seal guard.
The primary function of the TC module is to compensate for the changes in solution Conductivity or Resistivity due to process temperature variations. Therefore, it is important to be sure the sensor has been inserted a minimum of 1.5” into the process in order to ensure accurate and responsive temperature compensation.

ECD uses a 100,000-ohm thermistor for Conductivity and Resistivity temperature compensation. The temperature is detected by the RTD, and compensated through the circuitry in the T23 transmitter. Temperature slopes are defined in the transmitter.

2.3 Connector Modules
The connector module provides the internal sensor connections from the TC module, cartridge and solution ground to the signal conditioner.

Because S10 and S17 sensors vary in length, S10 and S17 connector modules are not interchangeable. However, all CS and RS connector modules of the same length are interchangeable.

2.4 Signal Conditioners
Various signal conditioners are available depending on the range of the sensor: low-range Conductivity (1μS through 50μS), high-range Conductivity (100μS through 20mS), or Resistivity (2, 20 and 50 megohm). The signal conditioner is located in the rear of, and internal to, the sensor housing in front of the strain relief and fitting. Standard signal conditioners are supplied with a 10-foot cable, but other lengths are available in 10-foot increments. Table 2 (SECTION 2.8) lists the signal conditioner ranges for Conductivity and Resistivity sensors.

*Note: If requested, signal conditioners can be located remotely in the transmitter or in a J- Box.

2.5 E-Modules
The encapsulated connector/amplifier module is an optional configuration to be used where sensors are subjected to severe external environmental conditions. The E-Module is a connector module with an encapsulated signal conditioner. Redundant seals at both ends of the E-Module protect the electronics from moisture that may have entered the sensor assembly. When a sensor incorporates the E-Module, the module must be removed from the front of the sensor housing. Like signal conditioners, E-Modules has cable lengths available in 10-foot increments.

2.6 Cartridges
The cartridge defines the specific Conductivity range and provides the electrical connection to the solution, in conjunction with the metallic housing. Table 2 (Section 2.8) lists the cartridge ranges for Conductivity and Resistivity sensors.

2.7 Seal Guards
As the name implies, this sensor component provides the process seals for the sensor assembly and guards against process intrusion into the sensor with two sets of o-rings. Standard o-rings are Viton; optional o-ring materials include EPR, Fluorosilicone, silicone, Kalrez, CV75 and VIT75.

The seal guard also defines the geometric constant of the sensor, which allows the sensor to be used in different ranges. The open style (refer to application drawing 4035016) is used in the 1μS Conductivity range and all Resistivity ranges. The closed style (refer to application drawing 4035016) is used in Conductivity ranges of 2μS and greater.

Cartridge seal guards are supplied in the same material as the housing. Materials include 316 Stainless Steel, Titanium (grade 2) and Hastelloy C22. Optional configurations include those for high viscosity or pulp service (refer to application drawing 4040001), but special consideration must be given to the installation of sensors with pulp-modified configurations (see Section 3.8).

2.8 Sensor Range Selection
Each sensor must be ordered for a specific range whether it is low range, high range or toroidal. This section presents the ranges currently available for the T23 Conductivity and Resistivity sensors however, because toroidal sensors are of a different construction, they are not included in the discussion.

The value listed in Table 2 is the nominal range of the sensor; however, the transmitter can be scaled to measure a range of 20% of the nominal sensor range to 150% of the nominal sensor range. For example, a sensor with a nominal range of 10 mS can be scaled to measure a range as low as 0 to 2 mS and a range as high as 0 to 15 mS. However, if ranges less than 20% or greater than 150% of the nominal sensor range are being measured, accuracy and stability will be adversely affected.
Changing sensor ranges also has some technical considerations. If changing from one low range Conductivity to another low range Conductivity, the only part requiring replacement is the cartridge. However, changing from a low range to a high range (or vice versa) requires the replacement of both cartridge and signal conditioner. Resistivity sensors also have their own signal conditioners and will require replacement in the event of a range change. Also, Resistivity and 1 µS Conductivity require open style guards, whereas, all others require closed style guards (refer to application drawing 4035016 for an illustration of open and closed style guards).

The transmitter also has some software and hardware considerations limiting the rangeability of high and low Conductivity, as well as Resistivity units. Table 2 lists the ranges, cartridges, guard styles, signal conditioners and instruments configuration required.

### TABLE 2

<table>
<thead>
<tr>
<th>Range</th>
<th>Cartridge</th>
<th>Guard Style</th>
<th>Signal Conditioner</th>
<th>Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 MΩ</td>
<td>2009282</td>
<td>open</td>
<td>2000916 (Resistivity)</td>
<td>Configuration Resistivity</td>
</tr>
<tr>
<td>20 MΩ</td>
<td>2009280</td>
<td>open</td>
<td>2000916 (Resistivity)</td>
<td>Configuration Resistivity</td>
</tr>
<tr>
<td>2 MΩ</td>
<td>2009281</td>
<td>open</td>
<td>2000916 (Resistivity)</td>
<td>Configuration Resistivity</td>
</tr>
<tr>
<td>1 µS</td>
<td>2007114</td>
<td>open</td>
<td>2000915 (Low Conductivity)</td>
<td>Configuration CDL</td>
</tr>
<tr>
<td>2 µS</td>
<td>2007113</td>
<td>closed</td>
<td>2000915 (Low Conductivity)</td>
<td>Configuration CDL</td>
</tr>
<tr>
<td>5 µS</td>
<td>2007112</td>
<td>closed</td>
<td>2000915 (Low Conductivity)</td>
<td>Configuration CDL</td>
</tr>
<tr>
<td>10 µS</td>
<td>2007111</td>
<td>closed</td>
<td>2000915 (Low Conductivity)</td>
<td>Configuration CDL</td>
</tr>
<tr>
<td>20 µS</td>
<td>2007110</td>
<td>closed</td>
<td>2000915 (Low Conductivity)</td>
<td>Configuration CDL</td>
</tr>
<tr>
<td>50 µS</td>
<td>2007109</td>
<td>closed</td>
<td>2000915 (Low Conductivity)</td>
<td>Configuration CDL</td>
</tr>
<tr>
<td>100 µS</td>
<td>2007108</td>
<td>closed</td>
<td>2000913 (High Conductivity)</td>
<td>Configuration CDH</td>
</tr>
<tr>
<td>200 µS</td>
<td>2007107</td>
<td>closed</td>
<td>2000913 (High Conductivity)</td>
<td>Configuration CDH</td>
</tr>
<tr>
<td>500 µS</td>
<td>2007106</td>
<td>closed</td>
<td>2000913 (High Conductivity)</td>
<td>Configuration CDH</td>
</tr>
<tr>
<td>1 mS</td>
<td>2007105</td>
<td>closed</td>
<td>2000913 (High Conductivity)</td>
<td>Configuration CDH</td>
</tr>
<tr>
<td>2 mS</td>
<td>2007104</td>
<td>closed</td>
<td>2000913 (High Conductivity)</td>
<td>Configuration CDH</td>
</tr>
<tr>
<td>5 mS</td>
<td>2007103</td>
<td>closed</td>
<td>2000913 (High Conductivity)</td>
<td>Configuration CDH</td>
</tr>
<tr>
<td>10 mS</td>
<td>2007102</td>
<td>closed</td>
<td>2000913 (High Conductivity)</td>
<td>Configuration CDH</td>
</tr>
<tr>
<td>20 mS</td>
<td>2007101</td>
<td>closed</td>
<td>2000913 (High Conductivity)</td>
<td>Configuration CDH</td>
</tr>
</tbody>
</table>

### 3.0 INSTALLATION

Four typical installation configurations are available for ECD sensors: insertion, submersion, flow-through and valve-retraction. Although there are many ways to accomplish these mounting configurations, ECD recommends the following installation configurations.

#### 3.1 Insertion Mounting

This mounting configuration is accomplished by using the "75" option on (refer to application drawing 4034035). Loosen the gland fitting nut and slide the gland fitting off the sensor. Apply a thread sealant and screw the gland fitting into the mating pipefitting where the sensor will be installed. After the gland fitting is installed, the S10 sensor can be inserted through the fitting by loosening the nut on the fitting. The minimum insertion depth is 1.5 inches; the maximum insertion depth is 8 inches.

To hold the sensor at the desired insertion depth, tighten the nut on the gland fitting to secure the sensor. Gland fittings with nylon or Teflon ferrules should not be over-tightened and only tightened enough to retain the sensor. The torque specification for the gland fitting is 20 ft/lbs. Tightening in this fashion will allow the sensor to be removed from service without removing the nut from the gland fitting and will also allow the sensor to be inserted at different depths when desired. Over-tightening of the nut may swage the nylon or Teflon ferrules to the housing, making it difficult to remove the internal sensor components for service.

Nylon and Teflon ferrules are recommended for applications where process line pressure is 100 psig or less. In applications where process line pressure exceeds 100 psig, ECD recommends the use of stainless steel ferrules or the installation of an S17 valve-retraction sensor. In all cases, proper tightening procedures should be followed for optimum retention and safety.

Gland fittings with stainless steel ferrules should be fully swaged on the sensor housing after the insertion depth is determined. Once the gland fitting is swaged on the sensor housing, the insertion depth is fixed and can only be
changed by replacing the sensor. Stainless steel ferrules are good for applications where the process line pressure exceeds 100 psig.

If the sensor is in an environment where it is exposed to adverse weather conditions or moisture, ECD recommends the installation of a cable seal/extension assembly (see section 3.7). If the customer prefers conduit, installation must incorporate a service loop to facilitate easy removal of the sensor for periodic maintenance.

### 3.2 Submersion Mounting

This configuration is accomplished by using the "75" option (refer to application drawing 4034035). For submersion service, the gland fitting must be positioned on the sensor housing so that the sensor housing will extend into the standpipe approximately 5 inches. Gland fittings for submersion service should be equipped with nylon or Teflon ferrules, which must be tightened on the sensor housing to prevent process intrusion into the standpipe. Application drawing 4035010 illustrates a typical submersion installation.

**IMPORTANT**

Never submerge the sensor without environmental protection where the cable exits the sensor. Never install a sensor in service where it is supported by its cable.

### 3.3 Flow-Through Mounting

Although the insertion configuration can be used as a type of flow-through mounting by inserting the S10 sensor into a pipe tee, ECD has various flow bodies available for convenience. The flow body is available in 316 Stainless Steel, PVC and Kynar. A typical flow-through mounting is shown in application drawing 4033095. Use of ECD's flow body can facilitate a self-cleaning action on the cartridge when the sensor is inserted completely into the flow body due to the increased velocity of the process stream.

If the sensor is in an environment where it is exposed to adverse weather conditions or moisture, ECD recommends the installation of a cable seal/extension assembly (see section 3.7). If the customer prefers conduit, installation must incorporate a service loop to facilitate easy removal of the sensor for periodic maintenance.

### 3.4 Valve-Retraction Mounting

The S17 sensor is specifically designed for valve retraction service (refer to application drawing 4034026). Normally, mounting is direct in a process line or through a tank wall. ECD recommends the valve-retraction mounting for convenience or in applications where process line pressure exceeds 100 psig. The valve-retraction configuration can be used up to 250 psig; however, as process line pressure increases, so does the insertion force required to push the sensor through the valve and into the process. The following table (Table 3) shows the required insertion force for each process pressure listed. For process pressures greater than 250 psig, contact the factory for recommendations.

---

**TABLE 3**

Required Insertion Force for an S17 Sensor at a Particular Process Pressure

<table>
<thead>
<tr>
<th>Process Pressure (psig)</th>
<th>Required Insertion Force (psig)</th>
<th>Process Pressure (psig)</th>
<th>Required Insertion Force (psig)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>11.0</td>
<td>150</td>
<td>66.3</td>
</tr>
<tr>
<td>50</td>
<td>22.1</td>
<td>175</td>
<td>77.4</td>
</tr>
<tr>
<td>75</td>
<td>33.2</td>
<td>200</td>
<td>88.4</td>
</tr>
<tr>
<td>100</td>
<td>44.2</td>
<td>225</td>
<td>99.5</td>
</tr>
<tr>
<td>125</td>
<td>55.3</td>
<td>250</td>
<td>110.5</td>
</tr>
</tbody>
</table>

The S17 with the stainless steel valve (VSS option), the carbon steel valve (VCS option), and the Kynar valve (VKY option) have a 1 inch MNPT connection. Minimum penetration depth is 1.5 inches. Maximum penetration depth is 8 inches with the VSS and VCS options; 7 inches with the VKY option.
To remove the sensor from the valve for installation of the valve refer to application drawing 4035080 and the following directions:

**Note:** Items in bold are identified on application drawing 4035080.

1. Loosen the small swage nut at the rear of the fitting assembly (do not remove the nut from the body of the fitting).
2. Slide the sensor to its stop by pulling it through the ball valve. The safety lanyards will be extended, confirming that the sensor is fully retracted. Note: the safety lanyards are redundant protection; the sensor will come to a stop when the high pressure stop reaches the front of the retainer fitting.

   **CAUTION**
   Do not put hands or fingers between the safety lanyard cables and any part of the sensor. Use the back of the safety lanyard fitting or cable seal handle assembly to pull or guide the sensor through the valve.

3. Lift safety latch.
4. Close the ball valve.
5. Remove the handle retaining nut and the valve handle.
6. Remove the safety lanyards from the valve stem.
7. Unscrew the large retainer nut until it is free from the 1” tube fitting.
8. Firmly pull the retainer fitting from the valve. The sensor will be removed with the fitting.

The valve body and nipple can now be installed.

3.5 Flange Mounting

Flange mountings can be accomplished with the insertion and valve-retraction configurations using the desired flange and by mounting the gland fitting or valve-retraction assembly to the flange. Refer to application drawing 4034033 for insertion assemblies, 4034028 for metallic valve-retraction assemblies, and 4034029 for Kynar valve-retraction assemblies.

3.6 Flow Velocity Considerations

Process stream velocity may affect the sensor mounting requirements. However, some factors must be considered in determining the maximum flow velocity a sensor can withstand. In a process stream composed mostly of water, such as cooling water, the recommended maximum velocity to which a fully inserted S10 or S17 sensor can be exposed is generally 10 feet per second. However, the recommended maximum velocity will decrease as the viscosity of the process stream increases or as turbulence increases. If a high velocity already exists, caution must be used in determining sensor location. Because velocity is amplified when turbulence exists, this caution applies to locations such as the discharge side of a pump or near a bend in the process piping.

In some cases, velocity may be beneficial in obtaining a “self-cleaning” effect, because the velocity of the process tends to keep solids from accumulating on the sensor and its cartridge. This is especially helpful in processes where coating of the cartridges is common. However, velocities that can create cavitation must be avoided because the air or bubbles created can adversely affect the Conductivity or Resistivity readings.

3.7 Cable Seal Installation

The cable seal/extension assembly (S10 sensors) and cable seal/handle assembly provides a redundant sensor back seal to protect the internal sensor components from the external environment. The cable seal/handle assembly provides a handle with which to retract an S17 sensor from the process.

A cable seal is necessary on sensors located outside or in an environment where the back of the sensor is exposed to moisture. Cable seals are detailed in ECD application drawings 4045030, 4045031 and 4045032. Refer to these drawings to select the proper cable seal installation configuration.

3.8 Special Mounting Considerations

For sensors with pulp-modified guard configurations, consideration must be given to the mounting and calibration. The standard guard configuration provides restriction of the magnetic flux lines generated by the Conductivity or Resistivity cartridges, making the sensor non-position sensitive (refer to figure 1 in application drawing 4035017). However, the pulp-modified configurations remove this protection. With the flux lines exposed, the sensor becomes position sensitive (refer to figure 2 in application drawing 4035017). Any interference with the exposed flux lines will change the geometric constant causing a change in the Conductivity or Resistivity reading. Therefore, if a sensor is calibrated in a non-restrictive environment, such as a large beaker, the calibration will be invalid when the sensor is re-installed into a restricted installation, such as a pipe tee or cross. If the pulp-modified sensor is submersed into a tank and located too close to the bottom or side of the tank, the Conductivity or Resistivity reading will also be affected.
Therefore, when a sensor with the pulp-modified configuration is installed into a restricted space, such as a pipe tee or a cross, consideration must be made in the manner the sensor is calibrated. The calibration should be performed in-line, or a mock-up of the installation should be made to add standard solutions and perform calibrations.

3.9 Wiring

Wiring connections for Conductivity and Resistivity sensors vary, depending on the instrument model number and range selected. The proper wiring drawing can be selected from the next page.

<table>
<thead>
<tr>
<th>Drawing</th>
<th>Instrument Model</th>
<th>Sensor Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>4014017</td>
<td>T23-CDH</td>
<td>High-range Conductivity sensors (100µS through 20mS).</td>
</tr>
<tr>
<td>4014025</td>
<td>T23-RS &amp; T23-CDL</td>
<td>All Resistivity sensors and low-range Conductivity sensors (through 50µS).</td>
</tr>
</tbody>
</table>

*NOTE: Wiring drawings can be found in section 9.0.*

Standard sensors are supplied with 10 feet of cable; however, other cable lengths are available in 10 foot increments. Although sensor to instrument cabling for CS10/17-T23 and RS10/17-T23 sensors can be extended to 50 feet, ECD recommends 10 feet for convenience. This allows a technician to perform buffer calibrations in the immediate vicinity of the instrument and eliminates the need for two people to perform the calibration. If the instrument cannot be located near the sensor, ECD recommends a junction box be mounted as close to the sensor as possible with wire terminations for the sensor cable. An extension cable can be then be used to connect to the instrument. See section 8.0 for junction box and cable part numbers.

4.0 MAINTENANCE

4.1 Cleaning

An important aspect of sensor maintenance is the service of the measurement surfaces (cartridge and guard). After being in operation, the sensor may begin to exhibit slow response or non-reproducible measurements. This may be due to coating of measurement surfaces from hard deposits, oil, grease or some other foreign substance. Regular sensor cleaning and calibration reduces the problems associated with coating of the measurement surfaces. Frequency of cleaning will depend on the process and application.

If the measurement surfaces are extremely pitted or coated, it may be necessary to replace the cartridge and guard. Refer to section 8.11 for replacement cartridges.

4.2 Cartridge Replacement

Replacement of the cartridge may be required if excessive pitting or coating is observed. Also, limited range changes can be accomplished by cartridge replacement. If a cartridge is not identified with the part number or range, refer to Section 6.0 for the testing procedure. The following procedure explains how to replace the cartridge in the sensor assembly (refer to application drawing 4035016):

1. Remove the seal guard from the front of the sensor assembly by unscrewing.
2. Remove the old cartridge by turning it counterclockwise 1/4 turn and pulling the cartridge from the front of the housing. Note: The cartridge may come out of the sensor assembly when the guard is removed.
3. Insert the new cartridge into the sensor assembly and lock it in place with a 1/4-turn clockwise twist.
4. Inspect the “o” ring seals on the guard assembly. Replace and lubricate the “o”-ring seals as needed.
5. Guide the seal guard over the front of the cartridge. Even when silicon grease is used, some resistance will be felt as the internal o-rings contact the body.
6. With a twisting motion, continue to slide the guard over the body until the threads on the guard engage.
7. Tighten the seal guard until the front external o-ring is seated within the housing. DO NOT OVER-TIGHTEN!!
8. The sensor may now be calibrated with the instrument.

*IMPORTANT*

If excessive force is required during seal guard installation, check for proper thread engagement or for an obstruction.

4.3 Seal Guard & O-Rings

The internal and external “o”-ring seals keep the process from entering the sensor electronics. Therefore, it is extremely important to maintain these seals, each time the seal guard is removed, by proper inspection & lubrication.

The guard is removed by unscrewing as shown in application drawing 4035016. Inspect the internal and external “o”-rings, and replace if they are damaged or flat. Before reassembly, thoroughly clean and dry the seal guard and lubricate the o-rings with a silicone grease (ECD p/n 9270111). Replacement o-ring kits and seal guards are found in sections 8.3 and 8.5, respectively.
4.4 Signal Conditioning Amplifier

Because the signal conditioning amplifier is sealed within the sensor, there is typically no maintenance of this component. However, in the event of moisture or process intrusion, the signal conditioner may become damaged, requiring replacement. In this case ECD will require the signal conditioner part number as branded on the signal conditioner housing. To remove the signal conditioner from the sensor body, follow the sensor disassembly directions section 4.6.

4.5 Temperature Compensator

Because the temperature compensation (TC) module is sealed within the sensor, there is typically no maintenance of this component. However, in the event of process intrusion, the TC module may become damaged, requiring replacement. In this case, ECD will require the full model number or serial number of the sensor to identify the correct TC for your sensor. To remove the TC module, follow the sensor disassembly directions section 4.6.

Should the removable pins between the TC module and the connector module become lost or damaged, they may be replaced with #22 solid copper wire or buss wire.

4.6 Sensor Disassembly

Refer to application drawing 4035058, an exploded view of the S10 and S17 sensors and drawing 6000002, the strain relief assembly. To disassemble the sensor and remove the connector module and TC module, follow the steps below:

1. Removal of the External Cable "T" or Safety handle
   a. Loosen the nut on the cord grip (Turn counter clockwise) until the cable is freed.
   b. Loosen the nut on the 75 fitting and slide the External cable "T" / Safety Handle down the sensor cable.

2. Removal of the Strain Relief / Back Cap
   a. Unscrew the strain relief tail, slide the strain relief tail, the plastic lock ring, and the rubber ferrule up the cable. (refer to drawing 6000002)
   b. Using a 6" crescent wrench on the rear cap (the white cap) remove the back cap.
      **CAUTION: Do not unscrew the body of the black strain relief fitting from the white back cap.**

3. Removal of the signal conditioner. (refer to drawing 4035058)
   a. Gently pull the sensor cable as close to the sensor housing as possible.
   b. The signal conditioner will pull out of the sensor body with the cable.
      **IMPORTANT: Do not force the signal conditioner. Force could cause the sensor to sustain further damage.**

4. Removal of the Temperature compensation (TC) module and the Connector module. (refer to drawing 4035058)
   a. Unscrew the seal guard until two o-rings are visible. The threads should still be engaged.
   b. Grasp the seal guard in one hand and the front of the housing in the other hand and firmly pull the electrode away from the housing. The TC and connector module will pull out the front of the housing.
   c. Fully remove the seal guard from the TC module threads.
   d. Lift the TC module away from the connector module to separate them. The pins are held in by sockets and can remain in either component.

4.7 Sensor Assembly

1. Installation of the TC module and the connector module.
   a. Inspect that both of the TC pins are present and not damaged, plug the TC module onto the connector module. Make sure that both of the pins are making contact between the TC and the connector module.
   b. Initiate installation of the seal guard by turning it one full turn. The threads should be engaged.
   c. Inspect the inside of the sensor housing. It should be free of dirt, oil, and water.
   d. Slide the back of the connector module into the front of the sensor housing. Continue to push the connector module until it bottoms on the inside lip at the rear of the housing.
   e. Thoroughly inspect (replace if necessary) and lubricate the o-ring seals with a silicone compound.

2. Installation of the signal conditioner
   a. Slide the signal conditioner into the back of the sensor housing. The signal conditioner is keyed. By turning the signal conditioner you will feel it line up with the connector module.

3. Installation of the back cap / strain relief. Follow section 1 of the disassembly procedure in reverse order.

4. Installation of external cable "T" / safety handle. Follow section 1 of the disassembly procedure in reverse order.
4.8 E-Module Replacement
Because the E-Module is a connector module with an encapsulated signal conditioner, it is necessary to disassemble the sensor in order to replace the E-Module. The following procedure is used to remove the E-Module.

1. Disconnect the sensor wires from the instrument.
2. Remove the strain relief, sliding it completely off the cable. Refer to section 4.6. However, do not attempt to pull the cable from the rear of the sensor.
3. Unscrew the electrode cartridge until the first o-ring is visible.
4. Grasp the electrode cartridge in one hand and the front of the housing in the other hand.
5. Firmly pull the seal guard away from the housing. The TC/E-module assembly will pull out the front of the housing.
6. Pull the remainder of the cable through the housing.
7. Remove the seal guard & cartridge. The TC module can now be separated from the E-Module.

4.9 Valve Retraction Assembly
The valve retraction assembly must be periodically inspected and serviced to provide maximum safety and optimum performance. There are two basic valve retraction assemblies: 316 stainless steel full-port ball valve and Kynar (PVDF) true-union ball valves. The retraction methods are basically the same with some minor differences as pointed out in the retraction procedure outlined below. Refer to application drawing 4035080 for the VSS and VCS options, application drawing 4035082 for VKY options (items in bold are identified on the application drawing).

1. Check to make sure the valve is fully opened.
2. Slowly loosen the small swage nut. Use caution in loosening this nut if the process is pressurized - sensor may retract without warning.
3. Grasp the sensor housing and slowly pull the sensor through the valve until it stops.
4. Verify that the sensor is fully retracted by inspection of the safety lanyards. The safety lanyards should be extended when the sensor is fully retracted through the valve. Note: the safety lanyards are for redundant protection; the sensor will come to a stop when the high pressure stop reaches the front of the retainer fitting.
5. Close the valve.
6. Remove the valve handle. The valve handle on the stainless steel ball valve can be removed after the handle retaining nut has been removed. The valve handle on the Kynar valve is removed by grasping the handle and firmly pulling it off the valve stem.
7. Remove the safety lanyards from around the valve stem.
8. For the stainless steel ball valves, loosen and remove the large retainer nut from the retainer fitting. For Kynar ball valves, loosen and remove the union nut on the sensor side of the ball valve.
9. Grasp the sensor and firmly pull away from the valve. A small amount of process coming out with the sensor is normal.

IMPORTANT
To ensure that the valve is not opened while the sensor is not installed, do not re-install the Valve handles on the valve until the sensor as been secured through the valve.

Service of the valve-retraction assembly includes the inspection of the o-rings, high pressure stop and the safety lanyards. The o-rings should be lubricated with a silicone grease whenever the sensor is removed from service and before it is reinstalled. Inspect the condition of the o-rings. If they are damaged or show signs of fatigue, replace them with the proper o-ring kit, available from ECD. Please note that in order to inspect the internal o-rings, the safety lanyard fitting must be removed so that the gland fitting can be removed from the sensor.

If the sensor is coated, making it difficult to retract through the valve, the housing should be cleaned and hand polished. After the polishing, the housing can be lightly coated with a silicone grease to help keep the internal o-rings lubricated.

The high pressure stop should be inspected every time the sensor is removed from the valve assembly. If the high pressure stop shows signs of fatigue or cracking, replace the housing. Also, if the sensor shows sign of chemical attack, the sensor housing should be replaced.

When inspecting the safety lanyards, look for kinks or fraying of the lanyard. Check to see if the lanyard is properly secured in the lugs and the back fitting. Also look for corrosion of the lanyard and lugs. If an inspection reveals any of the described anomalies, replace the lanyards.
If the safety lanyard fitting must be removed for any reason, inspect the nylon ferrule and replace if damaged. When re-installing the safety lanyard fitting, tighten properly to ensure that it is anchored to the housing. The proper torque specification for retaining the safety lanyard fitting is 20 ft/lbs.

**IMPORTANT**

To ensure maximum operator safety, the safety lanyards must always be properly installed.

Never modify or alter the safety lanyards or the safety lanyard mounting hardware.

5.0 SENSOR CALIBRATION

Calibrations are necessary to compensate for minor geometric variations of the sensor and to compensate for coatings or corrosion of the cartridges that occur over time. When installing new cartridges or when installing a new sensor a calibration must be performed. Refer to the calibration procedure in the T23 conductivity transmitter manual.

6.0 CARTRIDGE TESTING

Testing of Conductivity and Resistivity cartridges is only required if a cartridge is suspected of a failure or if the cartridge range value is not known. The two tests that can be performed on the cartridges are a continuity and resistance test.

The continuity test verifies the connection between the center conductor of the BNC connector on the back of the cartridge and the metallic cartridge at the front of the cartridge. An ohmmeter will verify the correct resistance value for the corresponding range. If either the continuity test or the resistance test reveals an open circuit, the cartridge is defective and should be replaced. If the resistance test reveals a direct short, the cartridge should be replaced.

Table 2 in the range selection section of the manual (page 5) provides the resistance values for each Conductivity and Resistivity cartridge range. The resistance is measured between the center conductor of the BNC connector and the BNC shell.
# 7.0 Troubleshooting Guide

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible Causes</th>
<th>Suggested Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erratic Conductivity or Resistivity readings</td>
<td>Sensor not wired properly.</td>
<td>Using the applicable wiring drawing, verify the sensor is properly wired.</td>
</tr>
<tr>
<td></td>
<td>Sensor and the cartridge are not properly submersed in the process.</td>
<td>Verify that the sensor housing and the cartridge are in contact with the process.</td>
</tr>
<tr>
<td></td>
<td>Cartridge is not fully engaged in the sensor body.</td>
<td>Check cartridge to see that it is fully engaged in sensor body.</td>
</tr>
<tr>
<td></td>
<td>Sensor is installed in a area where bubbles or air are present.</td>
<td>Relocate the sensor to an area where no air is present and where no air can become trapped in the guard.</td>
</tr>
<tr>
<td></td>
<td>Signal conditioner not properly engaged in the rear of the sensor body.</td>
<td>Verify that the signal conditioner is properly engaged in the sensor body.</td>
</tr>
<tr>
<td></td>
<td>Instrument is not properly calibrated. May have been calibrated with no slope (infinite gain).</td>
<td>Verify Instrument calibration electronically, then recalibrate with cartridges using buffers. Verify the value of the buffer solutions being used.</td>
</tr>
<tr>
<td></td>
<td>Cartridge insulator is dirty, creating an electrical leakage path.</td>
<td>Clean the cartridges and insulator; calibrate the instrument.</td>
</tr>
<tr>
<td>Conductivity or Resistivity readings are not linear</td>
<td>Sensor range is incorrect for the selected range.</td>
<td>Verify the sensor range.</td>
</tr>
<tr>
<td></td>
<td>Instrument is not properly calibrated.</td>
<td>Verify instrument calibration.</td>
</tr>
<tr>
<td>Slow response.</td>
<td>Coated or dirty cartridges.</td>
<td>Clean the cartridges and calibrate instrument.</td>
</tr>
<tr>
<td>Conductivity or Resistivity reading changes when temperature is rapidly increased or decreased</td>
<td>Temperature compensation element has not reached equilibrium.</td>
<td>Wait for the temperature compensation element to stabilize to the process temperature. Check sensor insertion depth to make sure the internal temperature element is exposed to the process.</td>
</tr>
<tr>
<td>Output is zero.</td>
<td>Sensor is not wired properly.</td>
<td>Using the applicable wiring drawing, verify the sensor is properly wired to the instrument.</td>
</tr>
<tr>
<td></td>
<td>Sensor is not immersed in the solution.</td>
<td>Check location of sensor and make sure the cartridges are in solution.</td>
</tr>
<tr>
<td>Output is off-scale.</td>
<td>Sensor is not wired properly.</td>
<td>Using the applicable wiring drawing, verify that the sensor is properly wired to the transmitter or analyzer.</td>
</tr>
<tr>
<td></td>
<td>Sensor range is incorrect for the selected range.</td>
<td>Verify the sensor range. Select a sensor range for the optimum process range.</td>
</tr>
<tr>
<td></td>
<td>Sensor is shorted.</td>
<td>Locate and remove the source of the short.</td>
</tr>
<tr>
<td></td>
<td>Temperature compensation element is open circuit.</td>
<td>Replace temperature compensation element.</td>
</tr>
<tr>
<td>Issue</td>
<td>Cause</td>
<td>Solution</td>
</tr>
<tr>
<td>-------</td>
<td>-------</td>
<td>----------</td>
</tr>
<tr>
<td>It is difficult to fully engage the seal guard.</td>
<td>There is an obstruction in the sensor housing.</td>
<td>Remove the seal guard and cartridge and look for the obstruction.</td>
</tr>
<tr>
<td></td>
<td>The o-rings are worn or not lubricated.</td>
<td>Remove the seal guard, inspect the o-rings, replace and lubricate as necessary.</td>
</tr>
<tr>
<td>Calibration readings are not repeatable.</td>
<td>Air is trapped in the sensor between the two cartridges.</td>
<td>Clear the air from the front of the sensor with vigorous agitation for a few seconds.</td>
</tr>
</tbody>
</table>
8.0 RECOMMENDED SPARE PARTS & ACCESSORIES

Recommended spare sensor parts will depend on the sensor configuration and the specific application. However, as a minimum, the following spare parts are recommended:

- 1 ea CA351 analyzer/calibrator
- 1 ea seal guard with o-rings
- 2 ea o-ring kit

Select the appropriate spare parts from the following sections. If the required part is not listed, contact the factory or your local factory representative.

8.1 Connector Modules

<table>
<thead>
<tr>
<th>P/N</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000720</td>
<td>CS10 connector module (also used for PHS10)</td>
</tr>
<tr>
<td>2000721</td>
<td>CS17 connector module (also used for PHS17)</td>
</tr>
</tbody>
</table>

8.2 TC Modules

<table>
<thead>
<tr>
<th>P/N</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007011</td>
<td>100,000 ohm thermistor</td>
</tr>
</tbody>
</table>

8.3 O-Ring Kits

<table>
<thead>
<tr>
<th>GUARD:</th>
<th>VALVE ASSEMBLIES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>P/N</td>
<td>Description</td>
</tr>
<tr>
<td>2000292</td>
<td>Guard kit, CV-75</td>
</tr>
<tr>
<td>2000293</td>
<td>Guard kit, Kalrez</td>
</tr>
<tr>
<td>2000309</td>
<td>Guard kit, EPR</td>
</tr>
<tr>
<td>2000310</td>
<td>Guard kit, Viton</td>
</tr>
<tr>
<td>9556201</td>
<td>Center o-ring for closed guards</td>
</tr>
</tbody>
</table>

8.4 Sensor Housings

<table>
<thead>
<tr>
<th>P/N</th>
<th>Description</th>
<th>P/N</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3300370</td>
<td>S10, 316 stainless steel</td>
<td>3300380</td>
<td>S17, 316 stainless steel</td>
</tr>
<tr>
<td>3300375</td>
<td>S10, titanium</td>
<td>3300381</td>
<td>S17, titanium</td>
</tr>
<tr>
<td>3300376</td>
<td>S10, Hastelloy C</td>
<td>3300382</td>
<td>S17, Hastelloy C</td>
</tr>
</tbody>
</table>

8.5 Guard Assemblies

<table>
<thead>
<tr>
<th>P/N</th>
<th>Guard Material</th>
<th>Style</th>
<th>O-Rings</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2500154</td>
<td>Titanium</td>
<td>Open</td>
<td>Viton</td>
<td></td>
</tr>
<tr>
<td>2500156</td>
<td>Stainless steel</td>
<td>Open</td>
<td>Viton</td>
<td></td>
</tr>
<tr>
<td>2500166</td>
<td>Hastelloy</td>
<td>Open</td>
<td>Viton</td>
<td></td>
</tr>
<tr>
<td>2500167</td>
<td>Stainless steel</td>
<td>Closed</td>
<td>Viton</td>
<td></td>
</tr>
<tr>
<td>2500172</td>
<td>Hastelloy C</td>
<td>Closed</td>
<td>Viton</td>
<td></td>
</tr>
<tr>
<td>2500174</td>
<td>Titanium</td>
<td>Closed</td>
<td>Viton</td>
<td></td>
</tr>
</tbody>
</table>

For other guard configurations or o-ring seal materials contact the factory.

8.6 Signal Conditioners, Cable Modules & Cable

<table>
<thead>
<tr>
<th>P/N</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000913</td>
<td>High range Conductivity, T23 (100 µS through 20 mS)</td>
</tr>
<tr>
<td>2000915</td>
<td>Low range Conductivity, T23 (1 µS through 50 µS)</td>
</tr>
<tr>
<td>2000916</td>
<td>Resistivity, T23</td>
</tr>
</tbody>
</table>

8.7 Fittings & Valve Assemblies

<table>
<thead>
<tr>
<th>P/N</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000070</td>
<td>Gland ftg, 3/4&quot; NPT, 316ss, nylon ferrule (75)</td>
</tr>
<tr>
<td>2000072</td>
<td>Gland ftg, 3/4&quot; NPT, 316ss, TFE ferrule (75HT)</td>
</tr>
<tr>
<td>2000743</td>
<td>Valve retraction assy (VPP), 1&quot; x 3/4&quot;, polypropylene valve, TFE ftg, Viton o-rings</td>
</tr>
<tr>
<td>2000745</td>
<td>Valve retraction assy (VSS), 1&quot; x 3/4&quot;, 316ss valve &amp; ftg, nylon ferrule, Viton o-rings</td>
</tr>
<tr>
<td>3600061</td>
<td>Gland ftg, 3/4&quot; NPT, all TFE (75TFE)</td>
</tr>
<tr>
<td>9360080</td>
<td>Ferrule, 3/4&quot; TFE</td>
</tr>
<tr>
<td>9360081</td>
<td>Ferrule, 3/4&quot; nylon</td>
</tr>
</tbody>
</table>
### 8.8 Sanitary Fittings

<table>
<thead>
<tr>
<th>P/N</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000076</td>
<td>Ingold fitting set, 25 mm port</td>
</tr>
<tr>
<td>2000755</td>
<td>Sanitary ftg for sterilization service, 1&quot;, 316ss, Viton o-rings, nylon ferrule</td>
</tr>
<tr>
<td>2000756</td>
<td>Sanitary ftg for sterilization service, 2&quot;, 316ss, Viton o-rings, nylon ferrule</td>
</tr>
</tbody>
</table>

### 8.9 Cable Seal Assemblies

<table>
<thead>
<tr>
<th>P/N</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000091</td>
<td>&quot;T&quot; style, no fitting</td>
</tr>
<tr>
<td>1000096</td>
<td>&quot;T&quot; style, 3/4&quot; polypro fitting</td>
</tr>
<tr>
<td>1000098</td>
<td>&quot;T&quot; style, 3/4&quot; SS fitting</td>
</tr>
<tr>
<td>1000166</td>
<td>&quot;T&quot; style handle, 3/4&quot; polypro fitting, with lanyards</td>
</tr>
<tr>
<td>2001050</td>
<td>&quot;T&quot; style handle, 3/4&quot; SS gland fitting assembly set</td>
</tr>
</tbody>
</table>

### 8.10 Junction Boxes

<table>
<thead>
<tr>
<th>P/N</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000056</td>
<td>Pull box, 1&quot; socket, PVC, 12-point terminal block</td>
</tr>
</tbody>
</table>

### 8.11 Cartridges

<table>
<thead>
<tr>
<th>P/N</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007101</td>
<td>20 mS, 316 stainless steel</td>
</tr>
<tr>
<td>2007102</td>
<td>10 mS, 316 stainless steel</td>
</tr>
<tr>
<td>2007103</td>
<td>5 mS, 316 stainless steel</td>
</tr>
<tr>
<td>2007104</td>
<td>2 mS, 316 stainless steel</td>
</tr>
<tr>
<td>2007105</td>
<td>1 mS, 316 stainless steel</td>
</tr>
<tr>
<td>2007106</td>
<td>500 µS, 316 stainless steel</td>
</tr>
<tr>
<td>2007107</td>
<td>200 µS, 316 stainless steel</td>
</tr>
<tr>
<td>2007108</td>
<td>100 µS, 316 stainless steel</td>
</tr>
<tr>
<td>2007109</td>
<td>50 µS, 316 stainless steel</td>
</tr>
</tbody>
</table>

Note: All the above cartridges have 316 stainless steel cartridges. If titanium or Hastelloy C cartridges are desired, add the suffix ".T" for titanium or ".HC" for Hastelloy C.

### 8.12 Conductivity Standard Solutions

<table>
<thead>
<tr>
<th>P/N</th>
<th>Conductivity Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010145</td>
<td>50 microsiemens (µS)</td>
</tr>
<tr>
<td>2010146</td>
<td>375 microsiemens (µS)</td>
</tr>
<tr>
<td>2010148</td>
<td>200 microsiemens (µS)</td>
</tr>
<tr>
<td>2010149</td>
<td>500 microsiemens (µS)</td>
</tr>
<tr>
<td>2010150</td>
<td>1,000 microsiemens (µS)</td>
</tr>
<tr>
<td>2010151</td>
<td>10,000 microsiemens (µS)</td>
</tr>
<tr>
<td>2010152</td>
<td>2,000 microsiemens (µS)</td>
</tr>
<tr>
<td>2010153</td>
<td>2,500 microsiemens (µS)</td>
</tr>
<tr>
<td>2010154</td>
<td>5,000 microsiemens (µS)</td>
</tr>
<tr>
<td>2010155</td>
<td>100,000 microsiemens (µS)</td>
</tr>
<tr>
<td>2010146</td>
<td>100 microsiemens (µS)</td>
</tr>
<tr>
<td>2010157</td>
<td>10 microsiemens (µS)</td>
</tr>
<tr>
<td>2010158</td>
<td>20 microsiemens (µS)</td>
</tr>
<tr>
<td>2010159</td>
<td>50,000 microsiemens (µS)</td>
</tr>
<tr>
<td>2010162</td>
<td>98 millisiemens (mS) 2% NaOH standard</td>
</tr>
<tr>
<td>2010163</td>
<td>142 millisiemens (mS) 3% NaOH standard</td>
</tr>
<tr>
<td>2010164</td>
<td>183 millisiemens (mS) 4% NaOH standard</td>
</tr>
<tr>
<td>2010165</td>
<td>53 millisiemens (mS) 1% NaOH standard</td>
</tr>
<tr>
<td>2010166</td>
<td>221 millisiemens (mS) 5% NaOH standard</td>
</tr>
<tr>
<td>2010188</td>
<td>356 millisiemens (mS) 10% NaOH standard</td>
</tr>
</tbody>
</table>
Check with the factory for a current listing of spare parts.
Part numbers not appearing in this manual may represent new additions or updates to the product line.

9.0 DRAWINGS
4033095  Flow Sensor Mounting
4034026  Sensor Dimensions, Model S17, VSS & VCS
4034035  Sensor Dimensions, Model S10
4035010  Sensor Installation, Submersion Application
4035016  Cartridge Installation, Illustration of Open & Closed Style Conductivity & Resistivity Sensors
4035017  Illustration, Magnetic Flux Lines, Conductivity Sensors
4035058  Modular Sensor Components, S10/17
4040001  Guard Assembly Options
6000002  Remove Strain Relief
4035080  Safety Features S17-VSS with ball valve
4034028  Sensor Dimensions, Model S17-VSS with flange
4045031  Drip Loop
4045032  VSS Tee Assembly
4034033  Sensor Dimensions, Model S10 with flange
4032007  Wiring chart

10.0 SENSOR INSTALLATION & MAINTENANCE MANUALS
4100002  PHS10/17 & MVS10/17 for pH, ORP and Specific Ion sensors.
4100027  DOS10/17 for Dissolved Oxygen sensors.
4100052  CS10/17-T23 Toroidal (no cartridge required) Conductivity Sensor
APPENDIX A

SPECIFICATION SUMMARY
CS10/17 & RS10/17 CONDUCTIVITY & RESISTIVITY SENSOR
for Model T23 Transmitters

MEASUREMENT RANGE
3 basic ranges:
1) Low range Conductivity: 1 µS through 50 µS.
2) High range Conductivity: 100 µS through 20 mS.
3) Resistivity: 2 MΩ through 50 MΩ.

OUTPUT
Signal conditioned output, intrinsically safe.

POWER SUPPLY
Provided by T23 transmitter.

CABLE LENGTH
Standard: 10 feet
Optional: Specify in 10’ increments.
Maximum: 50 feet
Type: 6-conductor shielded (Belden 8786)

OPERATING TEMPERATURE
Standard: +23°F to +212°F (-5°C to +100°C)
Optional: +302°F (+150°C)

OPERATING PRESSURE
Standard CS10 & RS10: 100 psig @ 100°C
Optional CS10 & RS10: 300 psig @ 150°C
Standard CS17 & RS17: 300 psig @ 100°C
Optional CS17 & RS17: 300 psig @ 150°C

DIMENSIONS
CS10 & RS10: 0.75” dia x 13.75” lg. (1.9 cm x 34.9 cm)
CS17 & RS17: 0.75” dia x 19.00” lg. (1.9 cm x 48.3 cm)

Dimensions are housing diameter x length of sensor. Length is measured from front of seal guard to rear of strain relief.

SHIPPING WEIGHT
CS10 & RS10: 2.50 lbs. (1.13 kgs)
CS17 & RS17: 2.75 lbs. (1.25 kgs)
without VSS: 2.75 lbs. (1.25 kgs)
CS17 & RS17: 5.80 lbs. (2.63 kgs)

HOUSING & MATERIALS
Standard: 316 stainless steel
Optional: Titanium, grade 2 (T)
Hastelloy C22 (H)

O-RING MATERIALS
Standard: Viton (VIT)
Optional: EPR (EPR)
Fluorosilicone (FSIL)
Silicone (SIL)
Kalrez (KLZ)
CV75 (CV)

PROCESS CONNECTIONS (optional)
CS10 & RS10: -75 3/4” 316ss gland fitting with nylon ferrule.
-75HT 3/4” 316ss gland fitting with Teflon ferrule.
-75SF 3/4” 316ss gland fitting with stainless steel ferrule.
-75TFE 3/4” all-Teflon gland fitting.
CS17 & RS17: -VSS 1” 316ss valve-retraction assembly.
-VCS 1” carbon steel valve-retraction assembly.
-VKY 1” Kynar valve-retraction assembly.

All sensors ordered with valve-retraction assemblies are provided with safety lanyards.

TEMPERATURE COMPENSATION
Automatic, 0°C to +100°C.
Accuracy within +/-0.2°C over a 45°C to -95°C span.
Uses a 100,000 ohm thermistor, integral to sensor.

1Optional temperature ratings are allowed with the use of high temperature polymers such as Ryton, PPS and Teflon.

2Optional pressure ratings are allowed with the use of metallic retaining ferrules. High temperature polymers should also be used where high pressure and temperature are present.
## APPENDIX B

# TABLE 1

**T23 Conductivity & Resistivity Sensor Designators**

<table>
<thead>
<tr>
<th>Base Model Designators:</th>
<th>Guard Configurations (see application drawing 4102028)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS10 Conductivity, insertion or submersion</td>
<td>PM1- Pulled modified (2 tines)</td>
</tr>
<tr>
<td>CS17 Conductivity, valve-retraction</td>
<td>PM2- Pulled modified, fully exposed</td>
</tr>
<tr>
<td>RS10 Resistivity, insertion or submersion</td>
<td>PM3- Shrouded bulb (slant front end)</td>
</tr>
<tr>
<td>RS17 Resistivity, valve-retraction</td>
<td>Open- Open construction</td>
</tr>
</tbody>
</table>

Note: An "X" followed by a number identifies an optional sensor length in inches. For example, a CS10X23 identifies a Conductivity submersion type sensor, 23 inches long.

**Signal Conditioner:**

T23- for use with model T23/T28 instruments

C22- for use with model C22 instruments

E - designates that the above signal conditioners are configured in an "E" module (encapsulated connector module)

CBL- 10' cable extending from sensor. Note: a CBL immediately followed by a number designates the cable to be a specific length; example: CBL20 designates a 20' cable.

CJB- Polymer junction box mounted on sensor.

XJB- Explosion-proof J-box mounted on sensor.

**Housing & Guard Materials:**

T- Titanium (grade 2)

H- Hastelloy C22

K- Kynar

Note: If a designator is not used, housing and guard material is 316 Stainless Steel.

**Sensor Ranges**

<table>
<thead>
<tr>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>50M</td>
<td>50 megohms</td>
</tr>
<tr>
<td>20M</td>
<td>20 megohms</td>
</tr>
<tr>
<td>2M</td>
<td>2 megohms</td>
</tr>
<tr>
<td>1µS</td>
<td>1 microsiemen</td>
</tr>
<tr>
<td>2µS</td>
<td>2 microsiemens</td>
</tr>
<tr>
<td>5µS</td>
<td>5 microsiemens</td>
</tr>
<tr>
<td>10µS</td>
<td>10 microsiemens</td>
</tr>
<tr>
<td>20µS</td>
<td>20 microsiemens</td>
</tr>
<tr>
<td>50µS</td>
<td>50 microsiemens</td>
</tr>
<tr>
<td>100µS</td>
<td>100 microsiemens</td>
</tr>
<tr>
<td>200µS</td>
<td>200 microsiemens</td>
</tr>
<tr>
<td>500µS</td>
<td>500 microsiemens</td>
</tr>
<tr>
<td>1mS</td>
<td>1 millisiemen</td>
</tr>
<tr>
<td>2mS</td>
<td>2 millisiemens</td>
</tr>
<tr>
<td>5mS</td>
<td>5 millisiemens</td>
</tr>
<tr>
<td>10mS</td>
<td>10 millisiemens</td>
</tr>
<tr>
<td>20mS</td>
<td>20 millisiemens</td>
</tr>
<tr>
<td>50mS</td>
<td>50 millisiemens</td>
</tr>
<tr>
<td>100mS</td>
<td>100 millisiemens</td>
</tr>
<tr>
<td>200mS</td>
<td>200 millisiemens</td>
</tr>
<tr>
<td>500mS</td>
<td>500 millisiemens</td>
</tr>
<tr>
<td>1000mS</td>
<td>1000 millisiemens</td>
</tr>
</tbody>
</table>

**Process Connection:**

75 - 3/4" 316 Stainless Steel gland fitting with Nylon ferrule

75HT- 3/4" 316 Stainless Steel gland fitting with Teflon ferrule

75SF- 3/4" 316 Stainless Steel gland fitting with Stainless Steel ferrule

75TFE- 3/4" all Teflon gland fitting

100- 1" all Teflon gland fitting (for Kynar sensors)

100HT- 1" X 3/4" 316 ss. gland fitting w/ Teflon ferrule (for S10 toroidal sensors with metallic housings)

VSS- 316 Stainless Steel valve-retraction assembly

VKY- Kynar (PVDF) valve-retraction assembly

VSST- 1 1/2" 316 ss. valve retraction assembly (for toroidal sensors)

VKYT- 1 1/2" Kynar valve retraction assembly (for toroidal sensors)

Note: If a process connection designator is not used, the sensor is being supplied without a process connection.

**O-Ring Materials (see application drawing 4102029):**

EPR- Ethylene propylene

SIL- Silicone

FSIL- Fluorosilicone

KLZ- Kalrez

CV75- CV75 compound (generic Kalrez)

VIT75- HF resistant Viton

Note: If an o-ring designator is not used, o-ring material is Viton.
FOR OTHER BALL VALVE MATERIALS
CONSULT FACTORY

NOTES: UNLESS OTHERWISE SPECIFIED

SAFETY LANYARDS

SAFETY HANDLE

CABLE SEAL

10' CABLE STD

ALLOW 30" FOR REMOVAL

7-3/4"

1-1/2" TO 8" ADJUSTABLE

.75 DIA

HIGH PRESSURE STOP
.840 DIA

19-1/2"

4-1/2"

.75 DIA

.840 DIA

TOLERANCE +/-.010
SCALE None
DRAWN Ch
CHECKED Ch

ELECTRO-CHEMICAL DEVICES, INC
23665 Via Del Rio Yorba Linda CA 92887
(714) 692-1333-FAX (714) 692-1222

APPL DWG, DIM, S17-VSS

SHT 1 OF 1

DWG NO. 4034026

REV
FOR OTHER BALL VALVE MATERIALS
CONSULT FACTORY

NOTES: UNLESS OTHERWISE SPECIFIED

1-1/2" TO 7"
ADJUSTABLE

10" CABLE STD

HIGH PRESSURE STOP
.840 DIA

1" NPT FLANGE

VSS

SAFETY LANYARDS

SAFETY HANDLE

CABLE SEAL

ALLOW 30" FOR REMOVAL

19-1/2"

.75 DIA

TOLERANCE +/- .010

ELECTRO-CHEMICAL DEVICES, INC
23665 Via Del Rio Yorba Linda CA 92887
(714) 692-1333—FAX (714) 692-1222

DIMENSIONS, SENSOR, S17
VSS W/FLANGE

REV

CHECKED
DATE

SHT 1 OF 1

DWG NO. 4034028
HOUSING OPTIONS: TITANIUM, HASTELLOY
NOTES: UNLESS OTHERWISE SPECIFIED
S10 SENSOR FOR SUBMERSION

EXTENSION SUPPLIED BY USER

USE TEFLON TAPE ON FITTING THREADS

75 FITTING OPTIMUM LOCATION +/- 1.00" (25.4)

LIQUID LEVEL

S10 SENSOR FOR INSERTION

MAXIMUM INSERTION 8.25" (209.55)

1.50" (38.10) MINIMUM INSERTION

3/4" FITTING 3/4" NPT

0.75" (19.05)

10' CABLE (STD)

(XXX.XX) = MM

NOTES: UNLESS OTHERWISE SPECIFIED

ELECTRO-CHEMICAL DEVICES, INC
23665 Via Del Rio, Yorba Linda, CA 92887
(714) 692-1333–FAX (714) 692-1222

DIMENSIONS, S10 SENSOR INSERTION & IMMERSION

SHT 1 OF 1 DWG NO. 4034035 REV D
3. OTHER MATERIALS ARE AVAILABLE FOR ELECTRODE CENTERS

2. APPLY A SILICONE LUBRICANT TO THE ORING SURFACE BEFORE INSTALLING ELECTRODE "FINGER TIGHT"

1. TO REMOVE GUARD USE ADJUSTABLE WRENCH.

NOTES: UNLESS OTHERWISE SPECIFIED
FIGURE 1

SENSOR HOUSING

CENTER CONDUCTOR

STANDARD GUARD

MAGNETIC FLUX LINES

FIGURE 2

PULP MODIFIED GUARD

NOTES: UNLESS OTHERWISE SPECIFIED
FOR OTHER BALL VALVE MATERIALS
CONSULT FACTORY

NOTES: UNLESS OTHERWISE SPECIFIED

SAFETY LANYARDS

HIGH PRESSURE STOP
.840 DIA

VSS

1"NPT

VALVE HANDLE

RETAINER FITTING
WITH INTERNAL &
EXTERNAL O-RINGS

NUT--
FERRULE
SWAGE NUT

10’ CABLE STD

CABLE GRIP

SAFETY HANDLE

REV  DESC  APR  DATE

TOLERANCE +/- .010
SCALE None
ELECTRO-CHEMICAL DEVICES, INC
23665 Via Del Rio, Yorba Linda, CA 92887
(714) 692-1333 – FAX (714) 692-1222

S17–VSS

CHECKED  DATE

SAFETY FEATURES

SHT 1 OF 1  DWG NO. 4035080

DRAWN Ron  DATE

REV
INTERNAL ORINGS NOT SHOWN
ALL GUARDS ARE SUPPLIED WITH
INTERNAL & EXTERNAL ORINGS
MATERIAL: POLYPROPYLENE.
NOTES: UNLESS OTHERWISE SPECIFIED

STANDARD
STD

PROTECTED
PM1

FULLY EXPOSED
PM2

ELECTRO-CHEMICAL DEVICES, INC
23665 Via Del Rio, Yorba Linda, CA 92887
(714) 692-1333 – FAX (714) 692-1222

GUARD ASSEMBLY OPTIONS
pH, ORP, PI & DO SENSORS

TOLERANCE +/− .010
SCALE None
DRAWN Ch
CHECKED Ch
DATE
DATE

REV

SHT 1 OF 2
Dwg No. 4040001
ORDER # 1000091
RECOMMEND KEEPING PROCESS FITTING ABOVE LIQUID LEVEL.
NOTES: UNLESS OTHERWISE SPECIFIED
1. Un-screw strain relief tail & slide up the cable.
2. Slide plastic lock ring up the cable.
3. Slide rubber ferrule up the cable.
4. Using 6" crescent wrench on surface designated by NOTE 4’s arrows.
   Un-screw ferrule body assembly.
NOTES: UNLESS OTHERWISE SPECIFIED