MILTON ROY®

Streaming Current Detector Model SC5200

INSTRUCTION MANUAL

Manual No. : 339-0031-000
Rev. : B
Rev. Date : 03/2022

MILTON ROY®

PRECAUTIONS

For Pumps with PVC & 316SS Liquid Ends
WHEN USED IN SWIMMING POOLS OR SPAS / HOT TUBS (ANSI / NSF 50)

Caution on Chemical Concentration:

There is a potential for elevated chemical concentration during periods of no flow, for example, during backwash in the system. Steps, such as turning the pump off, should be taken during operation or installation to prevent this. Contact your sales representative or distributor about other external control options to help mitigate this risk.

Flow Indicating Device:

To ensure operation of the pump it is recommended that some type of flow indicating device be installed to measure water flow rates and be appropriate for the output of the pump. Contact your distributor or sales representative for further information.

Head Loss / Over Pressure Protection / Back Pressure-Anti-Siphon Valve:

- Milton Roy metering pumps are positive displacement. Head loss is not applicable to the pump.
- To ensure safe operation of the pump, it is recommended that some type of safety / pressure relief valve be installed to protect the piping and other system components from failing due to excessive pressure.
- If you are pumping downhill or into low or no system pressure, a back pressure / anti-siphon device should be installed to prevent over pumping or siphoning. Contact your distributor or sales representative for further information.

Additional Operation and Installation Instructions for 316SS or PVC Liquid Ends:

- Application of this pump to swimming pool / spas only evaluated to NSF / ANSI 50.
- There is a potential for elevated chemical concentration during periods of no flow, for example, during backwash in the system. Steps, such as turning the pump off, should be taken during operation or installation to prevent this. See your sales representative or distributor about other external control options to help mitigate this risk.
- Liquid Compatibility CAUTION: Determine if the materials of construction included in the liquid handling portion of your pump are adequate for the solution (chemical) to be pumped. ALWAYS wear protective clothing, face shield, safety glasses and gloves when working on or near your metering pump. Additional precautions should be taken depending on the solution being pumped. Refer to SDS precautions from your solution supplier. Reference a Milton Roy Material Selection Chart for aid in selecting appropriate material of construction for fluids of your specific metering pump. Contact your sales representative or distributor for further information.

GENERAL PRECAUTIONS FOR ALL PUMPS

The following precautions should be taken when working with metering pumps.
Please read this section carefully prior to installation.

Protective Clothing

ALWAYS wear protective clothing, face shield, safety glasses and gloves when working on or near your metering pump. Additional precautions should be taken depending on the solution being pumped. Refer to **Material Safety Data Sheets** for the solution being pumped.

Hearing Protection

It is recommended that hearing protection be used if the pump is in an environment where the time weighted average sound level (TWA) of 85 decibels is exceeded.
(as measured on the A scale slow response).

Electrical Safety

- Remove power and ensure that it remains off while maintaining pump.
- **DO NOT FORGET TO CONNECT THE PUMP TO EARTH.**
- Electric protection of the motor (Thermal protection or by means of fuses) is to correspond to the rated current indicated on the motor data plate.

Liquid Compatibility

Verify if the materials of construction of the wetted components of your pump are recommended for the solution (chemical) to be pumped.

Pumps Water "Primed"

All pumps are tested with water at the factory. If your process solution is not compatible with water, flush the **Pump Head Assembly** with an appropriate solution before introducing the process solution.

Plumbing and Electrical Connections

Always adhere to your local plumbing and electrical codes.

Line Depressurization

To reduce the risk of chemical contact during disassembly or maintenance, the suction and discharge lines should be depressurized before servicing.

Over Pressure Protection

To ensure safe operation of the system, it is recommended that some type of safety / pressure relief valve be installed to protect the piping and other system components from damage due to over-pressure.

Lifting

This manual should be used as a guide only - Follow your company's recommended lifting procedures. It is not intended to replace or take precedence over recommendations, policies and procedures judged as safe due to the local environment than what is contained herein. Use lifting equipment that is rated for the weight of the equipment to be lifted.

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MILTON ROY LIMITED WARRANTY
STREAMING CURRENT DETECTORS

The Milton Roy Company ("Company") warrants that its pumping products will be free from defects in title, and so far as of its own manufacture, will be free from defects in materials and workmanship for a period of thirty six months from shipment by the Company. The Company additionally warrants that all of its other products, including actuators, will be free from defects in title, and so far as of its own manufacture, will be free from defects in materials and workmanship for a period of twelve months from shipment by the Company. The Company will, at its option, repair or replace its products provided the Company's inspection reveals the products to have been defective or nonconforming _within the terms of this warranty. This warranty is expressly conditioned upon the following: (a)proper installation, maintenance, and use under the Company specified service conditions, (b)prompt notice of nonconformance or defect, (c) the. Company's prior written authorization for return, (d)the products being returned to the Company, or at the Company's discretion, to a Factory Authorized Service Centre, all at no cost to the Company. The Company will deliver repaired or replacement products Ex Works its factory or Factory Authorized Service Centre. Products not of the Company's manufacture are warranted only to the extent provided by the original manufacturer. The Company shall not be liable for damage of any kind resulting from erosive, corrosive or other harmful action of any liquids, gases, or any other substance handled by the Company's products.

THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES, OBLIGATIONS, OR LIABILITIES, WHETHER EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

UNDER NO CIRCUMSTANCES SHALL THE COMPANY BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL, OR SPECIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM THIS CONTRACT, ITS PERFORMANCE, OR IN CONNECTION WITH THE USE OF, OR INABILITY TO USE THE COMPANY'S PRODUCTS.

The liability of the Company in respect of all damages, losses, costs or expenses, whether suffered or incurred by the Purchaser or any third party arising in any manner or incident related to this contract or the performance hereunder, shall be limited in the aggregate to the actual price paid by the Purchaser to the Company.

Revision B **15 March 2022**

SC5200 SPECIFICATIONS

Power Required . . . . . . 115 VAC, 50/60 hz (standard); 230 VAC, 50 hz (optional)

Instrument Output . . . . 4-20 mA Streaming Current Signal; 4-20 mA Process Signal (max. 500 OHM load each)

Meter Readout. . . . . Dual Digital Display: -100 to +100 Streaming Current Units; and Process Set Point

Control Function. . . . . . Single loop Proportional + Integral + Derivative (PID) control; Continuous auto tune Microprocessor based with self diagnostics, Automatic & Manual mode selectable

Communications . . . . . RS-485 (optional)

System Accuracy . . . . . ± 1 % of full scale

Response Time . . . . Less than 5 seconds

Gain Adjustment . . . . . . Full range

Zero Adjustment . . . . . . Full range

Signal Filter . . . . Adjustable low pass

Sample Cell . . . . Flow through, external type, Manual Jet Wash conn. (std); Automatic Jet Wash System (opt)

Sample Flow Rate. . . . . Standard probe: 2-4 L/min (0.5-1 gal/min); High flow probe: 4-20 L/min (1-5 gal/min)

Sample Flow Sensor . . Optional, consult Milton Roy

Sample Wetted Parts . . PVC, Delrin, PTFE, & Silver

Sample Connections . . Barb Type, 1/2” ID tube (standard) Barb Type, 1” ID tube (high flow)

Alarms . . . . Band type: deviation from set point; Relays: SPDT, 2 amps at 115 /230 VAC

Operating Temp . . . . . . 32°F to 120°F (0°C to 50°C)

Enclosure . . . . NEMA 4X, 316 Stainless Steel

Weight . . . . 24 lbs.

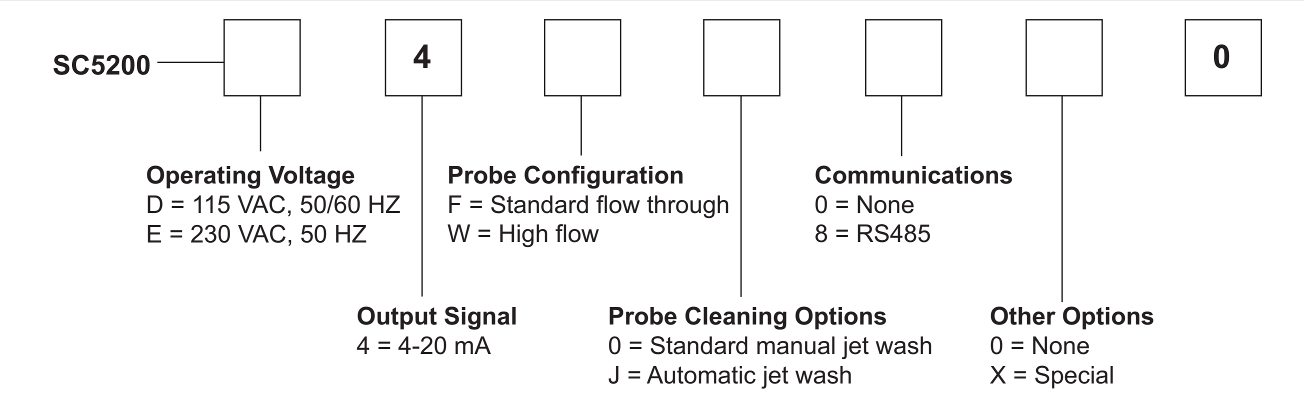

Figure 1. SC5200 Model Code.

SECTION 1 - DESCRIPTION

1.1 PRINCIPLE OF OPERATION

The Milton Roy Streaming Current Detector (SCD) is an on-line electrokinetic charge analyzer that offers monitoring, measuring, and/or control functions for the coagulation process. It is the only on-line instrument that directly measures the result of coagulant addition.

The SCD instantaneously measures the electric current generated between two electrodes by charged free counter-ions in a continuous water or wastewater sample. The counter-ions are hydraulically sheared from free colloidal particles present in the water sample which are adsorbed on the walls of the probe cell.

The shearing action is caused by a motor driven plunger reciprocating in the cell bore which hydraulically removes the ions and carries them past the electrodes. The result is an alternating streaming current that is proportional to the charge condition of the water. The charge condition, or net charge density, depends on the excess of positive or negative ions present in the water after coagulation.

The streaming current signal from the probe electrodes is processed by the main electronics board which also receives a timing signal from a slotted disc mounted on the motor shaft. The result is a 4-20 milliamp output and display in streaming current units which is proportional to the charge condition of the sample. This output can, then be used to monitor or control the coagulation process. A typical streaming current versus coagulant dose curve is shown in Figure 2.

1.2 MILTON ROY SCD MODELS

The Streaming Current Detector is available in three models:

- Model SC2200 Sample Analysis Module-A Remote Sampling Station which provides a 4- 20 milliamp signal proportional to streaming current and is used in conjunction with the RM6200 Remote Monitor Station or RM7200 Remote Controller Station.
- Model SC4200-A monitor station which provides a display in streaming current units between -100 and +100, 4-20 milliamp output, and alarm functions. The SC4200 can be mated with the RC7200 Remote Controller Station to provide a closed loop coagulant control system.
- Model SC5200-A process controller station which provides a display in streaming current units between -100 and +100, 4-20 milliamp output, and an integral PID (Proportional + Integral + Derivative) controller for complete closed loop coagulant dosing control.

In all three models an Automatic Jet Wash cell cleaning system can be specified to ensure signal reliability in dirty or high solids processes.

1.3 SCD BENEFITS

The SCD allows continuous monitoring of the coagulation process, thereby providing consistent water quality under varying treatment conditions. The SCD can help maintain:

1. Uniform chemical dosing proportional to the suspended solids content of the· water or wastewater.
2. Uniform chemical dosing regardless of fluctuations in suspended solids and/or raw water flow rate.
3. Uniform chemical dosing regardless of variations in the concentrations of the coagulant chemical solution.

1.3.1 Water Treatment Benefits

In water treatment applications, the SCD will maintain a set point which has been selected using jar tests or other observations. This set point corresponds to the optimum charge condition in the treated water which provides consistent and fully compliant finished water quality. The SCD can provide:

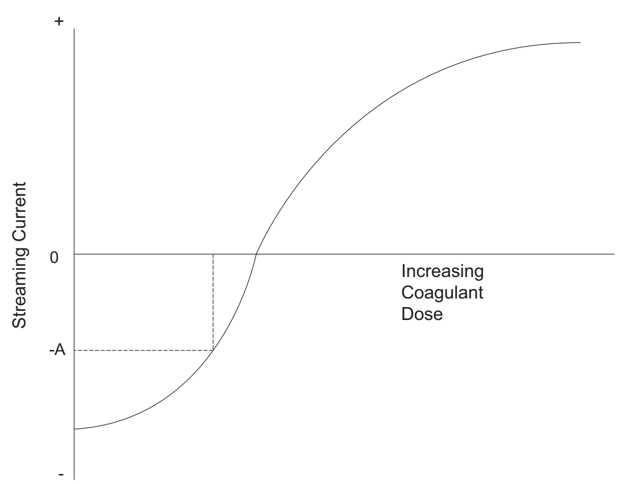

Figure 2. Typical Streaming Current Vs. Coagulant Dose Curve.

- Reduced coagulant usage for the same treated water quality, resulting in reduced costs.
- Reduced sludge volume due to optimum coagulant dosing.
- Longer filter runs due to -reduced sludge formation.
- Automatic operation of the coagulation process, permitting reduced manpower or unmanned operation.
- Minimum aluminum residual as a public health measure.
- Precise and consistent coagulant dosing to remove Giardia cysts.
- Tighter pH control due to optimum coagulant dosing.

1.3.2 Wastewater Treatment Benefits

In wastewater treatment applications, the SCD will monitor and maintain the optimum charge condition in the treated wastewater or sludge as established by suspended solids measurements, cake solids measurements, or other observations. The SCD will allow Optimization of the coagulant dosage at all times; thereby providing:

- Lower coagulant chemical costs by maintaining the appropriate dosing as sludge or waste water conditions change.
- Lower sludge disposal costs by eliminating overdosing and providing the driest possible cake.
- Reduced manual supervision of belt filter press. centrifuge, or dissolved air flotation systems.
- Automatic control capability of wastewater clarification and sludge dewatering processes.

2.1 PRE-INSTALLATION CHECKLIST

Before installing the SC5200, check the instrument for damage that may have occurred during shipping. Contact Milton Roy if missing parts or if damage is suspected.

The following is included with the SC5200:

- Instruction Manual
- Spanner wrench (for-probe removal)
- Potentiometer screwdriver (for main circuit board adjustment)
- 2 spare fuses (1 amp “Slo-Blo”)
- 1/8” Allen wrench
- 2 barbed tube connectors (3 connectors are included in Auto Jet Wash equipped units)
- 2 hose clamps
- 1/2 ” NPT ball valve (Not included with Auto Jet Wash units)

2.2 MOUNTING

The SCD should be installed as near to the sampling point as possible (see Section 3, Sample Requirements). The SCD is housed in a NEMA 4X, 316 stainless steel enclosure and can be mounted outdoors provided it has adequate protection from the elements.

Standard industrial practice should be followed to isolate the SCD from spills, rain, snow, and direct sunlight during operation. This prevents damage to the finish and prevents possible overheating in direct sunlight.

⚠ CAUTION **THE SCD MUST BE PROTECTED FROM FREEZING TEMPERATURES (32°F, 0°C) AND TEMPERATURES ABOVE 120°F (50°C).**

The SCD should be mounted vertically on a flat surface with clearances as shown in Figure 3 for standard units or Figure 4 for Auto Jet Wash equipped units. A minimum of 6 inches (15 cm) clearance should be provided on either side of the unit and beneath the probe to facilitate installation and maintenance.

2.3 ELECTRICAL CONNECTIONS

The instrument’s power requirement is coded in the model number as shown in Figure 1.

1. The instrument terminal block connections are accessed by removing the side panel on the unit. Three terminal blocks are available (see Figure 5):
   - Terminal block 1 (TB1) instrument Power Connections
   - Terminal Block 2 (TB2): Reserved for Automatic Jet Wash Only
   - Terminal Block 3 (TB3): Signal and Alarm Connections
2. Two openings for 1/2” conduit fittings are provided in the bottom of the enclosure. The unsealed opening is for power and alarm cables. The sealed opening is used to route the milliamp signal cable if required. A third opening is also available on Non-Automatic Jet Wash units. On Auto Jet Wash units this opening is reserved for the Jet Wash valve wiring.

IMPORTANT:

Connections must be made through cable connectors that will maintain the integrity of the NEMA 4X box (indoor/outdoor, weather and dust proof). Seal all unused openings with the conduit hole seals provided. All electrical wiring and connections should be made in accordance with local wiring codes.

2.3.1 Instrument Power Connections

IMPORTANT:

A surge suppressor is recommended on the instrument power if line surges are anticipated.

Connect the power leads to the appropriate terminals on terminal block 1 (TB1) as shown in Figure 5, Typical Wiring Connections.

IMPORTANT:

For proper operation, always observe correct polarity on TB1: Terminal 1-HI; Terminal 2-NEUTRAL.

Connect the ground lead to the stud on the bottom of the box using the connector provided.

2.3.2 Instrument Signal Connections

Two 4-20 milliamp output signals are provided on the SC5200 (see Figure 5, Typical Wiring Connections):

1. Streaming Current (SC) Output is available across terminals 8 and 9 of TB3. This signal is the direct 4-20 mA streaming current signal from the main circuit and can be used to monitor or record the streaming current output from the instrument. Gain and zero functions for this output are controlled by the potentiometers on the main circuit board. This output follows the SC5200 display (i.e., 4 mA = -100, 12 mA = 0,20 mA = +100). It can be connected directly to a remote display or recording device.

IMPORTANT:

If SC output is not utilized, a jumper must be installed across terminals 8 and 9 of TB3.

This output should not be used for direct control of the chemical feed pump.

2. Process output is provided across terminal 5 and 6 of TB3. This signal is the control output sent to the chemical feed pump or control valve from the PID controller. Its value is a function of the PID parameters installed in the controller. It can provide direct control of the pump with the SC5200 in the manual mode.

The process output and streaming current output signal circuits have a maximum of 500 ohms load resistance. Use a digital multimeter to check the DC circuit load of the controlled device (pump) or recorder.

All output signals should be carried through shielded cable (20 or 22 AWG is recommended) and kept separate from all power leads. Insert the shielded output signal cable through the second opening in the enclosure and not through the same opening as the power leads. Observe correct polarity on all 4-20 mA output signals.

If the SC5200 is being connected to a remote monitor or recorder, maximum separation should not exceed 3000 feet (1000 meters). Check the circuit load to ensure the 500 OHM load rating has not been exceeded.

2.3.3 Alarm Connections

A single pole, double throw (SPOT) relay is provided to trigger an alarm in the event the SC reading goes outside a preset range. The alarm relay can be wired for normally open (NO) or normally closed (NC) operation. The alarm relay is rated for 240VAC, 2 amps maximum.

·A typical alarm connection in which the alarm will be activated if the signal goes out of range (normally open configuration) is shown in Figure 5.

Alarm wires should be routed through the power cable entry to minimize interference with the milliamp output signal.

2.4 SAMPLE CONNECTIONS

1. Barbed tube connectors are provided for the probe inlet and outlet to connect the sample supply and drain. These connectors are for 1/2" inch [1.25 cm] ID tubing if the unit is equipped with a standard probe or 1 inch [2.5 cm] ID tubing if the unit has a high flow probe. Flexible polyethylene or PVC tubing is recommended for all sample lines. Use hose clamps to maintain a tight connection.

⚠ CAUTION **HARD PIPING INTO THE PROBE MAKES SERVICING THE INSTRUMENT IMPOSSIBLE AND CAN DAMAGE THE PROBE. NEVER ATTACH METALLIC PIPING DIRECTLY TO THE PROBE.**

2. Inlet and outlet ports are interchangeable. The flexible inlet and outlet lines should be long enough (approximately 12 inches [30 cm]) to allow probe removal.
3. The outlet or drain connection should not exceed 3 feet (1 m) whenever possible to avoid restricting the flow. If a longer drain must be used, the outlet tubing should terminate at an atmospheric pressure drain located below the instrument. Always avoid installing valves or other restrictions in the drain line. The outlet stream entering the drain should be easily visible to operators making their rounds.
4. All probes have a 1/8" inch NPT overflow port located on the back of the probe. This port should be kept clear at all times. Some leakage out this port during operation is normal. If necessary a drain may be installed from this port but it should be kept as short as possible and always terminate below the probe at an atmospheric pressure drain.

2.5 JET WASH CONNECTIONS

NOTE:

If the instrument is equipped with the Automatic Jet Wash option, refer to Jet Wash instruction manual #339-0034-000 for further installation instructions.

A 1/2 inch NPT connection (normally plugged) is provided on the bottom of the probe for use in a manual jet wash. The manual jet wash allows the probe to be flushed with clean water by manually opening and closing a user installed control valve.

The following guidelines should be followed when installing and using manual Jet Wash:

1. Mount the manual jet wash valve as close to the bottom of the probe as possible, preferably directly to the bottom of the probe. Always use a plastic valve. The 1/2” NPT PVC ball valve included with the SCD or a similar valve is recommended. (Refer to Figure 6.)

   Putting the valve directly on the probe minimizes the dead volume under the piston in the cell. Trapped air or solids in this volume can affect the SCD reading.

   ⚠ CAUTION **NEVER ATTACH A METALLIC VALVE OR PIPING DIRECTLY TO THE PROBE. THIS WILL RESULT IN INACCURATE SCD READINGS.**

2. Use only clean plant water to jet wash the probe. Recommended pressure is 25 to 30 psi. Higher pressures may cause the water to overflow past the plunger stem. Consult Milton Roy for compatibility of other cleaning agents if required.
3. The jet wash can be run for as little as 30 seconds or as long as a few minutes. Recovery time is dependent on how dirty the probe was before jet wash. A clean probe should recover in less than 1 to 2 minutes, and a dirty probe may take longer to return to the SC value it had before jet wash was initiated.

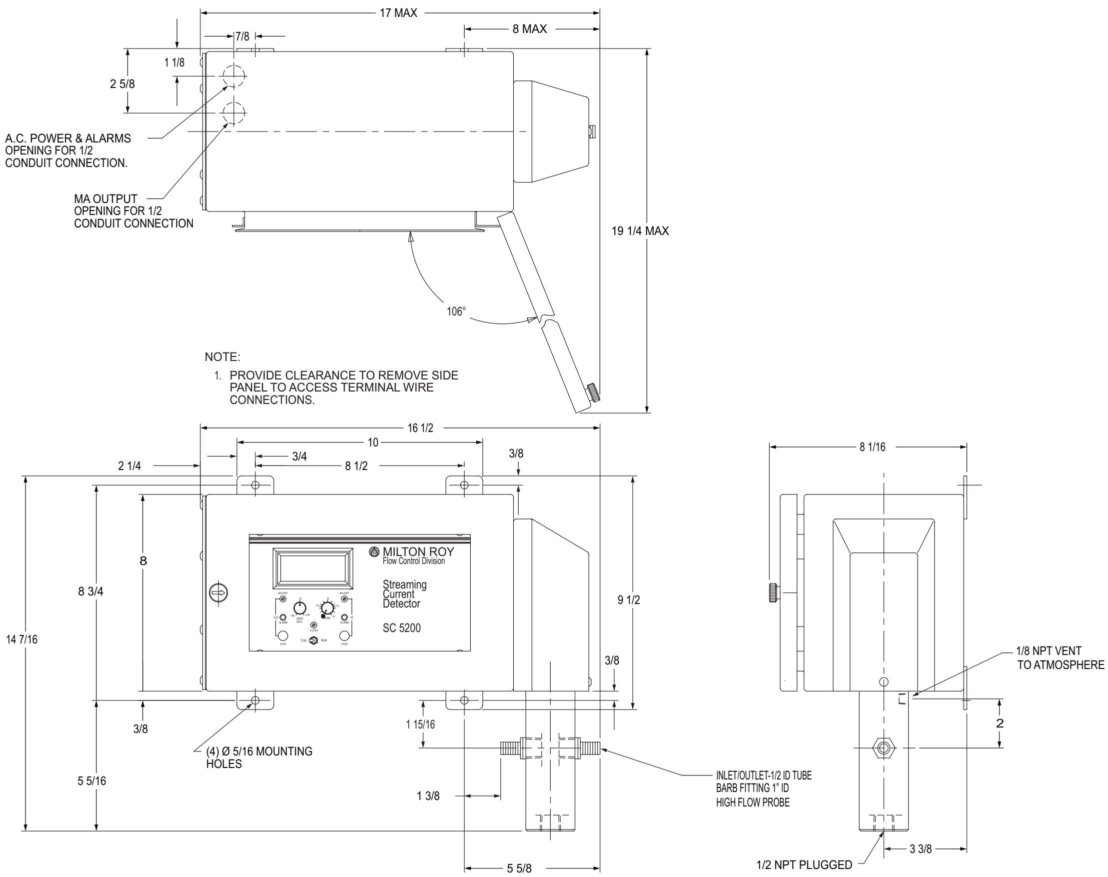

Figure 3. Customer Installation Drawing (C-102-1732-000).

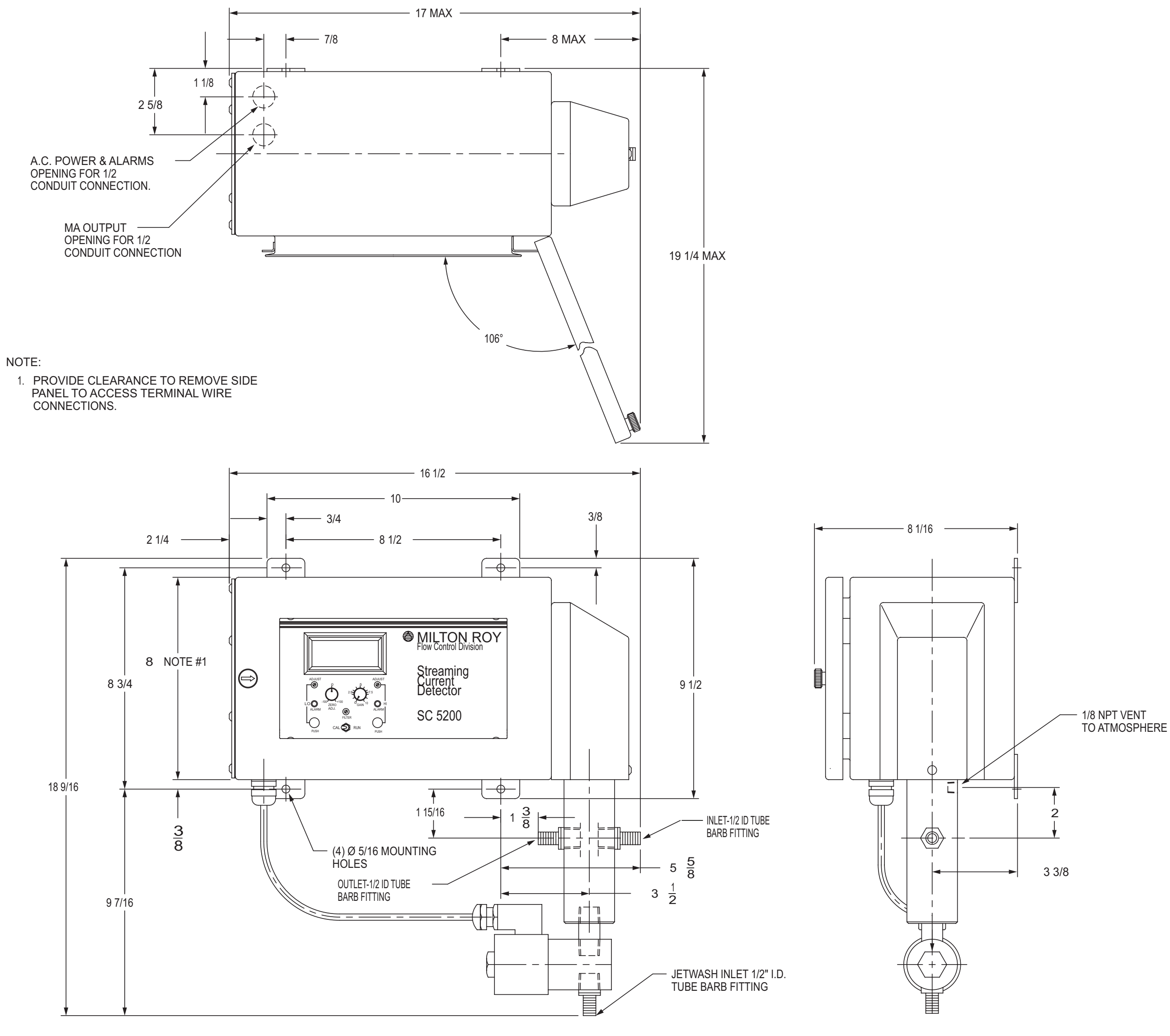

Figure 4. Customer Installation Drawing for Automatic Jet Wash (C-102-1823-000)

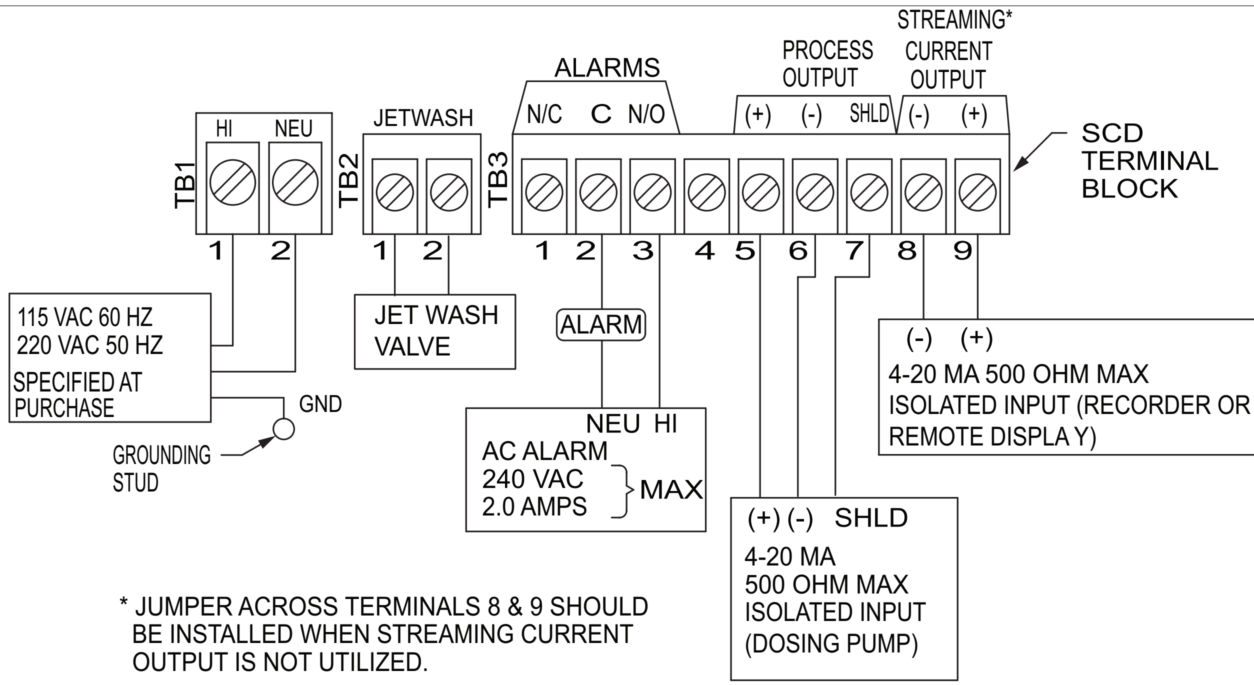

Figure 5. Typical Wiring Connections (C-102-1827-000).

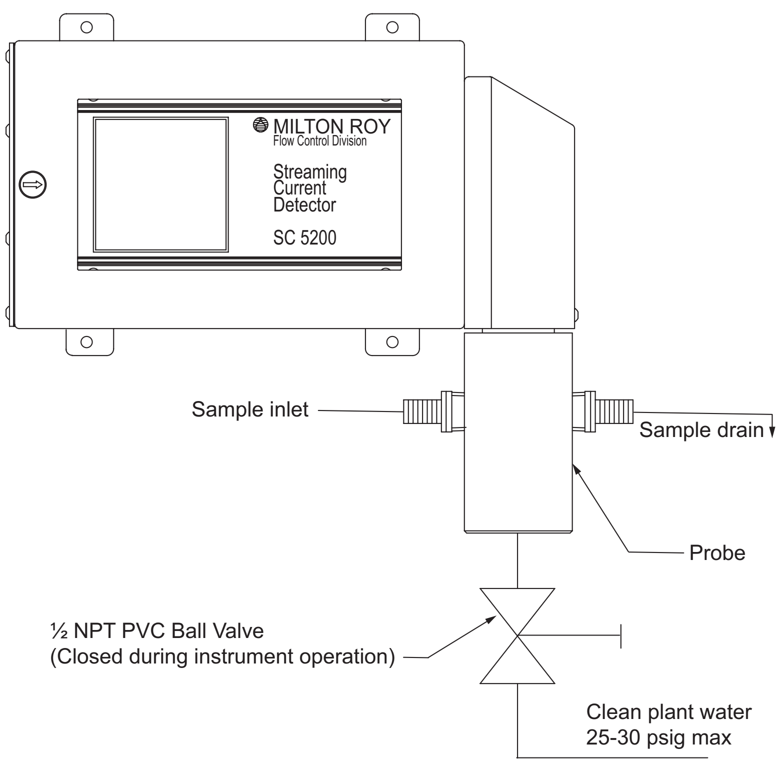

Figure 6. Typical Manual Jet Wash Connection.

SECTION 3 - SAMPLE REQUIREMENTS

3.1 SAMPLE REQUIREMENTS

Reliable and consistent operation of the Streaming Current Detector requires a good quality sample. Obtaining a good sample is probably the single most important operating consideration. The sample to the SCD unit should meet four main requirements:

1. The sample must be representative of the process being monitored or controlled.
2. The sample must be free of foreign matter that can damage the probe or impede sample flow.
3. The sample must be continuous during SCD operation.
4. The sample location must be selected to provide appropriate system delay times.

3.1.1 Representative Sample: Water Treatment

The sample sent to the SCD probe must be representative of the water or influent being treated for the SCD to give accurate readings. The SCD measures the result of coagulant addition, and therefore the sample must be taken after the injection and mixing of the coagulant in the raw water.

Typical sample point in a flash mix system is shown in Figure 7. The sample can be draw from a number of locations after coagulant addition and mixing:

1. Directly from the flash mix tank using a submersible or other type of sampling pump. If available, a gravity feed from the tank can also be used. Care should be taken to position the sample pump at a point in the tank where good mixing occurs. Some tanks have “dead” spots where little or no coagulant mixing takes place.
2. In the pipeline or weir between the mix tank and flocculators. This location may increase system delay time. Sampling in the flocculator tank normally is not recommended due to long response times and poor sensitivity.

If the process employs a pipeline coagulant injection system, the sample should be taken after the static mixer or mixer section of the piping.

It is essential that the raw water and chemical be well mixed before sampling to obtain a good SCD reading. Follow these guidelines whenever possible:

1. When injecting chemicals into a pipe, use an injection quill or probe to ensure that injection occurs at the center of the pipe. Injecting at the wall of the pipe usually gives poor results.
2. Avoid sampling at the wall of the pipe. Use a probe or quill whenever possible to sample from the center of the pipe.
3. Injection should take place upstream of turbulence causing points such as elbows, pumps, valves, etc. In line static mixers are very effective, even when used in large lines. Injecting into a pipe with laminar flow gives the least mixing effect.

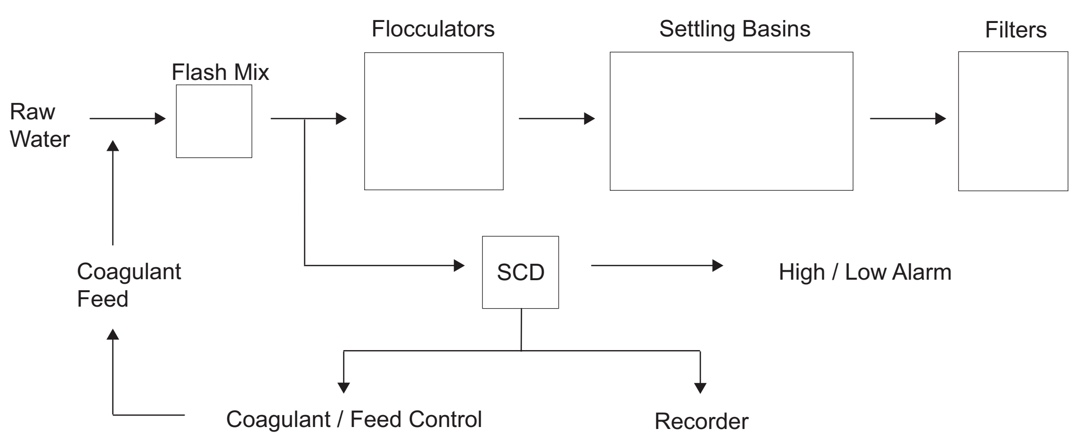

Figure 7. Typical placement of streaming current detector for water treatment

3.1.2 Representative Sample: Wastewater

In wastewater treatment, the wastewater is sampled after coagulant addition and mixing and before the clarification stage. In dissolved air flotation systems (OAF) this is normally just before the wastewater enters the OAF tank.

In sludge dewatering, the SCD can be applied to belt filter press or centrifuge applications to monitor and control polymer dosing.

For belt filter presses (BFP), the filtrate from the press is sampled at the earliest point possible, normally from the gravity drain section of the press. A tray or collector may have to be fabricated. The sample should be not obtained where filtrate and belt press wash water are mixed.

On centrifuges, the centrate should be sampled wherever the cleanest sample can be obtained. Care should be taken to avoid sampling lumps of sludge that may be present in the centrate, especially during centrifuge start-up and shut down.

The Milton Roy factory is available to provide application assistance for the SCD on a variety of wastewater as well as water treatment processes.

3.1.3 Clean Sample

If the water being sampled contains sand, silt, or other particulates or debris, Milton Roy recommends a sample cleaning device be used. Sand and debris will quickly wear the probe sensing area leading to erratic SCD readings and a loss in sensitivity.

Line strainers are normally not recommended because they tend to clog quickly and therefore require frequent maintenance. They also will not filter out sand or silt which are the leading cause of probe wear.

Separators using the hydrocylone principle will remove sand and debris from the sample without the problems associated with strainers. The Milton Roy Cyclone Separator (Part #247-0990-000) is effective in removing most fine sand and silt particles from the sample stream.

It may become necessary to establish a regular cleaning schedule to remove particles or coatings that accumulate on the cell. Regular use of the manual Jet Wash or installation of a automatic Jet Wash cell cleaning system will greatly improve signal reliability in dirty samples. Refer to Routine Maintenance for details on probe cleaning.

3.1.4 Continuous Sample

Interruption of sample flow while the instrument is operating will interrupt the instrument signal. This is particularly serious if the SC5200 is on automatic dosing control. Debris blocking the cell flow area can impede or stop sample flow completely, leading to a loss of SCD reading and possible probe damage. Loss of signal while in automatic mode will cause severe over or under dosing of the chemical feed pump as the SC5200 tries to maintain set point.

Reliability of the sample flow is therefore very important. The usual recommended flow for the SCD is 2 to 4 liters per minute (0.5 to 1 GPH).

Higher flows can be used for more turbid samples to aid in keeping the cell area free of sediment. Sample flow should be kept constant during operation since flow variations may cause SCD signal fluctuations.

A flow alarm should be considered for maximum loop security in an automatic dosing system. Consult Milton Roy for suitable devices

3.1.5 System Delay Time

The system delay time is the defined as the time between a change in the chemical dosing in the process and actual detection by the SCD.

This time must be sufficiently long to ensure adequate mixing between the chemical and raw water. Typically, the system delay time is a function of two factors:

1. The rate at which ·the coagulation process takes place.
2. The distance in the process between the chemical dosing point and the SCD sample point.

SECTION 3 - SAMPLE REQUIREMENTS

The coagulation process, provided good mixing is provided, is nearly instantaneous in most processes. The major factor in system delay time is sample point location. Normally a sample point which gives a delay time of approximately 2 minutes gives best results. Sampling at or very close the chemical injection point will usually provide very short delay times, less than 30 seconds, and is not recommended since it does not guarantee that adequate mixing has occurred.

Long delays times, in excess of 3 minutes, are not recommended for automatic dosing systems. The PID controller built into the SC5200 is not always able to handle upset conditions when the system delay time exceeds 3 minutes, although results vary from system to system. The system delay time should match the integral time setting in the PID controller whenever possible. See Section 4 for controller operation.

System delay time can be minimized by installing the SCD as close to the sampling point as possible. Pumping the sample to the SCD over long distances will increase the delay time. Whenever possible, the SCD should be mounted close to the sampling point and a monitor used to display and/or adjust the SCD signal in a remote location. Consult Milton Roy for recommended remote monitors and displays.

3.2 COAGULANT CONSIDERATIONS

The SCD can be used with all common coagulant chemicals applied in water and wastewater treatment. These include:

- Alum (aluminum sulfate)
- Aluminum Chloride
- Ferric Chloride
- Ferric Sulfate
- Polyaluminum Chloride (PAC)
- Cationic Polymers
- Anionic Polymers

Since non-ionic polymers have, by their nature, little or no charge, the SCD will not respond to a system dosing a non-ionic polymer.

Some treatment systems dose a primary coagulant such as alum and a coagulant aid such as a cationic polymer. In these systems the SCD cannot differentiate between the two chemicals and will respond to dosage changes in either or both coagulants. For the SCD to provide effective control in such systems, one chemical dosage should be kept constant (usually the coagulant aid) and the primary coagulant controlled by the SCD.

The addition of lime for pH control before the SCD sampling point may affect the SCD reading.

This occurs for two reasons:

1. The lime itself can act as a mild coagulant, causing the SCD to react to it the same way it might to a weak chemical coagulant.
2. If the lime is not well mixed before the SCD sample is taken, the SCD will react to the free lime particles in the sample. The residual lime may also coat the SCD cell, requiring frequent cleaning.

If possible, always sample after coagulant injection and before the addition of lime. If this is not possible, make sure the lime is very well mixed in the water before the sampling point. This may require moving the sampling point further down stream from the coagulant and lime injection location.

The same recommendations apply to other pretreatment chemicals including potassium permanganate and powder activated carbon.

The SC5200 is a SCD integrated with a proportional +integral+derivative (PID) controller with continuous self-tuning capability. The instrument has a display readable in SC units, a 4-20 mA SC output for recording and monitoring functions, and a 4-20 mA process output for direct PID control of a chemical dosing pump or other supplied equipment.

4.1 DESCRIPTION OF CONTROLS

The SC5200 has a dual LED display (figure 8):

4.1.1 Upper LED Display

The upper display shown streaming current process value from + 100.0 to -100.0 streaming current (SC) units. The scale is preset at the factory as follows:

- Low limit = -100.0
- Zero= 0.0
- High limit = +100.0

1. Over-range is displayed as [HH].
2. Under-range is displayed as [LL].

This display follows the milliamp output available on terminals 8 & 9.

- 4 mA = -100.0
- 12 mA = 0.0
- 20 mA = +100.0

Adjustments to the streaming current reading are made using the ZERO, GAIN, and FILTER controls accessed through the front panel. (See “Display Calibration.”)

4.1.2 Lower LED Display

The lower display shows the streaming current set point value for the PID controller. This value also has a range of -100.0 to + 100.0 SC units. Adjustments to the set point are made using the buttons on the PID controller face.

4.1.3 LED Indicator Lights

Five LED indicator lights are also present on the LED display:

- ALM: flashes to indicate an alarm condition.
  1. Solid on when setup mode is selected, and flashes to indicate manual mode
- OP1: not applicable to standard SC5200.
- OP2: not applicable to standard SC5200.
- AT: indicates that the self-tune facility is engaged and operating.

4.1.4 Process Set Point Adjustment

The process set point (SP) can be adjusted to any value within the operating range of the display:

-100 to + 100. To adjust the SP:

1. Depress and release the FUNC key; the lower display will read SP and the upper display will indicate the current set point value.
2. Using the RAISE or LOWER keys, adjust the SP to the required value. The upper display will indicate the changes in value of the SP.
3. To return to normal display mode, depress the FUNC key twice.

4.2 AUTO/MANUAL OPERATION

The PID controller has two operating modes, auto and manual. In auto mode, the controller compares the process value (upper display reading) and set point (lower display) and outputs a 4-20 mA control signal across terminals 5 & 6 to maintain process value at set point. The internally set PID parameters determine how large a response (gain) and how quickly to respond (rate) to variations between process value and set point. The PID parameters are set at the factory for a general range of conditions found in most water treatment plant operations. If the PID parameters need to be adjusted to match plant conditions, refer to "Controller Set Up & Adjustment" and Section 6.

The control output from the SC5200 can be manually set using the manual mode. This allows direct adjustment of the dosing pump or other chemical feed device from 0-100% (4-20 mA) at the SC5200.

To access manual control:

1. Press the AUTO/MAN key (far left button).
2. The MAN indicator will flash. The lower display will show process control output at terminals 5 and 6 displayed as a percentage of 4-20 mA: P100 = 20 mA, P50 = 12 mA, P0= 4 mA. The upper display will continue to show the process variable (sc output).
3. To adjust the process output to any value from 4-20 mA, press the RAISE or LOWER keys

NOTE:
If the process output is being used to control a dosing pump, the pump flow rate will be directly controlled by the manual setting chosen in step 3.

4. To exit manual mode, press the AUTO/MAN key.

Controlling the process output manually may be useful for new plant start up, when SC readings may be significantly different from those during normal operation. Manual operation is used at first so that the PID will not control to abnormal conditions existing during start up. The system can be transferred to automatic control once it is stabilized. Manual control also is useful for system troubleshooting.

4.3 START UP

1. Adjust the sample flow to the instrument to between 2 and 4 liters per minute (0.5 to 1 gpm). The sample should be representative of normal or average chemically treated water (see Section 3, Sample Requirements). Sample flow should be constant during operation to avoid signal upsets.

⚠ CAUTION **DO NOT OPERATE THE INSTRUMENT UNLESS SAMPLE WATER IS FLOWING THROUGH THE PROBE OR THE PROBE IS IMMERSED IN WATER AS IN A JAR TEST. EXTENDED OPERATION WHILE DRY MAY RESULT IN PROBE AND INSTRUMENT DAMAGE.**

2. Turn the instrument on by engaging the power switch on the front panel.
3. Allow the instrument to operate for 30 minutes to stabilize.

4.4 STREAMING CURRENT PROCESS VALUE ADJUSTMENT

The upper display of the SC5200 indicates the streaming current value for the treated water being sampled. This value must be within the operating range of the SCD (-100 to +100 SCU) and be selected to provide adequate system response without going out of scale during abnormal or upset conditions in the process.

Typical water treatment operations usually operate in the negative streaming current rang (between 0 and -100 SCU) at optimum coagulant dose. Operation in the positive range (0 to +100 SCU) can occur in some situations. Remember, the SCD measures the charge value of the treated water at the conditions determined by jar tests or other off line methods (see Section 5, Set Point Selection).

Observe the SC reading after the recommended warm up period. The optimum operating range for most water treatment applications is between -5.0 and -50.0 SC units (or +5.0 to +50.0 SC units for positive readings). If the display is outside this range, out of scale (indicated by double brackets), operates close to the -100 to +100 limits, or is reading close to zero, the gain and zero may need to be adjusted. If the display is erratic, refer to Section 3, Sample Requirements, to provide a consistent sample.

4.5 GAIN AND ZERO ADJUSTMENTS

The SC5200 has zero, gain, and filter adjustments that effect the display and streaming current output. The adjustments are made using three potentiometers on the main circuit board. These potentiometers are accessed through the front panel using a potentiometer screwdriver. Filter, gain, and zero adjustments are marked. These are 15 turn potentiometers. Use the potentiometer screwdriver included with the SCD to make adjustments.

All gain and zero adjustments should be mad with the unit operating and sample flow through the probe.

4.5.1 Zero Adjustment

The instrument is configured at the factory for a 0.0 ± 0.5 reading at a streaming current of zero (12 mA at SC output terminals 8 and 9). This can be checked and adjusted as follows:

1. With the instrument operating and warm, disconnect the probe cable at the connector at the bottom right corner of the enclosure. With the probe disconnected, the display should read 0.0 ± 0.5 units (SC output 12 mA ± 0.1 mA).
2. If this reading is incorrect, adjust the zero potentiometer with the potentiometer screwdriver until the display reads 0.0 ± 0.5 units.
3. Reconnect the probe cable. The unit is now configured to read zero at zero streaming current input and to output 12 mA at terminals 8 and 9 when SC is 0.

The zero adjustment can also be used to set the process value to 0.0 to read deviation from SP.

1. Operate the unit at the process set point (see Section 5, Set Point Selection).
2. Record the display value.
3. Adjust the zero control until the output reads 0.0 ±0.5 (or any other desired value between -100 and +100).
4. The unit will now output deviation from the set point, (0.0 or whatever value was chosen).

Example:

Customer set point = -20 SC units

Process normal deviation = -30 to -10 SC units

Adjust zero for set point = 0.0 units

Process normal deviation now reads -10 to 10 SC units

5. The instrument can be reconfigured to the factory setting (0.0 = 0 SC value) at any time by using the zero calibration procedure outline above.

4.5.2 GAIN Adjustment

The GAIN controls affects the sensitivity of the instrument to streaming current changes which directly reflect changes in treated water and coagulant addition.

Gain adjustment should be done only after reviewing the following points:

1. A high gain setting may amplify unwanted small deviations in the SC signal. These include electrical noise and small process changes which are unimportant in process control. These small deviations may cause constant fluctuations in the display and control signal.

2. A high gain setting may also cause the instrument to go out of scale in response to moderate SC changes.
3. A low gain setting may cause small but important changes in the treatment process to go undetected.
4. Some recording or control equipment may require a minimum milliamp change before responding. Response must be adequate to go outside the equipment's dead band.

Adjusting GAIN

Operate the SC5200 under normal treatment conditions to establish a process set point. If the instrument shows little or no response or reads below -10.0 units, gain must be increased. If the instrument operates out of scale or very close to the scale limits (-100 or +100), the gain must be decreased.

To increase gain, use the following procedure:

1. With the unit operating at process set point, record the displayed value. Rotate the GAIN potentiometer clockwise 1-2 turns. Allow this reading to stabilize, usually 1-2 minutes.
2. Disconnect the probe and adjust the ZERO (if necessary) until the display reads 000.0 ±0.5 units.
3. Reconnect the probe and allow the reading to stabilize. The new output should now be more negative for a negative SC reading and more positive for a positive SC reading.
4. If the required sensitivity is observed, normally between -5.0 and -50.0 (or +5.0 to +50.0 for positive readings) for water treatment applications, the procedure is complete. If the gain setting is still not adequate then repeat steps 1, 2, and 3 until better sensitivity is observed.
5. For best operation, avoid extreme adjustments of the GAIN potentiometer. To restore the GAIN setting to approximate factory defaults, rotate the potentiometer 15 turns CCW followed by 4 turns CW.

To decrease gain, follow the above procedure but rotate the GAIN potentiometer counterclockwise. Adjust the gain until the instrument operates within the -100 to +100 scale at set point and during an upset condition.

Selecting the Correct Gain, Upset Test

Selection of the correct gain is a function of the treatment process, coagulant type, and anticipated system upsets. To determine the gain setting for a particular process, it may be necessary to perform a Process Upset Test.

1. Establish the treatment process set point.
2. Upset the treatment system by changing the chemical dosing rate. This is normally accomplished by adjusting the coagulant feed pump. An alternative upset is to increase or decrease the raw water feed at a fixed coagulant feed rate.
3. Allowing for the system delay time, the time from initiation of the upset to the point the SCD senses the change, note the deviation from set point.
4. If the deviation from set point is too small, increase the GAIN. For example, if the upset condition gave a change of -5.0 units and a change of -10.0 units is desired, increase the GAIN.
5. If the deviation from set point is too large, reduce GAIN.

Example:

A treatment process is feeding coagulant at 30 ppm for a given water condition. The SC process set point is -10.0. An upset is initiated by cutting the coagulant dose to 15 ppm.

After a 2 minute system delay time, the SCD reacts and stabilizes at -15.0 SC units. The operator would like to see a minimum 10.0 SC unit change for a 50% reduction in coagulant. The feed rate is returned to 30 ppm and the reading allowed to stabilize. The gain is then increased (rotate gain pot clockwise) so that the process set point is -20.0 at 30 ppm. The test is repeated by cutting coagulant dose to 15 ppm, and a SC reading on or around -30.0 is obtained. This corresponds to a 10.0 SC unit change for a 50% coagulant reduction.

4.5.3 FILTER Adjustment

The display and 4-20 mA output closely follow the SC signal. The SC5200 incorporates an adjustable filter to remove the effects of external electrical interference and to smooth out small fluctuations in the display and SC output due to process conditions. To increase the filter setting, use a potentiometer screwdriver to rotate the filter control clockwise. To decrease the filter setting, rotate the filter control counterclockwise.

4.6 AUTOMATIC CONTROL OPERATION

This procedure describes start up and operation of the SC5200 in automatic operation using “Bumpless transfer” from manual to automatic. This procedure should only be carried out provided the following conditions are met:

a. The SCD set point has been established using procedures outlined previously and in Section 5.

b. The SC5200 is wired to the electronic capacity control of the dosing pump and the SC5200 directly controls the pump in manual mode. The pump capacity should be configured for no flow at 4 mA (P0), 50% capacity at 12 mA (P50), and 100% capacity at 20 mA (P100). Check that the control signal operates the capacity adjustment correctly. Refer to Section 2, Installation, for correct wiring instructions.

NOTE:

This is very important. If the dosing pump capacity control does not respond to the control signal in the manual, the system will not work in automatic. Check the dosing pump to ensure it accepts a 4-20 mA signal and is set for automatic operation.

The SC5200 controller PID parameters are preset at the factory for a normal range of operating conditions. The first attempt at automatic control in the system should be at the default parameters. Review Section 6, Automatic Control Fundamentals before adjusting parameters.

1. With the SC5200 in manual mode, control pump capacity using the up and down arrow keys until the process set point is reached & maintained.
2. With the controller still in manual mode, press the FUNC key. The controller set point will now be displayed. With the RAISE and LOWER arrow keys, enter the value of the process set point determined in step 1. At this point, the top (SCD process value) and bottom (controller set point) should read the same.
3. Press the FUNC key twice. The controller will now go back to manual mode.
4. Press the AUTO / MAN key. The controller will now go into automatic mode (Bumpless transfer). The top display is the SCD process value, and the bottom is the set point. The controller will automatically adjust the pump to maintain set point. Its response is determined by the PID parameters set in the controller set up menu.

Example

The controller is in manual mode (manual pump control) and the SCD process value at good water is determined to be -30.0 SC units with the pump running at 40% capacity (“ P40” controller output). The FUNC key is depressed and -30.0 is entered into the controller as the set point. The FUNC key is depressed again to return to manual mode. The AUTO/MAN key is pressed and the controller is put into automatic mode. The controller will now adjust the pump capacity from the initial starting value of 40% to maintain set point (upper and lower display the same) If, for example, the SC value goes to -40.0 due to an increase in raw water turbidity, the controller will tell the pump to provide more coagulant to drive the SC reading back to -30.0. The pump capacity will gradually change to greater than 40%. The magnitude and speed of the pump response will depend on the proportional band (PB) and reset (I) settings in the controller. Increasing the PB decreases the gain of the controller and slows response. The reset time is normally the delay time of the system.

5. The pump commanded output can be checked at any time in AUTO mode by pressing the AUTO/ MAN key. The capacity will be displayed as Pxxx. This also puts the controller in manual, allowing the operator to set the pump to any value in case of emergencies or conditions where automatic control cannot adequately respond to a major system upset.

4.6.1 Summary Bumpless Transfer Procedure

1. Pump and SC5200 are installed for feedback system.
2. With the SC5200 in .manual mode, manually adjust pump output until process optimization is achieved.
3. Once process is optimized, note the process value reading on the upper display of the SC5200. Enter this value as the PID controller's set point using the FUNC and RAISE and LOWER arrow keys.
4. Switch the PID controller from manual to automatic mode.
5. PID controller will now adjust pump output based on deviation from set-point.
6. Make adjustments (if necessary) to proportional band, etc., for proper response.

4.7 CONTROLLER SET UP AND ADJUSTMENT

These instructions describe the adjustment of the SC5200 PID controller. The SC5200 PID controller normally operates in AUTO mode using parameters preset at the factory for a normal range of conditions. In most cases, the user will not need to access or adjust the PID parameters stored in the controller. If these parameters need be adjusted to match particular process requirements, they can be accessed by entering the Configuration and SET UP modes of the controller.

The CONFIGURATION mode permits definition of hardware features of the controller. It is here that mA input and output is chosen, forward or reverse acting output, and the alarm type is defined. Configuration must be completed before entering SET UP mode. The SET UP mode permits adjustment of the alarm, low output limit, auto-tune, and display range settings.

The CONFIGURATION mode is accessed as follows:

1. Power down the controller.
2. Power up the controller and, within 30 seconds of power up, hold down the RAISE and FUNCTION keys simultaneously for approximately five seconds, or until the initial display (inPt) appears.
3. The PID controller is now in CONFIGURATION mode.
4. Depress the FUNCTION key to scroll through the parameters. The upper display will show the parameter value; the lower display indicated the parameter legend that corresponds to that value. Configuration parameters are preset as shown in Figure 9.
5. Scroll the display until the parameter legend to be adjusted is shown in the lower display. The current value will be shown in the upper display at this time. Using the RAISE and LOWER keys, adjust the parameter value to the desired setting within the range specified above.
6. Once the setting is selected, press the AUTO/MAN key to enter value.
7. While in CONFIGURATION mode, the “Hardware Definition Code” (dEFn) can be accessed by simultaneously pressing the LOWER and FUNCTION keys both to enter and exit this parameter.
8. To leave CONFIGURATION mode:
   a. Press RAISE and FUNCTION keys simultaneously.
   b. This will return you to the Operator Mode.

The SET UP mode is accessed as follows:

1. Make sure the PID controller is in normal display mode. Change with the FUNC key if necessary.
2. Press RAISE and FUNCTION keys simultaneously until “ULOC” appears in lower display.
3. Using RAISE and LOWER keys, set the upper display to unlock value (factory default is 10). Press FUNCTION key to enter unlock value.
4. The PID controller is now in SET UP mode. Set LED will flash predominately on.

NOTE:
If no key is pressed within 120 seconds of entering SET UP mode, the controller automatically returns to the display mode and steps 1-3 will have to be repeated before continuing to step 5.

5. Depress the FUNC key to scroll through the SET UP display. The upper display will show the parameter value; the lower display indicates the parameter legend that corresponds to that value. Controller parameters are preset as shown in

Figure 9.

6. Scroll the display until the parameter legend to be adjusted is shown in the lower display. The current value will be shown in the upper display at this time. Using the RAISE and LOWER keys, adjust the parameter value to the desired setting within the range specified above.
7. Once the setting is selected, press the FUNC key and continue to scroll through the SET UP menu until the process value and set point are displayed again (this occurs immediately after the ENBL display). If you scroll past this point, continue to scroll until it appears again.
8. To leave SET UP mode:
   a. Wait 120 seconds and the unit will automatically revert to display mode and the SET indicator light will go out.
   b. Or, simultaneously depress and hold down the RAISE and LOWER keys until the SET indicator goes out.

4.7.1 Alarm Adjustment & Operation

The SC5200 controller is equipped with a band alarm that controls a SPDT relay. The value of the band specifies the range around the set point value in which the process value is allowed to fluctuate. If the process value reading goes outside the selected band, the alarm relay will trip, as indicated by the flashing ALM indicator light. The relay is not latching.

For example, if a band alarm setting of 20 is selected at a set point of -10, the alarm will trip at a reading of less than -30 and greater than 10. The alarm band is factory preset at 100.

To adjust the alarm band, enter the set up mode and scroll to b_AL. Adjust the value using the RAISE and LOWER keys.

4.7.2 Display Range Adjustment

The SC 5200 controller display is configured to read -100 to 100 streaming current units. This can be adjusted to any desired range using the SETUP mode. The minimum and maximum values chosen correspond to 4 and 20 milliamps streaming current output (terminals 8 and 9 of TB3) respectively. For example, a -10.0 to 10.0 range corresponds to 4 mA SC output at -10.0 and 20 mA at 10.0.

To adjust the display range, enter the set up mode and scroll to rhi. Adjust the setting using the RAISE and LOWER keys. Repeat for RLO. Adjusting the range values will automatically adjust the SPHI and SPLO settings to stay within the display range.

4.7.3 Auto/Manual Lockout

The SC5200 controller can be configured to lock out the manual control accessed through the AUTO/MANUAL key. This is used to prevent unauthorized of adjustment of the process output to the dosing pump while the system is running in automatic control. To lock out manual control, enter the set up mode and scroll to PoEn. Adjust the setting to read “0” to disable manual control.

4.7.4 Auto-Tune Operation

The SC5200 controller has a continuous self-tune feature which automatically updates the PID parameters as a result of process changes. This allows the controller to adapt itself to the particular process variations and trends without manually adjusting PID settings.

Auto-tune should only be used in processes which are relatively stable with few major upsets. In processes which experience large variations in streaming current readings over short periods of time, the auto-tune feature tends to tune PID parameters to extreme values and therefore is not recommended. Experiment with this feature before relying on it in full automatic process control.

To access auto-tune:

1. Make sure the controller is in normal display mode. Make sure that “AUTO PRE-TUNE” (APt) has been enabled in setup.
2. Depress and hold down the RAISE and LOWER keys simultaneously until the indicator flashes (Blinks once).
3. Within 3 seconds of the time the AT indicator starts to flash, depress and hold down the AUTO/MANUAL key until the AT indicator remains on continuously.
4. The controller is now in auto-tune operation.

To disable auto-tune, repeat the above procedure until the AT light goes out.

Configuration Parameters (factory presets)			
Legend	Description	Range	Preset Value
inPt	Selected input code		3414
dEFn	Hardware definition code	1100-4777	3701
Optn	Options installed	nonE	nonE
CtrL	Forward or reverse acting output	rEv, dir	rEv
b_A1	Alarm type	Band 1	bAnd
None	No Alarm 2	nonE	nonE
USE3	Define alarm usage	A1_d, A1_r, Or_d, Or-r, Ad_d, Ad_r, LP_d. LP_r, HY_r. rEc5, rEcp	A1_d
Setup Parameters (factory presets, SET rLo FIRST)			
Legend	Description	Range	Preset Value
FiLt	Digital Filter Time Constr.	OFF, 0.5 to 100.0 secs. In 0.5 sec. increments	2.0 secs
OFFS	Process Variable Offset	+/- input span of Controller	0
Out1	Output Power	0 to 100%	Read Only
Pb1	Proportional Band 1	0.0 to 999.9% of input span	200.00%
rSEt	Reset (Integral Time Const.)	1 sec. To 99 mins. 59 secs. And OFF	3 min. 00 sec
rAtE	Rate (Denvat1ve Time Const.)[1]	00 secs. To 99 mins. 59 secs	0
biAS	Manual Reset (Bias)	0% to 100% (Output 1 only) -100% to 100% (Output 1 & Output 2)	25%
Sphi	Setpoint High Limit	Setpoint to Range Max	100
SPLo	Setpoint Low Limit	Range Min. to Setpoint	-100
Ophi	Output 1 Power Limit [1]	0% to 100% of full power	100%
b_A1	Band Alarm	Range min. to range max.	100
LAEn	Loop Alarm Enable	0 (Disabled)/ 1 (Enabled)	0
rPnt	Scale Range Decimal Point[4]	0, 1, 2 or 3	1
rni	Scale Range Maximum[4]	-1999 to 9999	100
rLo	Scale Range Minimum[4]	-1999 to 9999 ***SET THIS FIRST***	-100
APt	Auto Pre-Tune Enable / Disable	0 (Disabled) / 1 (Enabled)	0
PoEn	Manual Control enable / Disable	0 (Disabled) / 1 (Enabled)	1
rPEn	Setpoint Ramp Enable / Disable	0 (Disabled) / 1 (Enabled)	0
SPSt	Setpoint Strategy	1, 2, 3, 4 or 5	1
LOC	Lock Value	0 to 9999	10
Operator Mode Displays: (Still accessible in Set Up Mode)			
SP	Setpomt[10]	Sphi-SPLo	0
rP	Setpoint Ramp Rate[9]	1-9999 and OFF	OFF (Blank
ALSt	Alarm Status	Read Only display \ see Subsection 2.4)	

Notes on Figure 9
[1]These Parameters are not operative if the proportional Band = 0.
[2]Switching differential with ON/OFF control output
[3]These parameters are optional; only one legend will appear for each alarm.
[4]Only applicable if a DC Linear input Is fitted. Affects other settings, must be set first.
[5]Only application if output 2 Is fitted.
[6]Only applicable if Proportional Band = 0
[7]Appears only if ramp rate rP is not switched OFF.
[8]This parameter is applicable only if the Communications Option PCB is fitted.
[9]Does not appear in Operator mode unless rPEn = 1.
[10]For Dual Setpoint operation the legend displayed is SP1 or SP2, as appropriate.

Figure 9. Controller Parameter

5.1 INTRODUCTION

The Streaming Current Detector provides a process value which corresponds to the net charge density of the treated water or wastewater. This measurement can then be related directly to the amount of chemical dosing required to maintain proper coagulation and/or flocculation. The SCD cannot directly determine the correct coagulant dose for a given raw water influent. This is a function of the treatment process, raw water conditions, chemical used, chemical injection point, and many other factors. The optimum coagulant dosage for a particular system should be established by other traditional methods and then the SCD used as a tool to maintain that condition under varying treatment conditions.

5.2 PROCESS SET POINT: WATER TREATMENT

Optimum process set point is the SCD process value that produces a treated water that, after filtration, yields a finished water quality that meets turbidity and color standards. The process set point is maintained by appropriate increases and decreases in the chemical dosing range either manually or automatically (see Section 6). In manual operation the pump dosage is adjusted by the operator to maintain set point. In automatic operation, a programmable controller maintains the established set point.

Several methods can be used to establish the initial process set point.

5.2.1 Observation

Observation of the SCD reading over a period of plant operation is probably the most common method of set point selection. By observing the SCD process value and studying plant operating data, an initial set point can be selected that will ensure adequate chemical dosing for satisfactory finished water quality. During this period, plant operating conditions are optimized using typical off line methods such as jar tests. The established set point can be checked periodically using jar tests to ensure optimum dosing once the SCD is put on line.

5.2.2 Jar Tests

A normal jar test sample tested in the SCD will not yield the correct SCD process set point value. This is because the SCD is designed to provide a reading 2 to 3 minutes after chemical injection, whereas a typical jar test is read after 15 minutes of reaction time. A jar test can be used to establish a rough process set point if the following procedure is used.

1. Prepare the SCD unit for a jar test by disconnecting all fittings from the SCD probe. Locate a beaker large enough so that the probe can be totally immersed in it (typically 1 liter or larger).
2. Conduct a normal series of jar tests to establish optimum coagulant dosing.
3. Repeat the jar test for the optimum dose, but stop mixing the at a time equal to the SCD system delay time. (See Section 3, Sample Requirements for an explanation of delay time). Immediately immerse the probe in the jar test sample. Use the process value obtained after 2 minutes as the initial process set point.
4. Put the SCD on line and fine tune the initial set point to plant conditions. Note that samples measured by immersing the probe and by flowing through the probe will yield different process values. The jar test method provides a starting point reading which must be refined by on line operation.

5.2.3 Zeta Potential

The SCD process value is directly related to zeta potential and therefore a zeta reading can be used to set SCD process set point. A zeta meter is used initially to establish optimum coagulant dosage and the corresponding SCD reading at this coagulant dose is then used as set point.

Optimum process set point may change seasonally, or in some cases even monthly, in some water treatment plants as the character of the suspended solids and/or color level in the raw water changes. Temperature of the raw water will affect the chemical reaction rate and therefore the SCD process value. Cold water may be more difficult to coagulate than warm water, leading to decreased SCD sensitivity and response.

5.3 PROCESS SET POINT: WASTEWATER TREATMENT

In wastewater treatment, the optimum set point is that which provides the lowest coagulant dosage while yielding driest acceptable cake or lowest suspended solids in the effluent. In dewatering processes such as filter presses or centrifuges, the following criteria are often-used to establish SCD set point.

1. The percent solids in the dewatered sludge cake is optimized by adjusting the coagulant dose. The SCD process value at this condition is then used as set point.
2. Total suspended solids in the centrate or filtrate are monitored and the SCD set point selected accordingly.
3. Centrate or filtrate clarity is monitored by direct observation. A dark effluent usually indicates underfeeding and a milky white effluent overfeeding of coagulant. This is a very subjective measure which requires experienced operators to interpret.
4. In belt presses, visual observation of the feed sludge can be used to establish SCD set point. To the trained operator, incorrect coagulant dose is evident in the sludge consistency and color.

The SC5200 can be used to monitor the coagulation process or provide a means of direct online control of coagulant dosing. Control schemes can be either manual or automatic.

6.1 PID CONTROLLERS

The PID (Proportional+Integral+Derivative) controller is the most widely used type of process controller. Although there are other, more complex control schemes involving PID control, generally these controllers are used in a feedback system.

A feedback system is one where the sensing device (i.e. SCD, PH sensor, etc.) is located downstream of the metering device, with the PID controller schematically wired in between the pump & sensor. On the SC5200, the PID controller is built into the streaming current detector (see figure 10).

The PID controller is capable of being programmed to maintain a certain set point. The set point, which is usually system “optimization,” is determined and programmed into the controller by the customer.

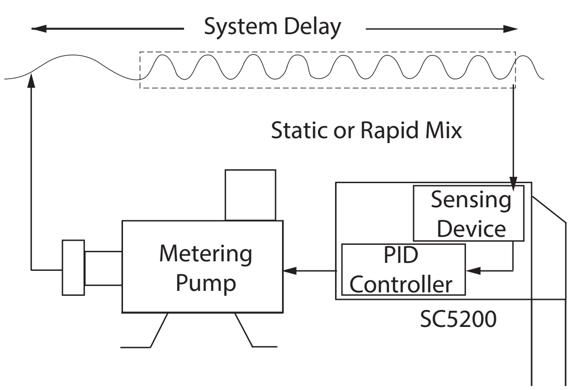

Figure 10. Typical SC5200 Feedback System

The PID controller is configured by the user to display, in engineering units, the exact scale of engineering units as that of the sensing device (i.e., SCD units: -100 to +100 pre-configured in the SC5200). Via the output of the sensing device (which is now the PID’s controller input), the PID controller should display whatever value the sensing device is monitoring.

The PID controller accepts its input signal from the sensing device, compares this value to the user configured set point, and then adjusts its output (to pump) based on the deviation that the input is away from the set point.

How much, how often, and how fast the controller adjusts its output based on a set point deviation is determined by the tuning of the three PID modes.

6.2 PID CONTROL MODES

The PID controller continually monitors its input signal and, based on the deviation from the programmed set point, the controller will adjust its output (to pump) with the sole objective of returning the process back to set point. There are three modes to PID control:

P = Proportional Band:

Proportional band is best described as an output signal change (to pump) based on an input signal change (from sensing device) The input signal change can be assumed as a deviation from set point. The amount of input signal change (deviation) will determine how much the output to the pump will be adjusted. The proportional band itself is adjustable, usually in percentage (i.e. 1/1000%). The selection of a specific proportional band value will result in a specific output (to pump) change vs. an input signal change (from sensing device) (see figure 11).

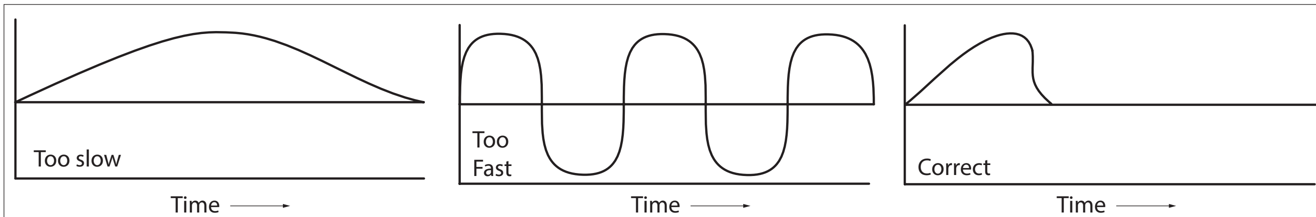

Figure 11 . Correct Proportional Band Adjustment

The proportional band is related to system gain by the formula gain = 100% / PB%. A proportional band value of 100% would result in the same output change vs. input signal change (gain of 1). A proportional band value of 200% would result in an output change one half the value of an input change (gain of 1/2). A proportional band value of 50% would result in an output change twice that of an input change (gain of 2).

The SC5200 controller is preset at the factory for a PB = 200. This is a typical value for an average range of operating conditions. Varying conditions

may require adjusting PB in the field.

I= Integral

Integral responds to the amount of time that a process is away from set point. Integral will contribute to the output of a controller (in addition to the proportional band) for the duration of time that the process is away from set point. Integral is programmed in periods of time (minutes and seconds). The integral time, which is configured by the user, is generally the system delay. Whatever time value is configured, that is the time it will take for the controller to add an equal amount, that of the proportional band, to the output if the process has not reached its set point. This is referred to as a repeat of the proportional band.

The integral time is pre-configured in the SC5200 at 3.00 minutes. On system start up, adjust this value to match or slightly exceed the system delay time.

D = Derivative

Derivative responds to the rate, or how fast a process is changing or deviating from set point. The controller can be configured to adjust the output (in addition to the proportional band and integral) based on the rate a process is changing. The derivative is preconfigured to 0.0 (off) on the SC5200.

For most SCD applications, the use of proportional band and integral are sufficient for satisfactory process control (or maintenance of a set point). Therefore, the derivative should be set to 0.0 and not adjusted. A properly tuned controller is one that senses a deviation from set point, adjusts the output (to pump), and the process returns to set point in a suitable time frame.

Bumpless Transfer Procedure

A process can be started up for automatic control in several different ways. One of the most convenient methods is known as “Bumpless Transfer”

1. Pump and SC5200 are installed for feedback system.
2. From the SC5200, manually adjust the pump output until process optimization is achieved.
3. Once process is optimized, note the process· value reading on the upper display of the SC5200. Enter this value as the PID controller’s set point using the FUNC RAISE and LOWER arrow keys.
4. Switch the PID controller from manual to automatic mode.
5. The PID controller will now adjust the pump output based on deviation from set point. Make adjustments (if necessary) to the proportional band, etc., for proper response. Refer to Figure 11 for correct proportional band adjustment

6.3 MANUAL DOSING CONTROL

In manual dosing control, the SC5200 is used for display only. This may be required in situations where the dosing pump is not configured to accept a 4-20 mA control signal.

When in manual dosing control, the SCD process value is observed and the coagulant dosage is adjusted by the operator. Typically the process set point is established (see Section 5) and the instrument is zeroed at that condition. Variations of the SCD value from zero indicate the need to adjust the coagulant pump to return the SCD value to zero. A reading greater than zero (the process set point) usually indicates overfeeding and the dosage should be reduced. A reading below zero indicates underfeeding and a increase in coagulant is required.

The operator will usually work within a established dead band around the set point, +5.0 to -5.0 streaming current units for example. Adjustments will only be made if the SCD value moves outside this range. This system can be improved by using the high and low SCD alarms to activate visible or audible alarms at the dead band limits to alert operators.

This type of control is often referred to as manual dead band operation. It gives fair dosing results and good system security provided raw water conditions are stable.

6.4 AUTOMATIC DOSING CONTROL

The full advantages of the SCD are obtained when it is used in a automatic dosing control system. Even raw water that appears uniform has micro- variations over time that can be detected by the SCD and to which the automatic control system responds immediately and accurately. During raw water upsets such as storms, when turbidity increases rapidly, the SCD control system responds with an immediate increase in chemical dosing to maintain the process set point. Operator input is reduced or eliminated in many cases.

A typical automatic coagulant control system usually consists of the SCD, a process controller with PID (Proportional + Integral + Derivative) functions, and a coagulant dosing pump with electronic capacity control capable of accepting a 4-20 milliamp signal.

NOTE:

The SC5200 has a built in PID controller. No external PID device is required for automatic control.

In basic automatic mode, the SCD milliamp output signal is input into the process controller. The operator has programmed the controller with the SCD process set point. The process controller compares the SCD process value and set point and sends a modulated milliamp signal to the dosing pump electronic capacity control. The pump responds by increasing or decreasing chemical flow, thus maintaining the treated water at the SCD set point. The output from the controller is a function of the difference between the set point and process value and the controller Proportional, Integral, and Derivative (PID) settings. The PID settings establish the controller response to the magnitude of a SCD signal change versus set point, the response time, and the rate of response.

A recorder can be added to the system to log SCD process value and pump setting. A output limit function in the controller prevents the pump from dosing below a preset minimum value.

6.5 AUTOMATIC CONTROL CONFIGURATIONS

6.5.1 Plan I. Simple Feedback System

Figure 12 shows a simple feedback control system utilizing the SC5200 to control the dosing pump. The SCD process signal is sent to the integral process controller where it is compared to the set point. The SC5200 then continuously outputs a 4-20 mA control signal to the dosing pump in response to SCD signal changes. The SC5200 is wired as shown in Figure 13. The recorder is optional but recommended to chart trends in system operation.

6.5.2 Plan I I. Feed Forward & Feedback Control System

Figure 14 shows a more advanced control scheme which employs the SCD for feedback control and raw water flow rate for feed forward control. This type of system allows rapid adjustments in-chemical-dosing based on plant flow while fine tuning the dose with the SCD input. In this case a dosing pump with variable stroke and variable speed control is utilized. The flow signal makes step changes in pump speed to respond to gross flow changes while the SCD feedback from the controller adjusts pump stroke to optimize coagulant dose to streaming current. Typical wiring connections are shown in Figure 15.

6.5.3 Automatic Control Plan Selection

The selection of an automatic control plan depends on the individual plant conditions. Plan I is adequate where flow changes are slight. Plan II should be considered where flow change greater than 10% are frequent.

Consult Milton Roy for information on chemical dosing pumps for all plans and for additional information.

6.5.4 Automatic Control Operating Considerations

To ensure successful automatic operation, follow the guidelines on sampling given in Section 3, Sample Requirements. The system delay time should be as close to 2 minutes as possible. System delay times above 3 minutes make automatic control-difficult to maintain.

To operate correctly on automatic dosing control, the hydraulics of the plant dosing and sampling systems occasionally need improvement. The SCD signal may tend to wander or become erratic even under perceived stable flow and chemical dosing. The same instabilities that affect the SCD reading usually adversely affect coagulation as well. They may indicate poor coagulant mixing or a poor injection point. These instabilities need to be eliminated or minimized before automatic control can be implemented.

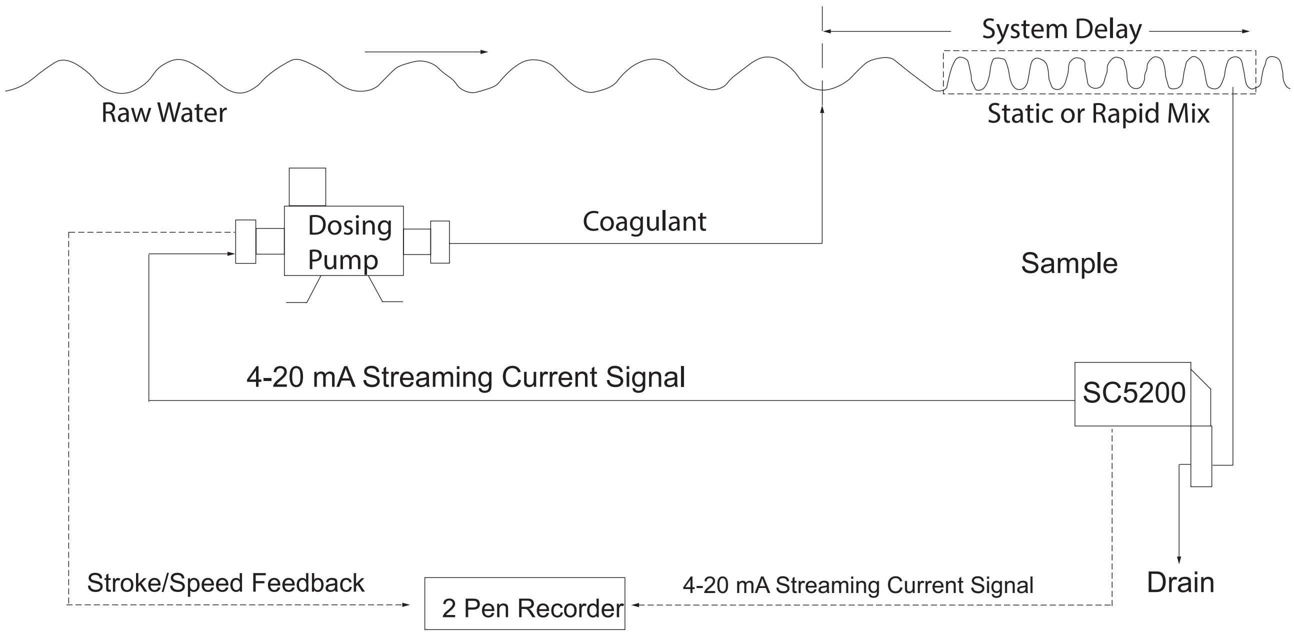

Figure 12. Plan 1-Feedback System with SC5200 Control Only

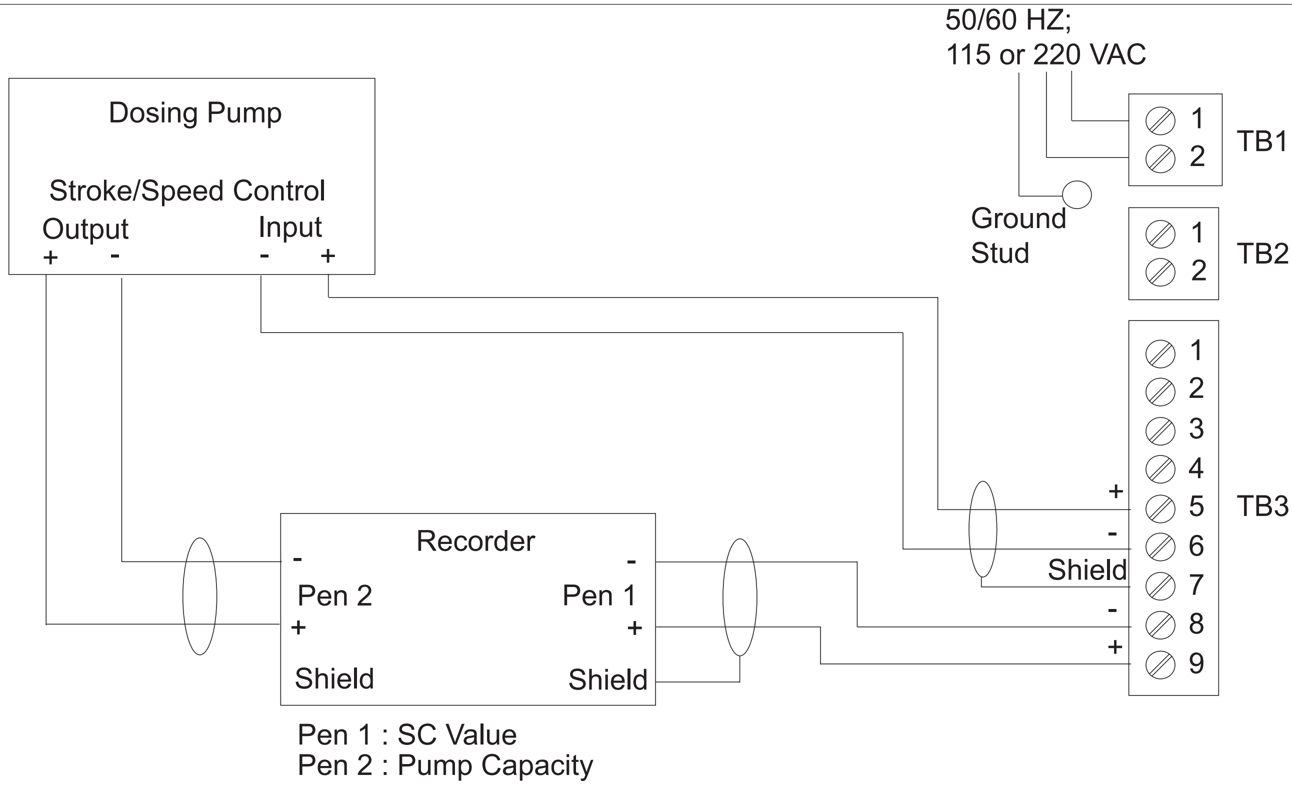

Figure 13. Plan I - Control Loop Interconnections

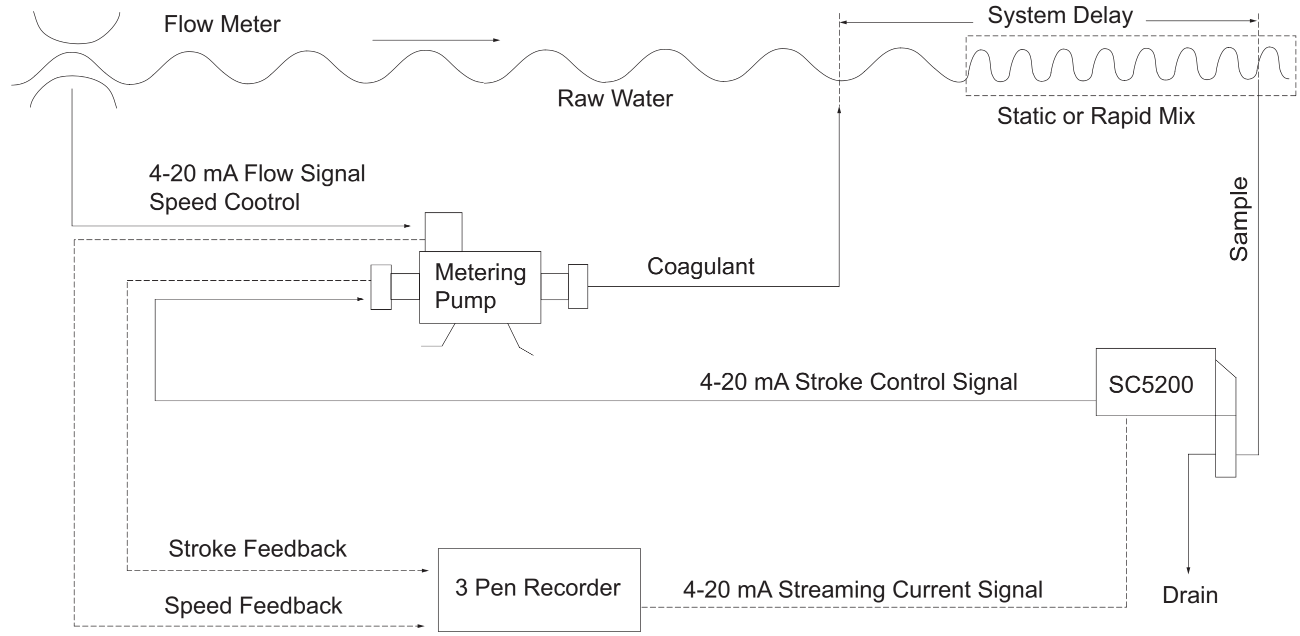

Figure 14. Plan II - Feedback System w/SCD Control & Feed Forward Flow Proportioning Control.

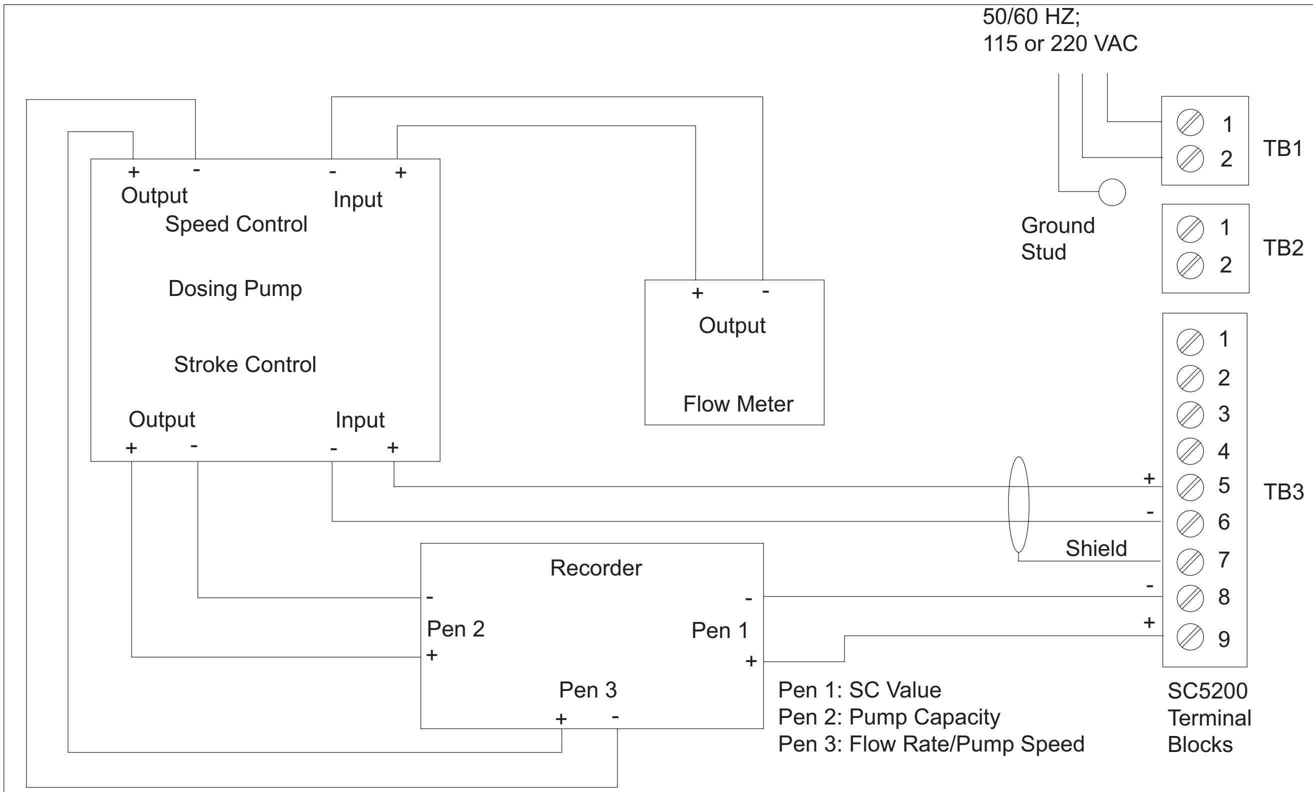

Figure 15. Plan II - Control Loop Interconnections.

7.1 GENERAL MAINTENANCE

The SC5200 is housed in a Nema 4X, 316 stainless steel enclosure that does not require painting. Regular wash down or cleaning of the enclosure with a mild detergent and water will help preserve the exterior finish and appearance of the unit. Always make sure the enclosure door and side panel are secure before washing down the SCD.

7.2 TIMING SENSOR MAINTENANCE

The SCD timing sensor is located under the probe side cover. Its purpose is to pick up a timing signal from the timing disk located on the bearing assembly.

The timing sensor and disk should be inspected at regular intervals for dirt or debris that may have accumulated on the disk surface or in the sensor slot. The sensor may be fouled as a result of sample fluid leaking past the plunger and spraying on the sensor surfaces. Also, grease from the bearing assembly may work its way into the slot.

To clean the sensor assembly, carefully wipe any contaminants from the sensor disk and around the sensor slot. Ensure that the slot in the disk is clear. Do not use alcohol, thinner, benzene, or other such solvents that can damage the plastic surface of the sensor. Use only commercial electrical contact cleaner to clean the interior of the sensor slot.

7.3 PROBE MAINTENANCE AND CLEANING

The SCD sampling cell consists of a closed end bore with two silver electrodes. A close fitting plunger reciprocates in the bore during operation (see Figure 16). The cell surfaces must be kept clean to prevent measurement error.

Under normal operation, the probe is designed to be self cleaning. The reciprocating .action of the plunger constantly purges the cell of the sample water and forces out most contaminants that may affect SCD operation, replacing them with fresh samples. The standard manual Jet Wash or optional automatic Jet Wash also help retard the buildup of material on the cell walls.

In many cases contaminants will build up on the cell surfaces over time. Minerals and chemical additives in the water will eventually form deposits on the cell walls. These include coagulants such as ferric and alum, lime, hard water deposits, and potassium permanganate. Sand and other particulate matter can also build up in the cell and cause damage to the cell and plunger.

Signal drift or erratic signals usually indicate the need for cell cleaning. Visual inspection is not always sufficient for determining cell cleanliness. particularly when alum and/or polymer are being dosed. The frequency of cleaning should be enough to prevent drift in the SCD reading. After cleaning, the instrument reading on the same water sample should stabilize very close to the reading obtained before cleaning. If the post cleaning reading differs, then cleaning should be performed more often. The object is to clean before noticeable signal drift or erratic behaviour occur.

A regular interval should be established to clean the probe. The frequency of cleaning depends on plant conditions, chemicals dosed and raw water conditions. This can vary from every week to twice a year. Milton Roy recommends monthly inspection and cleaning of the probe to ensure reliable operation. This interval can be extended with the use of the manual or automatic Jet Wash.

7.4 SCD CELL CLEANING PROCEDURES

There are three basic cleaning procedures:

1. Standard Procedure: for simple particulate matter.
2. Special Procedure I: for chemical deposits and coatings.
3. Special Procedure II: for iron or permanganate deposits and stains.

These procedures cover the range of contaminants that are likely to be encountered in water and wastewater. Before cleaning, remove and disassemble the probe as outlined in Section 9.

NOTE:

Sand or other abrasive materials will cause premature wear of the plunger and cell bore, requiring replacement. Abrasive materials must be separated from the sample before it reaches the cell. Refer to Section 3, Sample Requirements.

7.4.1 Standard Procedure

This procedure is appropriate where the surfaces are not heavily stained or discolored and debris trapped in the cell need to be removed.

1. Using a clean test tube or bottle brush, vigorously scrub the plunger surf ace and cell bore while flushing with clean water. Continue brushing as required to remove any contaminants on the cell surfaces.
2. Flush thoroughly with clean water before reassembling.
3. Operate the SCD on-line for 10 to 15 minutes until it returns to near the original value.

⚠ CAUTION **NEVER USE DETERGENT OR OTHER SURFACE ACTIVE CHEMICAL TO CLEAN THE PROBE. DETERGENTS LEAVE A RESIDUAL SURF ACE CHARGE ON THE PROBE SURFACES, WHICH IS DIFFICULT TO REMOVE. USE DETERGENTS ONLY AS A LAST RESORT TO REMOVE OIL OR GREASE IN THE CELL.**

7.4.2 Special Procedure I

If the SCD signal does not return to its previous value or remains erratic after cleaning using the Standard Procedure, then chemical cleaning is required. This will remove organic and chemical coatings, many times not noticeable by eye, which effect SCD operation.

1. Clean the probe as outline under Standard Procedure.
2. Prepare a bleach solution of approximately 10 ml household bleach (5.25% Sodium Hypochlorite, NaClO) to 100 ml of water (10:1). This dilute bleach solution oxidizes polymer or other foreign material. It is also very effective in removing organic solids or biological growth in the cell.
3. Using the solution, thoroughly scrub the cell and plunger surfaces
4. Rinse thoroughly with clean water and reassemble.
5. Operate the SCD on-line for 10 to 15 minutes until it returns to near the original value.
6. If the SCD reading does not return to within 2 SC units of the original reading, repeat the cleaning procedure until satisfactory .operation is obtained. Always flush the probe thoroughly with clean water before operating.

⚠ CAUTION **NEVER USE DETERGENT OR OTHER SURFACE ACTIVE CHEMICAL TO CLEAN THE PROBE. DO NOT USE BLEACH THAT CONTAINS SURFACE ACTIVE CHEMICALS.**

The cell may also be cleaned by running the SCD in the bleach solution in a jar test for a period of time. To do this, first remove all tubing and fittings from the probe. Immerse. The probe in the bleach solution and allow to operate for several minutes. The cell should be drained and the probe thoroughly flushed with water before resuming operation.

7.4.3 Special Procedure II

When ferric salts (ferric chloride or ferric sulfate) and/ or .potassium permanganate ($KMnO_4$) are dosed, the SCD cell can become coated with deposits of iron (reddish to light brown) and manganese (dark brown to black). These stains are not easily removed by scrubbing or bleach and require the use of a stain or rust removal chemical. Milton Roy recommends RoVer™ Rust Remover, available through HACH Company, PO Box 389, Loveland, CO 80539, USA (800) 827-4224.

RoVer™ is a non-detergent based, laboratory chemical stain remover available in 1 pound (454 gm) containers.

Cleaning procedure is as follows:

1. Make a solution of 30 grams Rover™ to 1 liter of water (approximately 1 tablespoon to a quart of water) and mix well.
2. Disassemble the probe and, using a clean brush, thoroughly scrub the cell bore and plunger with the solution, removing all discoloration on the cell surfaces.
3. Flush the probe cell and plunger thoroughly with water and reassemble.

4. Operate the SCD on-line for 10 to 15 minutes until it returns to near the original value.

As in Special Procedure I, the cell may also be cleaned by running the SCD in the Rover™ solution in a jar test for a period of time. To do this, first remove all tubing and fittings from the probe. Immerse the probe in the solution and allow to operate for several minutes. The cell should be drained and the probe thoroughly flushed with water before resuming operation.

Figure 17 summarizes the chemical operations for Special Procedures I and II.

7.5 PROBE CLEANING: SPECIAL CONSIDERATIONS

The best cleaning tool for the probe is a stiff bristle test tube or bottle brush which is used exclusively for the SCD to avoid contamination.

Minor scratches on the plunger surface and cell bore are acceptable and will not have a major impact on instrument operation. Replace the plunger if the tip is wearing unevenly and is no longer round as viewed from the end of the plunger. Similarly, if the cell bore exhibits uneven wear and becomes oblong, the probe body should be replaced. As the plunger and cell bore wear, the instrument may lose sensitivity and become erratic.

Under normal operating conditions, it may be necessary to replace the probe assembly at approximately 1 year intervals. Abrasive sample conditions may require more frequent replacement.

Very thorough flushing of the probe with clean water is very important after any chemical cleaning operation. Residual cleaning chemicals left on the probe surface will affect instrument operation and may take long periods to wash away in operation.

Remember that the SCD signal is both a function of the condition of the probe and the quality of the sample. If cleaning does not improve an erratic signal or signal drift, always double check that sample requirements have been met (Section 3) before consulting the factory.

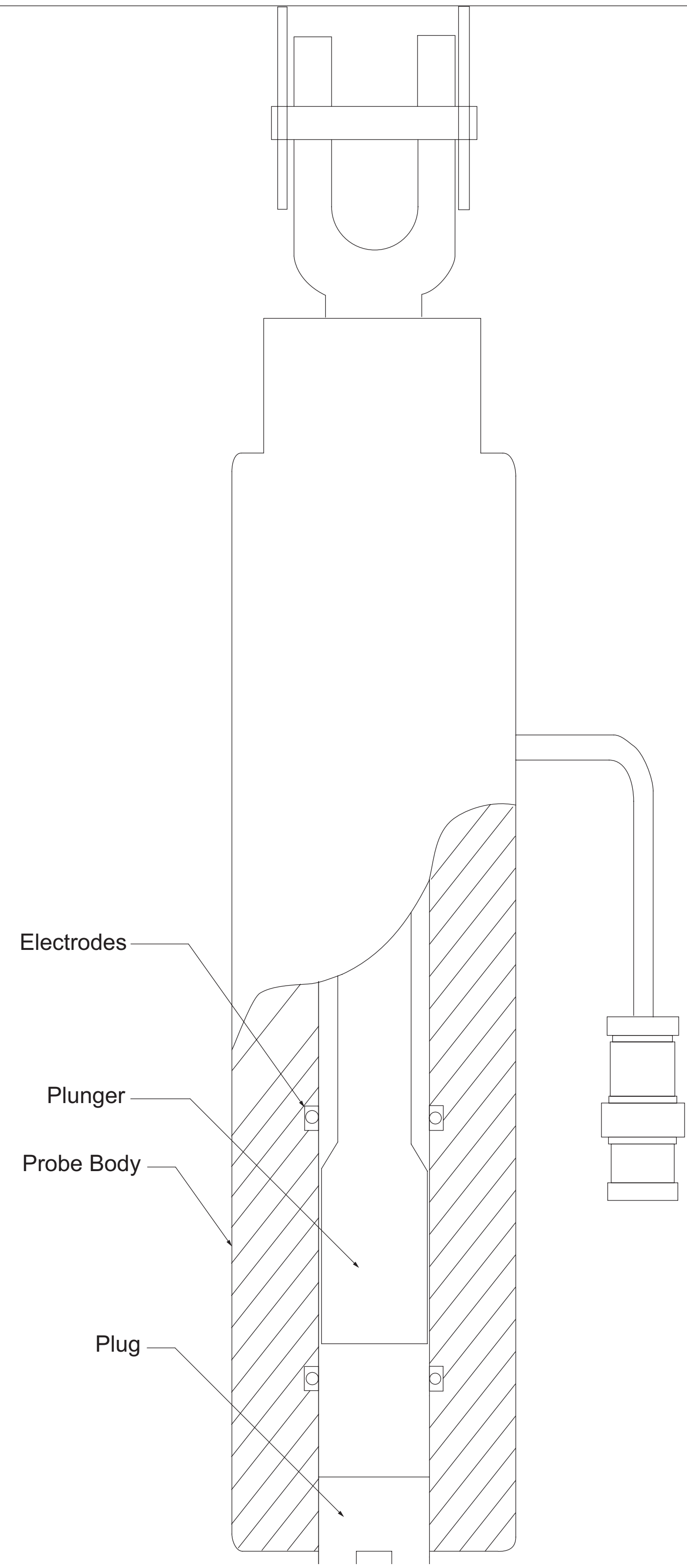

Figure 16. SCD Probe.

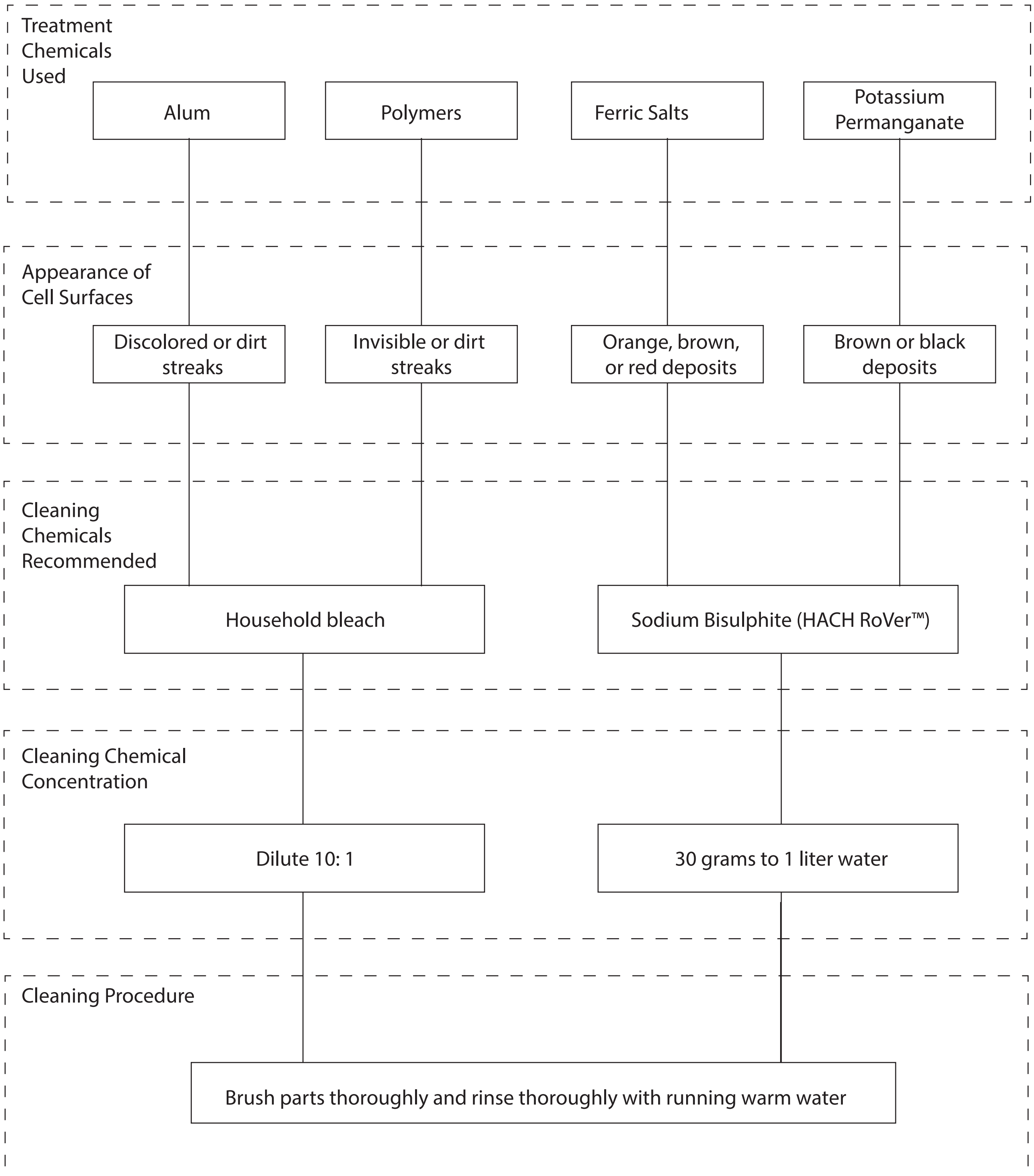

Figure 17. Cell Cleaning Procedures

⚠WARNING **DO NOT USE DETERGENT UNLESS CELL IS CONTAMINATED BY OIL OR GREASE.**

SECTION 8 - TROUBLESHOOTING

When troubleshooting the SC5200, refer to Section 9 for disassembly instructions.

CAUTION ALWAYS DISCONNECT POWER BEFORE DISASSEMBLING THE SCD UNIT.

8.1 SYMPTOMS & REMEDIES

No meter display; no motor rotation . . .
- Check for power at terminal block (TB) connections.
- Check for proper wiring-at TB connections.
- Remove front panel and check both fuses located at rear of circuit board.
- Check motor plug located at front right side of circuit board.
- Consult the Milton Roy factory

No meter display; motor rotates . . . . . .
- Check for proper wiring at terminal block connections
- Remove front panel and check that the cable connecting the main circuit board to the controller (on front panel) is securely plugged in at the circuit board and that all wire connections are tight at the controller terminals.
- Consult the Milton Roy factory.

Meter display satisfactory, but motor fails to rotate or rotates erratically . . . . .
- Remove front panel and check motor plug on circuit board.
- Remove probe cover. Using care, manually rotate the sensor disc and bearing assembly to confirm free movement of the piston assembly. If the assembly binds or feels tight, then (a) check clearance between the disc and the sensor or (b) disassemble the probe and check for binding between the plunger and the probe body.
- Check and,replace the motor.
- Consult the Milton Roy factory.

Display does not react to process changes or display reads zero. . . . .
- Clean probe (see Section 7).
- Verify that sample requirements have been met (see Section 3).
- Increase instrument gain (see Section 4).
- Check for proper probe connection at underside of enclosure. Check the probe cable for kinks or fraying.
- Check that a jumper is installed between terminals 8 and 9 of the main board (TB3). If terminals 8 and 9 are connected to a recorder or other device, verify wiring and polarity.

Display does not react to process changes or display reads zero (cont.)	• Check that the pipe plug on the bottom of the probe housing is in place and tight. If a manual backwash valve (manual jet wash) has been installed, make sure that the valve is closed tightly. • Remove the front panel. Check that the probe signal cable (2-pin, thin black wire) and sensor signal cable (gray wire) are properly connected at their plugs in the circuit board. Check all cables for kinks or frays. • Remove the probe cover. Check that the sensor disc rotates freely inside the sensor slot. Make sure that the slot in the disc is clean. Replace sensor cable if required. • If the instrument is equipped with the optional Auto Jet Wash, verify instrument power polarity on TB1. Terminal 1 must be HI and Terminal 2 NEUTRAL. • Consult the Milton Roy factory.
Display reading out of scale	• Check that a jumper is installed between terminals 8 and 9 of TB3. If terminals 8 and 9 are connected to a recorder or other monitoring device, verify wiring and polarity. • Check electrical connections on the main board and display board. • Adjust zero and gain settings to operate within range (see Section 4). • Consult the Milton Roy factory.
Erratic display readings	• Clean probe (see Section 7). • Verify that sample requirements have been met (see Section 3). • Increase filter adjustment) to remove small fluctuations SCD signal and external electrical noise. · • Check synchronous sensor disc under probe cover. Make sure disc is not contacting sensor and that discard sensor slot are clear of dirt and debris. • Remove front panel. Check all electrical connections to main board, including sensor and probe cables. • Check that sample flow rate is steady and that all flow passages are clear. • Perform a jar test as outlined below. • Consult the Milton Roy factory.

8.2 JAR TESTING

If the SCD output continues to be erratic after the above remedies have been attempted, a jar test should be performed.

To perform a jar test, first disconnect the sample supply lines from the inlet and outlet of the probe and remove both barbed fittings. If the unit is equipped with an automatic jet wash, remove the jet wash valve and plug the hole at the bottom of the probe with a 1/2 inch NPT plastic pipe plug. If a manual jet wash is being used, remove any piping from the bottom of the probe and plug the hole as specified.

Obtain a representative process sample in a 1 liter (approximate size) container and immerse the probe in the sample so that it is above the inlet and outlet holes in the probe. After allowing a few minutes for the system to react and stabilize, observe the output.

1. If the output continues to be erratic, repeat the steps as outlined above to troubleshoot the unit. Confirm that the unit is stable and the output reads 12 milliamperes (or zero on the display if so equipped) with the probe disconnected. If still unsuccessful, consult the factory.
2. If the output stabilizes, check that the flow through sample is representative and well mixed (see Section 3). Also check for correct sample flow (approximately 2 to 4 liters per minute), and try reducing the flow to reduce cell turbulence.

A jar test can also be used to troubleshoot the SCD if it still does not respond to process changes after the previously noted remedies have been attempted. Obtain jar samples at 3 or 4 chemical addition rates. Immerse the probe in each sample and observe the output. If the output does not respond to the changes in chemical dose rates from sample to sample or has a very small response, increase the gain as outlined in Section 4. If an increased gain still provides no significant response, consult the factory.

9.1 SPARE PARTS

To avoid delays in repairs, the following spare parts should be stocked for each SC5200:

1. Probe Assembly:

Standard Probe, Part #281-0260-000

Wastewater Probe, Part #281-0260-010

(refer to SCD Model Code for correct probe)

2. Fuses, 1 Amp Slo-Blo:

Part #406-0333-020

Parts orders must include the following information:

1. Quantity required
2. Part Number
3. Part Description
4. SCD serial number (found on nameplate)
5. SCD model number (found on nameplate)

Always include the serial and model numbers in all correspondence regarding the unit.

9.2 RETURNING UNITS TO THE FACTORY

SCD units will not be accepted for repair without a Return Material Authorization, available from the factory or other authorized Customer Service Department.

All inquiries on part orders should be addressed to your local Milton Roy SCD sale representative or sent to:

Parts Department

Milton Roy Company

Flow Control Division

201 Ivyland Road

Ivyland, PA 1897 4-0577

Phone: (215) 441-0800

FAX: (215) 441-0735

9.3 DISASSEMBLY

The Milton Roy Streaming Current Detector has a modular design that allows easy removal of individual components and subassemblies. Refer to Figure 19 and the parts lists to identify component location.

These instructions cover the removal and replacement of the following components and subassemblies:

1. Probe Assembly
2. Bearing Assembly
3. Front Panel and Controller
4. Main Circuit Board
5. Drive Motor
6. Signal Cable
7. Timing Sensor Cable

For disassembly procedures on the optional automatic Jet Wash system, refer to Milton Roy Automatic Jet Wash manual 339-0034-000

For other repairs, consult Milton Roy.

⚠ WARNING **BEFORE PERFORMING ANY OF THESE PROCEDURES, DISCONNECT ALL POWER TO THE SCD UNIT AND SAFETY TAG THE SWITCH.**

9.3.1 Probe Assembly

1. Shut off sample flow. Remove the sample feed and drain tubing at the barbed connections.
2. Disconnect the probe cable at the connector located at the bottom of the enclosure.
3. Remove the probe cover.
4. Remove the clevis pin and cotter pin holding the plunger to the bearing assembly.
5. Using the spanner wrench provided with the SCD, remove the bearing nut holding the probe housing to the enclosure. Remove the probe assembly.
6. Remove the plunger by pulling it straight out of the probe bore. Unscrew the plug on the bottom of the probe body.
7. Inspect the plunger surf ace and probe bore for abrasion and scratches which may necessitate replacement of the probe.
8. Clean the probe according to the instructions given in Section 7, Routine Maintenance.
9. Reassemble in reverse order. (Note: Install with the probe cable .and vent .hole to the rear of the unit.)

9.3.2 Bearing Assembly

1. Remove the side probe cover.
2. Remove the cotter pin and clevis pin holding the plunger to the crank. Swing the bearing assembly clear of the plunger.

3. Remove the two (2) screws holding the timing sensor to its bracket. Carefully lift the sensor clear of the timing disc.
4. Remove the screw holding the bearing assembly to the motor shaft and carefully pry the assembly off the shaft. Be careful not to damage or bend the timing disc during this procedure.
5. To reinstall the bearing assembly:
   a. Slide the bearing assembly hub onto the motor shaft. Align the locating pin in the end of shaft with one of the holes in the bearing assembly hub. Make sure that the hub is fully seated on the shaft and the pin fits into one alignment hole.
   b. Replace the screw holding the hub to the shaft.
   c. Position the timing sensor on its bracket so that the timing disc passes cleanly through the sensor slot. Align the sensor so the disc is centered in the slot and then replace the screws that hold the sensor in place.
   d. Position the bearing assembly in the plunger and replace the pin and cotter.
   e. Replace the probe cover.

9.3.3 Front Panel and Controller

1. Remove the four (4) button head screws holding the front panel to the enclosure.
2. Slide the panel forward. Carefully reach into the enclosure and unplug the controller cable -from the main circuit board.
3. Lift the controller/panel assembly away from the enclosure.
4. To separate the controller from the panel:
   a. Locate the four (4) ratchet tabs on the plastic fixing strap. Gently pry each tab in turn to work it back from their ratchet locks.
   b. Carefully slide the controller fixing strap forward and off the locking ramps in the controller body. Hold the matching ramps on the collar away from the controller while sliding the collar back and off the controller.
   c. Remove the controller from the panel:’
   d. Disconnect the controller cable at the terminal block at the rear of the controller. Note the position of each wire before removing. See Figure 18 below for controller terminal locations.
5. Reassemble in reverse order.

Wire Color	Terminal location	Description
Black	14	AC power - Neutral
White	13	AC power - Line
Green		AC ground - Not connected
Gray	10	N/C (Band Alarm Connection)
Yellow	11	C (Band Alarm Connection)
Tan	12	N/O (Band Alarm Connection)
Pink	Not used	None
Red	21	+ (4-20mA Control Output)
Blue	19	- (4-20mA Control Output)
Purple	Not used	None
Orange	4	+ (4-20mA Input from Main Circuit Board)
Brown	1	- (4-20mA Input from Main Circuit Board)

Figure 18. Controller Terminal Locations

9.3.4 Main Circuit Board

1. Remove the side panel. Disconnect all wires · from the main board terminal blocks, noting their positions.
2. Remove the front panel following the directions under "Front Panel" and set aside.
3. Locate the signal cable and sensor cable. Unplug both from the main circuit board.
4. Locate the 2-pin motor plug on the right side of the main circuit board and remove.
5. Remove the two (2) screws holding the main circuit board in place; these are located at the front of the board. Do not remove the screw located at the rear of the board.
6. Slide the board forward. Lift the rear of the board up and over the rear mounting studs.

Lift the front of the board up and carefully pull the board out through the front of the enclosure.

7. To install the main circuit board:
   a. Insert the board under the motor through the front of the enclosure. Make sure the terminal block is on the left side.
   b. Lift the rear of the board over the two back mounting studs.
   c. Slide the front of the board forward and under the two front panel mounting tabs.
   d. Align the slots in the rear of the board with the slots in the mounting studs and slide the board back in place.
   e. Replace the two (2) front mounting screws.
8. Continue the reassembly by following steps 1- 4 in reverse.

9.3.5 Drive Motor

1. Follow the appropriate directions to remove the main circuit board and bearing assembly.
2. Remove the four (4) screws holding the motor to the enclosure. Carefully lift the motor out of the enclosure.
3. The motor gearbox is grease lubricated and not normally serviceable.

9.3.6 Signal Cable

1. Disconnect the probe cable at the connector located at the bottom of the enclosure.
2. Remove the front panel and main circuit board following the directions given in the appropriate sections.
3. Working inside the enclosure, loosen and remove the nut holding the signal cable bulkhead connector to the enclosure.
4. Pull the connector and-cable out of the enclosure from the outside.
5. Reassemble in reverse order

9.3.7 Timing Sensor Cable

1. Remove the probe cover.
2. Remove the sensor from its bracket mounted above the timing disk.
3. Remove the front panel following the directions given in the appropriate section.
4. Unplug the sensor cable from the main circuit board.
5. Working from the outside of .the enclosure;. carefully pry the sensor cable grommet out of its hole in the enclosure; then pull the cable out of the enclosure.
6. Reassembly in reverse order. When mounting the sensor over the timing disk, make sure the disk is centered in the sensor slot.

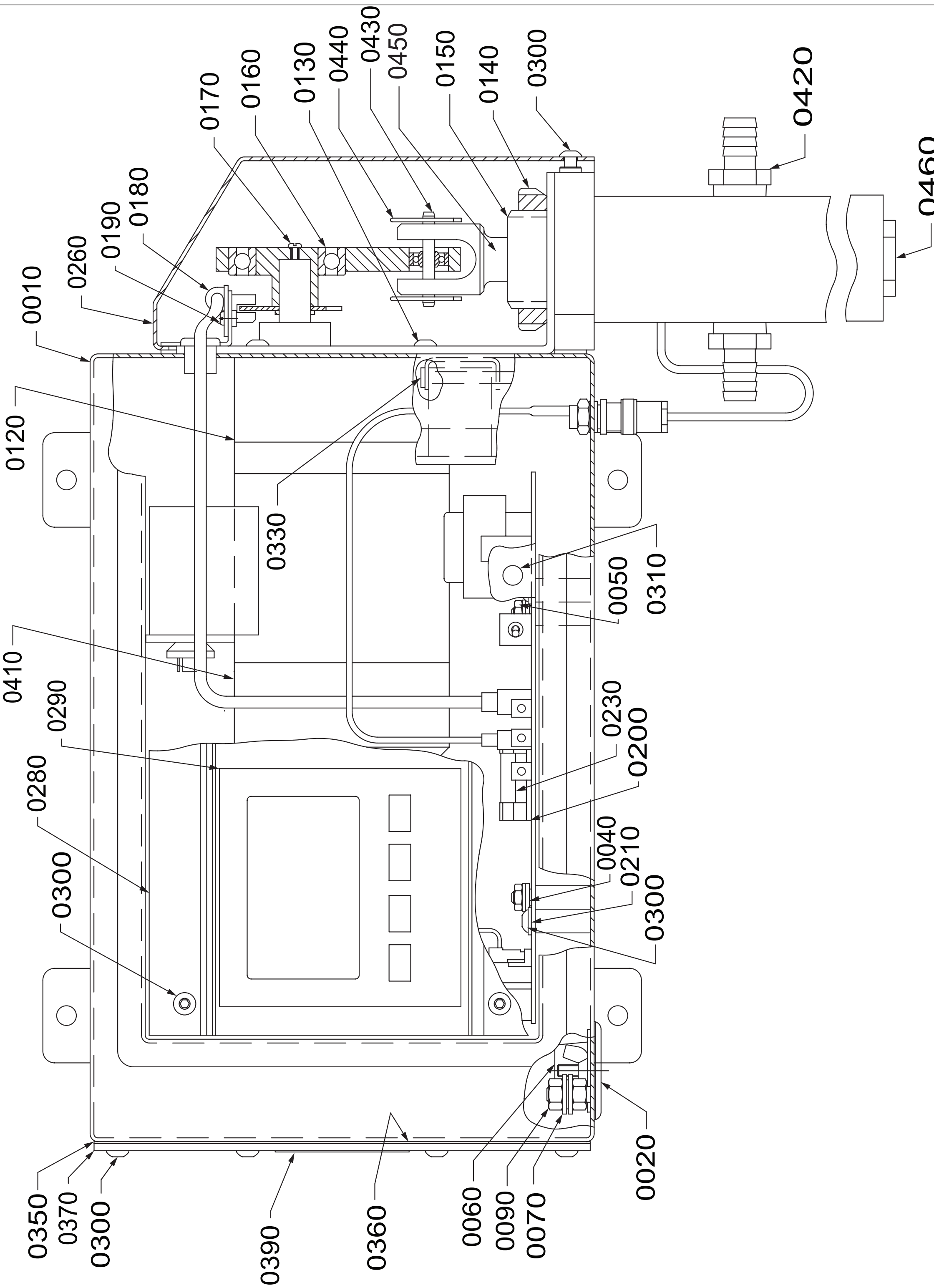

Figure 19. (Front View)
SC5200 Parts (D-102-1715-000-D.

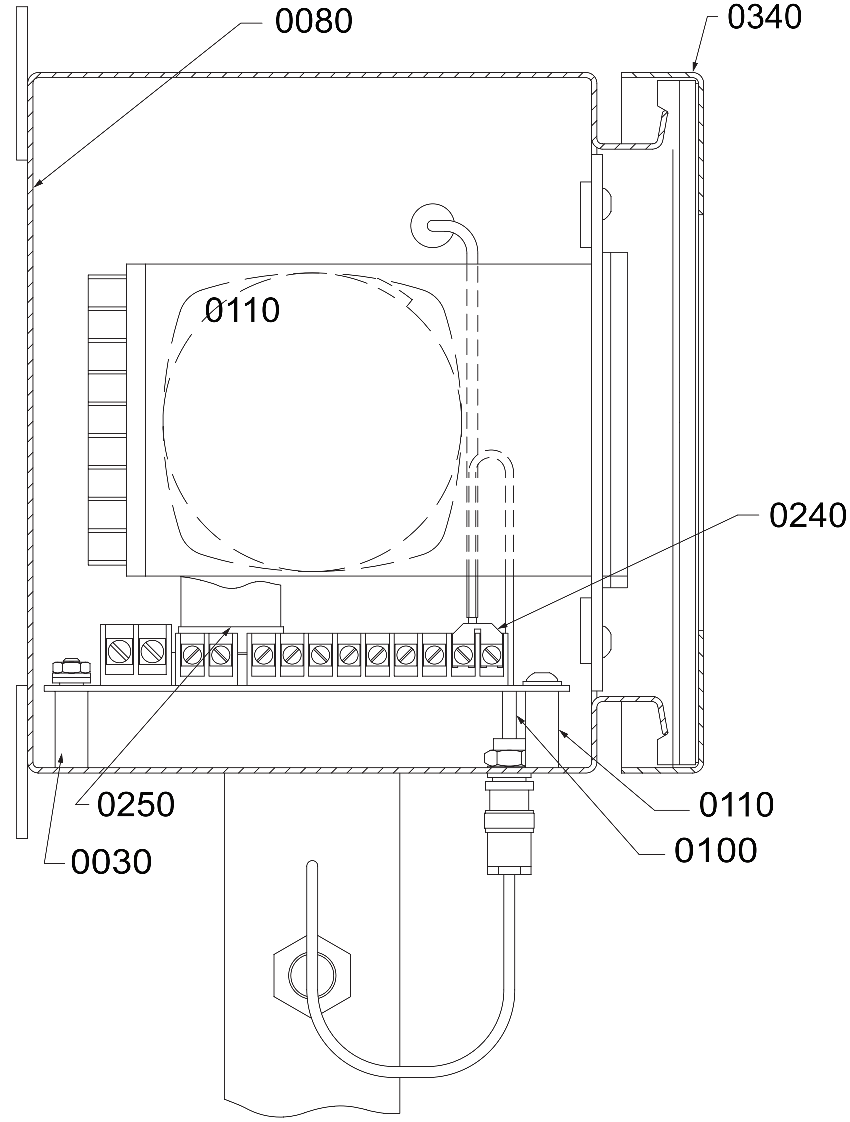

Figure 19. (Side View)
SC5200 Parts (D-102-1715-000-D)

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