Catalog Number DOC026.52.00769

Surface Scatter® 7 sc Turbidimeter

USER MANUAL

Edition 2 November 2006

HACH®

Be Right™

Catalog Number DOC026.52.00769

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Table of Contents

Table of Contents

Section 1 Specifications

Specifications are subject to change without notice

Range	0.01–9999.9 nephelometric turbidity units (NTU)
Accuracy	± 5% of reading or ± 0.1 NTU (whichever is greater) from 0.01 to 2000 NTU; ± 10% of reading from 2000 to 9999 NTU
Resolution (displayed)	0.01 NTU up to 999.99 NTU; 0.1 NTU from 1000.0 to 9999.9 NTU
Repeatability	Better than ± 1.0% of reading or ± 0.04 NTU, whichever is greater for each range.
Response time	Initial response in 45 seconds
Sample flow required	1.0 to 2.0 L/min (0.3 to 0.5 gal/min) (15 to 30 gal/hr)
Sensor storage temperature	–20 to 80 °C (–4 to 140 °F); 95% relative humidity, non-condensing.
Operating temperature	**sc100:** 0 to 50 °C (32 to 122 °F) for one SS7 sc on an sc100; 0 to 40 °C (32 to 104 ° F) for one SS7 sc and another smart sensor that consumes less than 5 watts on a single sc100 (provided by sc100). See Figure 1 on page 6.
	sc1000: –20 to 55 °C (–4 to 131 °F); 95% relative humidity, non-condensing
Sample temperature range	0 to 50 °C (32–122 °F); HST model—0 to 70 °C, intermittent 70 to 80 °C. (An approved heat exchanger is available to reduce sample temperature.)
Operating humidity	5 to 95% non-condensing
Power requirements	12 VDC ±5%, 20 watts maximum (provides by sc100)
Sample inlet fitting	¾-in. NPT female
Overflow drain fitting	1-in. NPT female
Body drain fitting	¾-in. NPT female
Alr purge fitting	¼-in. quick-connect compression fitting; 0–50SCFH airflow of clean instrument air
Signal average (filter) time	No averaging, 6, 30, 60 and 90 seconds, user selectable. Default is 30 seconds.
Sensor dimensions	64.2 x 67.5 x 19.0 cm (25.3 x 26.6 x 7.5 in.)
Sensor cable length	2 m (6.6 ft); Optional 7.62 m (25 ft) extension cable. Maximum cable length is 9.62 m (31.6 ft).
Sensor cable rating	Cable: 105 °C, 300 V, PVC jacket Wires: 22 AWG, PVC jacket
Mounting options	Wall
Shipping weight	SS7 sc—15.8 kg (34.8 lb); SS7 sc-HST—18 kg (39.6 lb)
Calibration method	Formazin – user-prepared primary or wet calibration of the instrument
Verification (dry) method	Standardization plates with approximate values of 100 or 1000 NTU. Unique value is assigned when dry verification is done immediately after calibration and is used with pass/fail criteria for subsequent verifications.
Recommended cleaning intervals	Mandatory before calibration Optional before verification Mandatory upon verification failure
Languages	English (default), German, French, Spanish, Italian, Swedish, Polish, Korean, Chinese, Japanese
Installation environment	Indoor
Primary compliance method	USEPA 180.1; Hach Method 8195; ASTM D 6698; Standard Methods 2130B

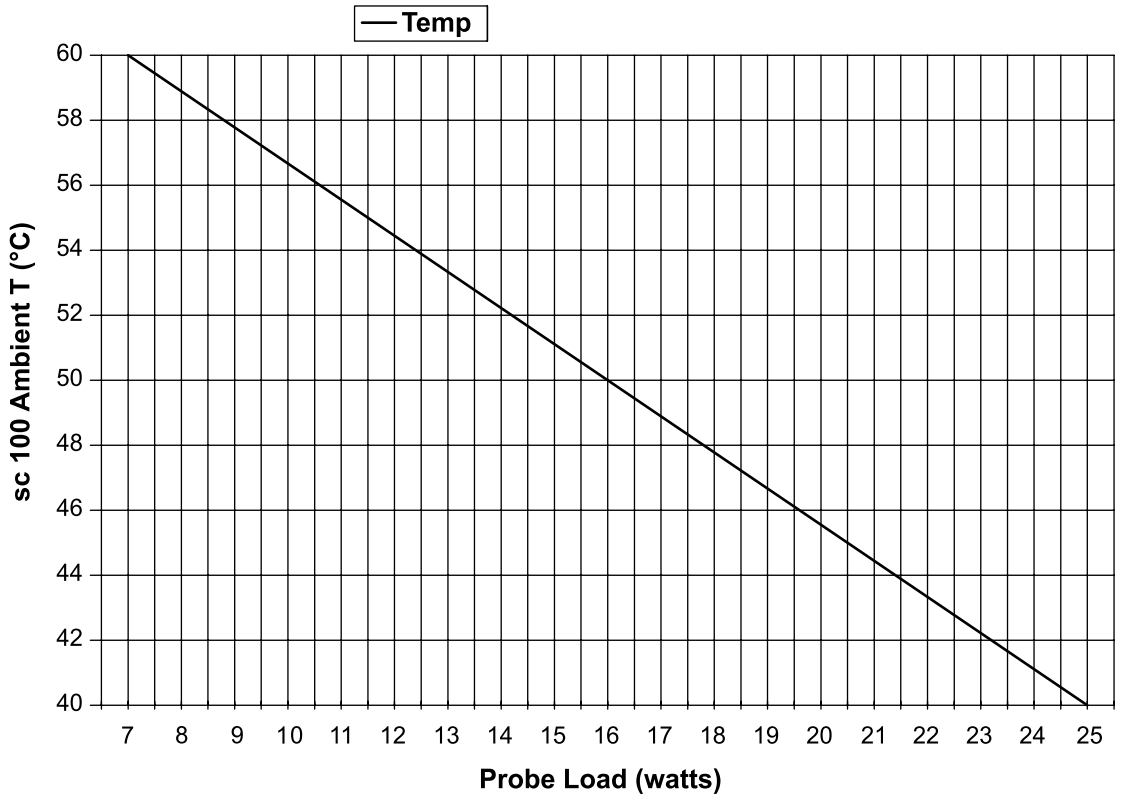

Figure 1 Maximum ambient temperature vs. probe load

Table 1 sc100 controller capacity

Controller operating temperature (°C)	Power available (watts)	Controller capacity
40	25	1 SS7 sc plus 5 watts for other devices
50	16	1 SS7 sc plus 4 watts for other devices
60	7	Out of power range for SS7 sc

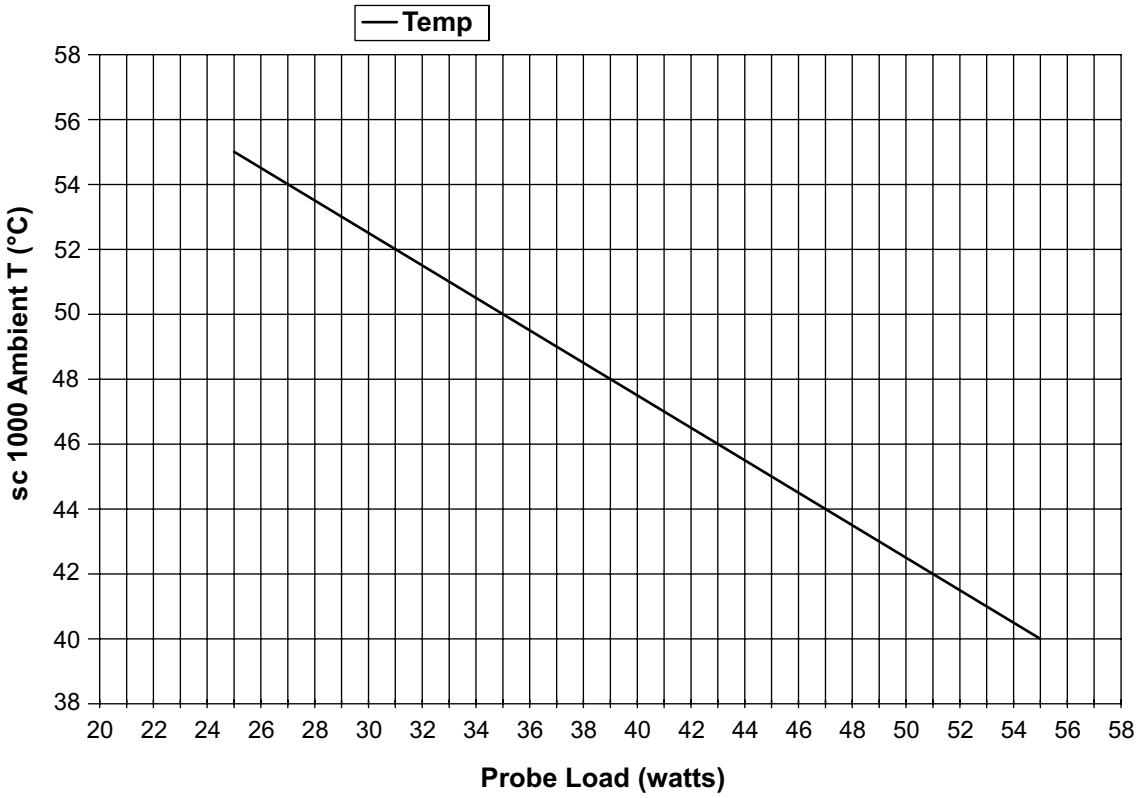

Figure 2 Maximum ambient temperature vs. probe load

Table 2 sc1000 controller capacity

Controller operating temperature (°C)	Power available (watts)	Controller capacity
40	55	2 SS7 sc plus 15 watts for other devices
50	35	2 SS7 sc plus 11 watts for other devices
55	25	1 SS7 sc plus 13 watts for other devices

Table 3 sc1000 component power consumption

Component	Power consumption (watts)
Display module	10
Current output card	2.5 maximum load
Current input card	1.5
Relais card	1
Fieldbus module (Profibus)	2.5
Fieldbus module (Modbus)	0.5

Section 2 General information

2.1 Safety information

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

To ensure that the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that specified in this manual.

2.1.1 Use of hazard information

DANGER
Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION
Indicates a potentially hazardous situation that may result in minor or moderate injury.

Important Note: *Information that requires special emphasis.*

Note: *Information that supplements points in the main text.*

2.1.2 Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. A symbol, if noted on the instrument, will be included with a danger or caution statement in the manual.

	This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.
	Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/96/EC), European electrical equipment users must now return old or end-of life equipment to the Producer for disposal at no charge to the user. ***Note:*** *For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories and all auxiliary items for proper disposal.*
	This symbol, when noted on a product enclosure or barrier, indicates that a risk of electrical shock and/or electrocution exists.
	This symbol, if noted on the product, indicates the need for protective eye wear.
	This symbol, when noted on the product, identifies the location of the connection for Protective Earth (ground).
	This symbol, when noted on the product, identifies the location of a fuse or current limiting device.
	This symbol, when noted on the product, identifies a risk of chemical harm and indicates that only individuals qualified and trained to work with chemicals should handle chemicals or perform maintenance on chemical delivery systems associated with the equipment.
	This symbol, when noted on the product, indicated the presence of devices sensitive to Electro-static Discharge (ESD) and indicated that care must be taken to prevent damage with the equipment.

2.2 General product information

2.2.1 Instrument description

The Surface Scatter® 7 sc (SS7 sc) Turbidimeter is a sensitive, continuous-monitoring instrument designed for measuring turbidity in fluids. The instrument design is based on the nephelometric principle, where light scattered by particles suspended in the fluid is measured to determine the relative amount of particulate matter in the fluid. It meets all U.S. Environmental Protection Agency (USEPA) design criteria, features an automatic-ranging digital display and is capable of measuring turbidities from 0–9999 NTU. Calibration is based on formazin, the primary turbidity reference standard adopted by the APHA Standard Methods for the Examination of Water and Wastewater and the USEPA. The instrument consists of a control unit and a sample unit (Figure 3).

DANGER
The SS7 sc and SS7 sc-HST Turbidimeters are not designed for use with samples that are flammable or explosive in nature. If any sample solution other than water is used in this product, test the sample/product compatibility to assure user safety and proper product performance.

DANGER
The SS7 sc/sc controller platform product configuration is not intended for installation in hazardous locations. See the sc controller platform installation control drawing 58600-78 for approved hazardous location sensors.

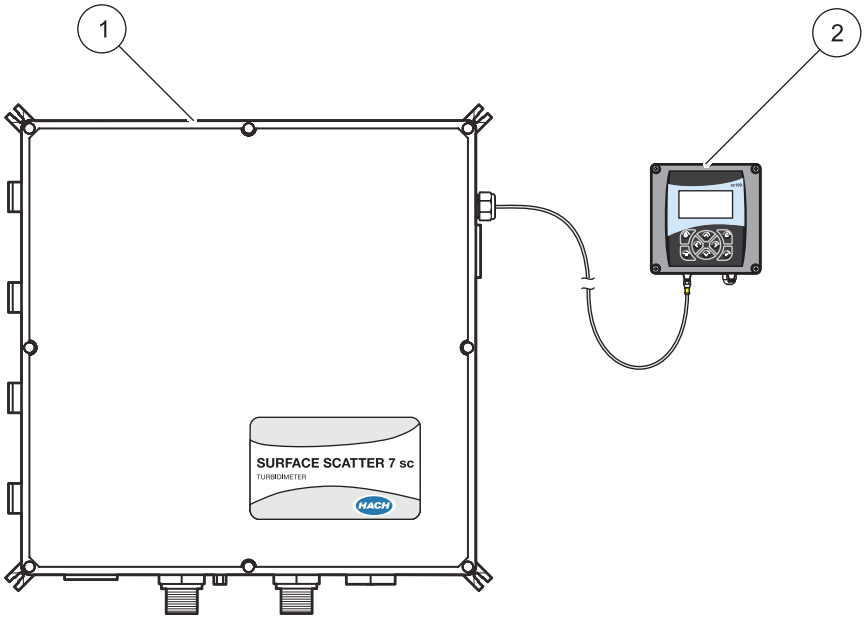

Figure 3 SS7 sc Turbidimeter

1	Sample unit	**2**	Control unit

2.2.1.1 Controller

The SS7 sc and SS7 sc-HST operate in conjunction with an sc100 controller. The controller enclosure houses the keypad, display, microprocessor board and power supply components.

Operating controls and indicators are on the controller. The controller is used to program the instrument for turbidity level alarm set points and to perform diagnostic self-tests and programming operations.

Sample turbidity is displayed continually by the digital display during normal operation. Because of the automatic decimal point positioning, no range selection is needed. Indicators of turbidity level alarm conditions, certain critical system malfunctions or other possible malfunctions are also on the controller.

Programmable alarm circuits provide three relay closures, both normally open and normally closed, for selectable turbidity alarm level set points. Set points can be programmed by the operator anywhere within the overall range. The alarm circuits can be programmed for Alarm, Feeder Control, Event Control, PWM Control, Frequency Control and Warning. Refer to the sc100 manual for setup and use of these different settings. An alarm relay can be programmed in the sc100 to control the optional Auto Flush Kit.

The sc100 controller is designed to meet NEMA 4X water-tight requirements. It is constructed of corrosion-proof materials. It is suitable for indoor installation. Mounting hardware is included with the sc100 to provide the capability to wall mount, pipe mount and panel mount the controller without affecting the environmental integrity of the case. Electrical access holes are sized for ½-in. conduit.

2.2.1.2 Sample unit

Sample flows through the sample unit (Figure 4) where sample turbidity is measured. The sample unit enclosure contains all the electronics for measuring the turbidity. A NEMA 12, corrosion-proof case protects the optical components and hydraulics from industrial environments and supplies the measurement signal to the control unit. The case is designed for wall mounting with external mounting blocks.

Hydraulic connections to the sample unit are at the bottom of the enclosure. An air purge fitting is installed in the enclosure bottom. Air purge is suggested to control condensation inside the enclosure.

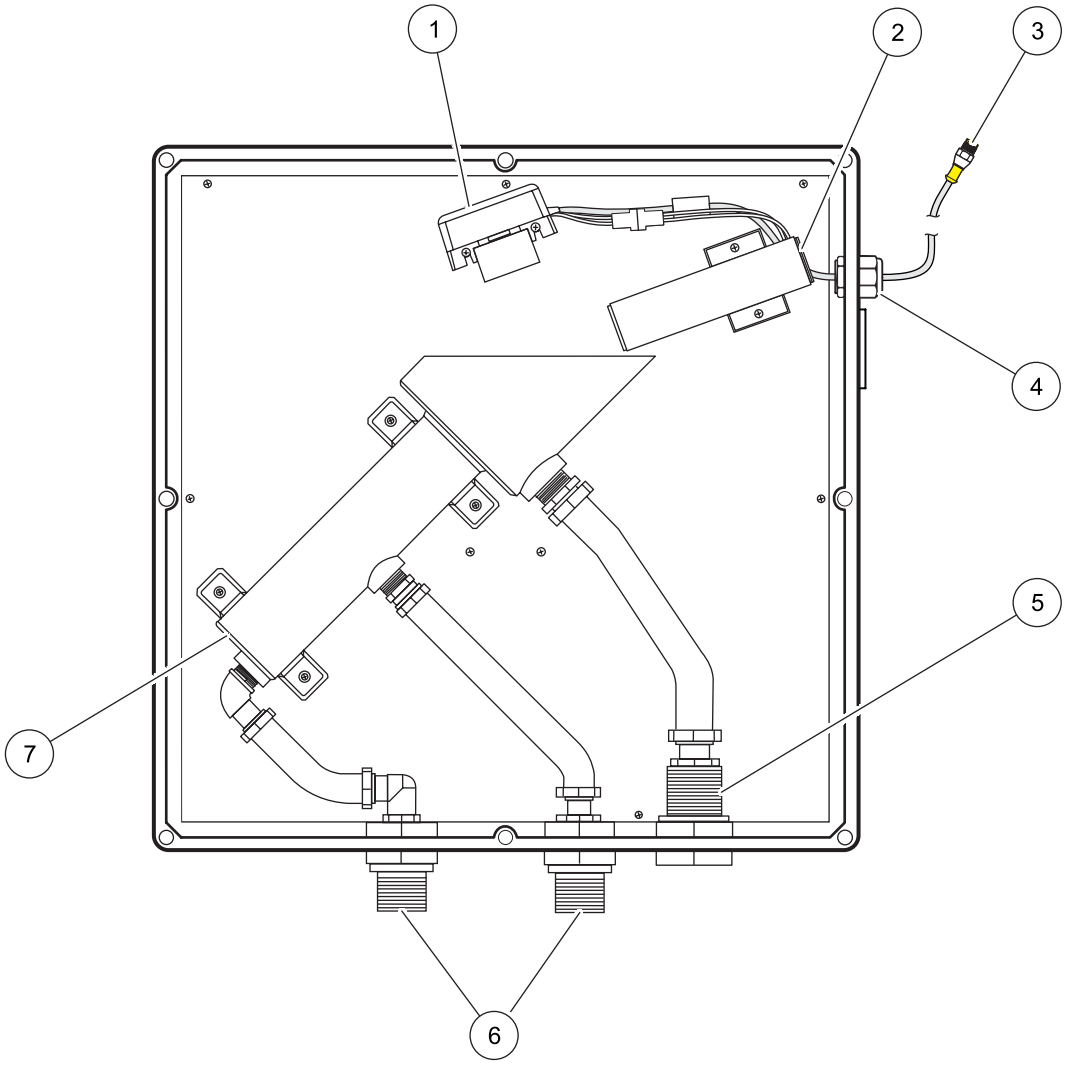

Figure 4 SS7 sc components

1	Detector assembly (Cat. No. 71221-00)	**5**	Bulkhead fitting, 1-in. NPT (Cat. No. 40355-00)
2	Light source assembly (Cat. No. 45004-00)	**6**	Bulkhead fittings, ¾-in. NPT (Cat. No. 40311-00)
3	To sc100	**7**	Turbidimeter body (Cat. No. 45002-00)
4	Cord grip (Cat. No. 61287-01)		

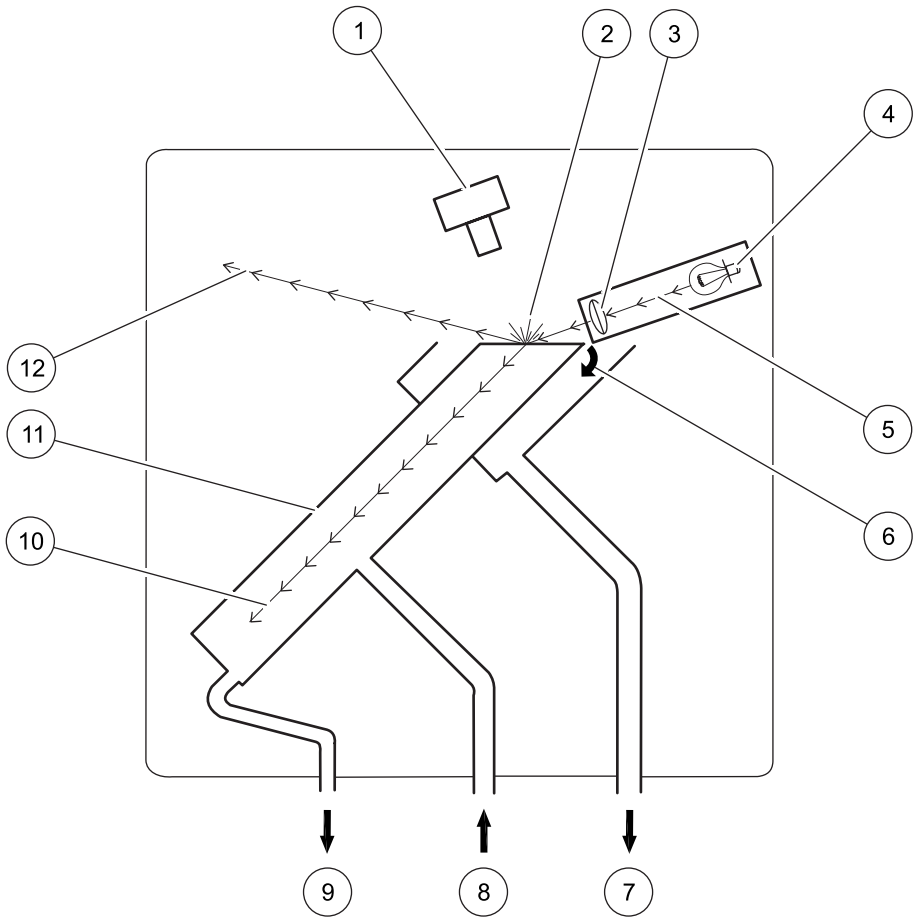

Figure 5 Optical diagram

1	Detector assembly	**5**	Light beam	**9**	Instrument drain
2	Scattered light	**6**	Over-flowing sample	**10**	Refracted light
3	Lens	**7**	Overflow drain	**11**	Turbidimeter body
4	Lamp	**8**	Sample in	**12**	Reflected light

2.2.2 Surface Scatter 7 sc High Sample Temperature

The Surface Scatter 7 sc High Sample Temperature Turbidimeter (SS7 sc-HST) has been designed for high sample temperature. The basic design and principle of operation are the same as the standard SS7 sc model. Differences between the standard and HST models will be noted in this manual where appropriate.

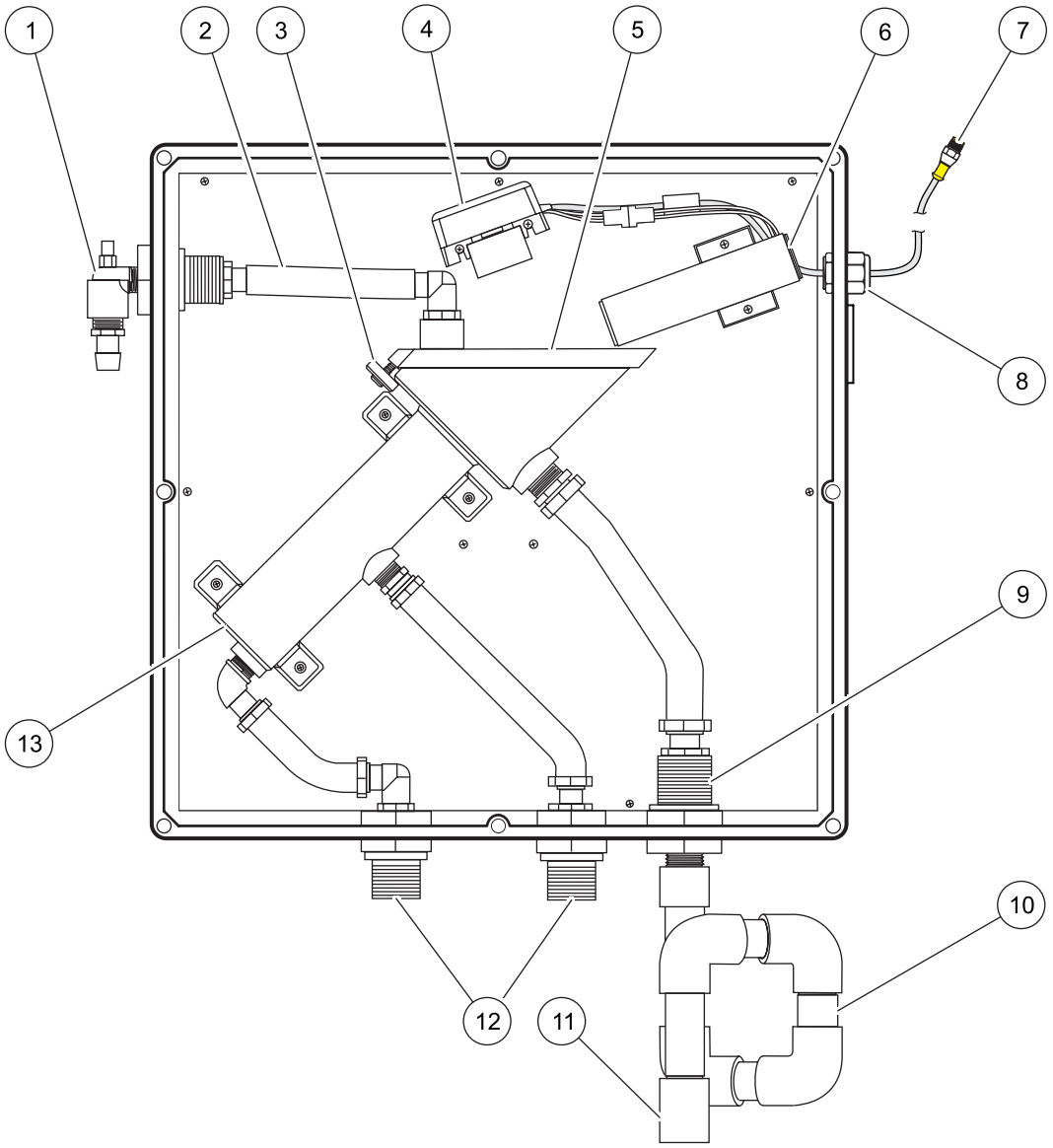

Figure 6 SS7 sc-HST components

1	Flow multiplier	**8**	Cord grip (Cat. No. 61287-01)
2	¾-in. hose	**9**	Bulkhead fitting, 1-in. NPT (Cat. No. 40355-00)
3	Threaded disk (Cat. No. 40299-00) with ¼-in. screw (Cat. No. 7858-11)	**10**	Drain trap
4	Detector assembly (Cat. No. 71221-00)	**11**	1-in. NPT gravity drain
5	Vent cover (Cat. No. 40294-00)	**12**	Bulkhead fittings, ¾-in. NPT (Cat. No. 40311-00)
6	Light source assembly (Cat. No. 45004-00)	**13**	Turbidimeter body (Cat. No. 45002-00)
7	To sc100		

Section 3 Installation

DANGER
Only qualified personnel should conduct the tasks described in this section of the manual. The SS7 sc/sc controller product configuration is not intended for installation in hazardous locations.

The tasks described in this section requires individuals to be technically knowledgeable of the associated dangers. Burns, shock, eye damage, fire and chemical exposure may occur if this work is not done by qualified personnel. Always review appropriate Material Safety Data Sheets (MSDS) before working with chemicals.

3.1 Basic installation overview

1. Unpack the SS7 sc or SS7 sc-HST Turbidimeter (section 3.2).
2. Review the environmental requirements and select the mounting location (section 3.3.2 on page 17).
3. Mount the sample unit (section 3.3.3 on page 17).
4. Install the optional heat exchanger, if required (section 3.3.4 on page 19).
5. Install the 3-way ball valve, if required (section 3.3.5 on page 20).
6. Connect the sample in, body drain and overflow drain (section 3.5 on page 21).
7. Connect the air purge valve (section 3.6 on page 24).
8. Connect the sample unit to the controller to supply power to the system (section 3.7.2 on page 24).

3.2 Unpacking the instrument

1. Remove the instrument from the shipping carton.
2. Verify that no visible damage has occurred during shipment. Be sure the following items are included in the carton:
   - Sample unit
   - Instruction manual
   - Installation kit items (Figure 7)

Contact the manufacturer immediately to report missing or damaged items.

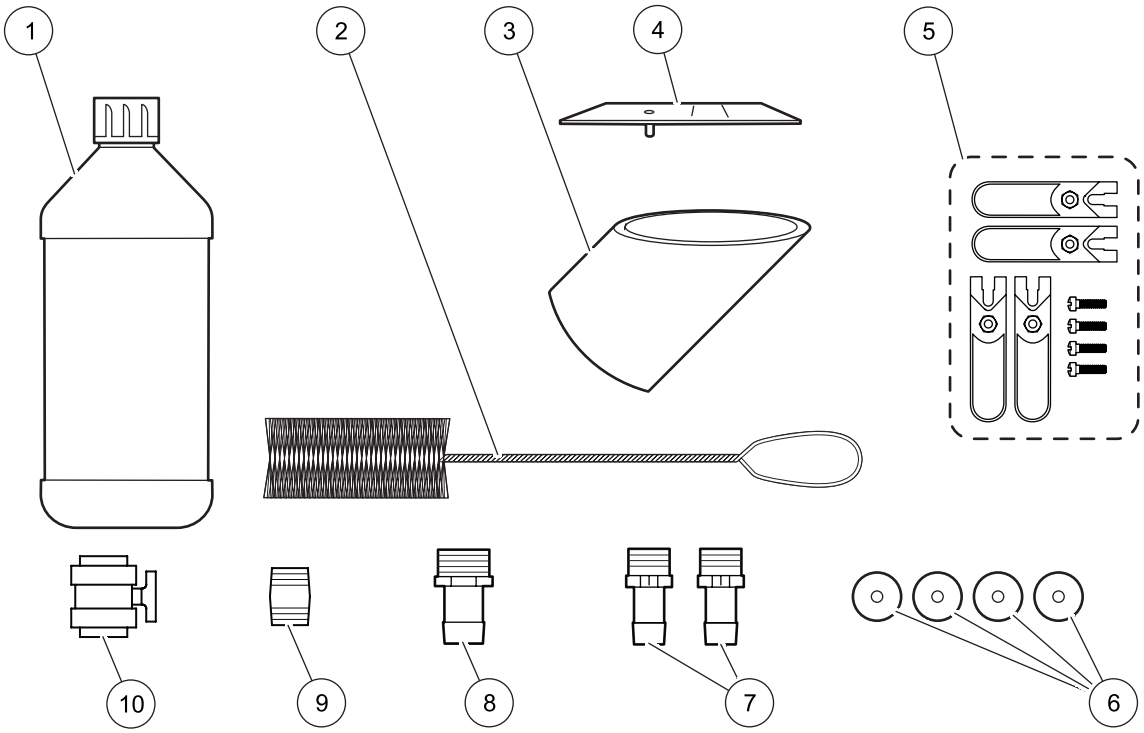

Figure 7 Installation kit items[1]

1	Formazin stock solution, 4000 NTU, 500 mL	**6**	Washer, ¼ ID x 1.00 OD (4x)
2	Brush, cylinder, size 2	**7**	Adapter, barb fitting, ¾” NPT to ¾” ID hose barb (2x)
3	Calibration cup, SS7 sc	**8**	Adapter, barb fitting, 1” NPT to 1” ID hose
4	Light source alignment plate	**9**	Nipple, ¾” NPT
5	Wall mounting kit	**10**	Drain valve

[1] See Section 8 Replacement parts and accessories on page 51.

3.3 Mechanical installation

3.3.1 Environmental requirements

The SS7 sc and SS7 sc-HST enclosures are designed for general-duty, indoor installation. Ambient temperatures within specifications are allowed, but best performance will result if temperature does not change rapidly. Do not mount in direct sunlight. Shield from dripping water.

The controller enclosure is designed to protect the electronics from typical conditions in water treatment and industrial facilities.

3.3.2 Selecting the installation location

Turbidimeters should always be located as close to the sampling point as possible. The shorter the distance traveled by the sample to the turbidimeter, the faster the turbidimeter can respond and indicate changes in sample turbidity.

Dimensions and other installation information are shown in Figure 8 on page 18, Figure 9 on page 19 and Figure 10 on page 20. The control and sample unit are designed for wall mounting. The turbidimeter sensor must be mounted within six feet of the controller unless an extension cable is used. Maximum cable length is 9.6 m (31.5 ft).

3.3.3 Mounting the SS7 sc or SS7 sc-HST

1. To ensure proper performance, the sample unit must be level (Figure 9 on page 19). Use a small level across the top opening of the turbidimeter body to verify that the instrument does not slope left-to-right or front-to-back.
2. Use one rubber washer (supplied) at each wall mounting block between the block and the wall. Mounting blocks are secured to the four corners of the sample unit to facilitate wall mounting without affecting the integrity of the enclosure protection.
3. Attach the sample unit to the wall with four customer-supplied mounting bolts.

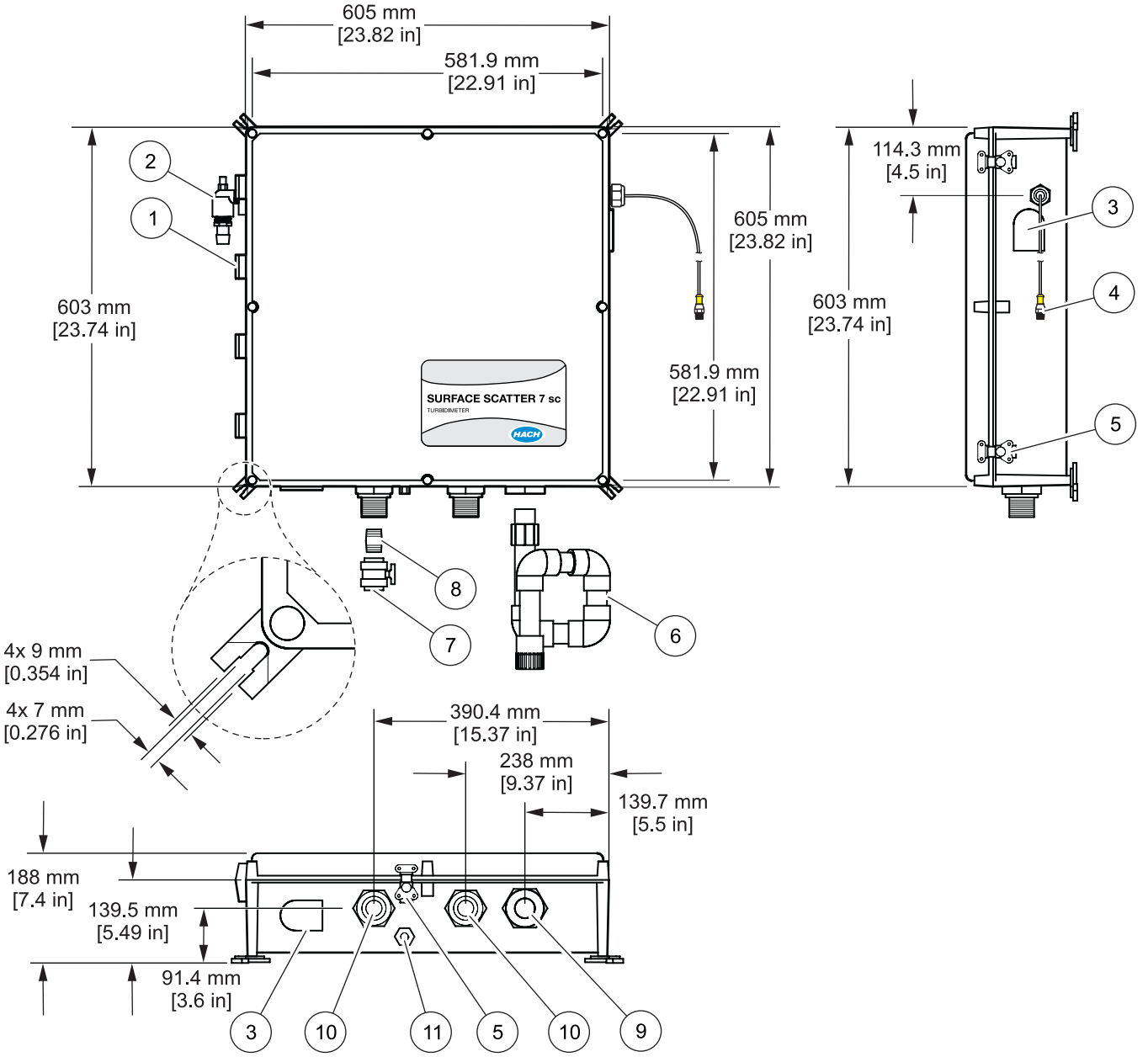

Figure 8 SS7 sc and SS7 sc-HST installation drawing

1	Door hinges (4x)	**7**	Ball valve
2	Flow multiplier (SS7 sc-HST only)	**8**	¾-in. NPT nipple
3	Ventilator (2x)	**9**	1-in. NPTF bulkhead fitting
4	Cable assembly	**10**	¾-in. NPTF bulkhead fitting
5	Enclosure door latch (4x)	**11**	Air purge fitting
6	Drain trap (SS7 sc-HST only)		

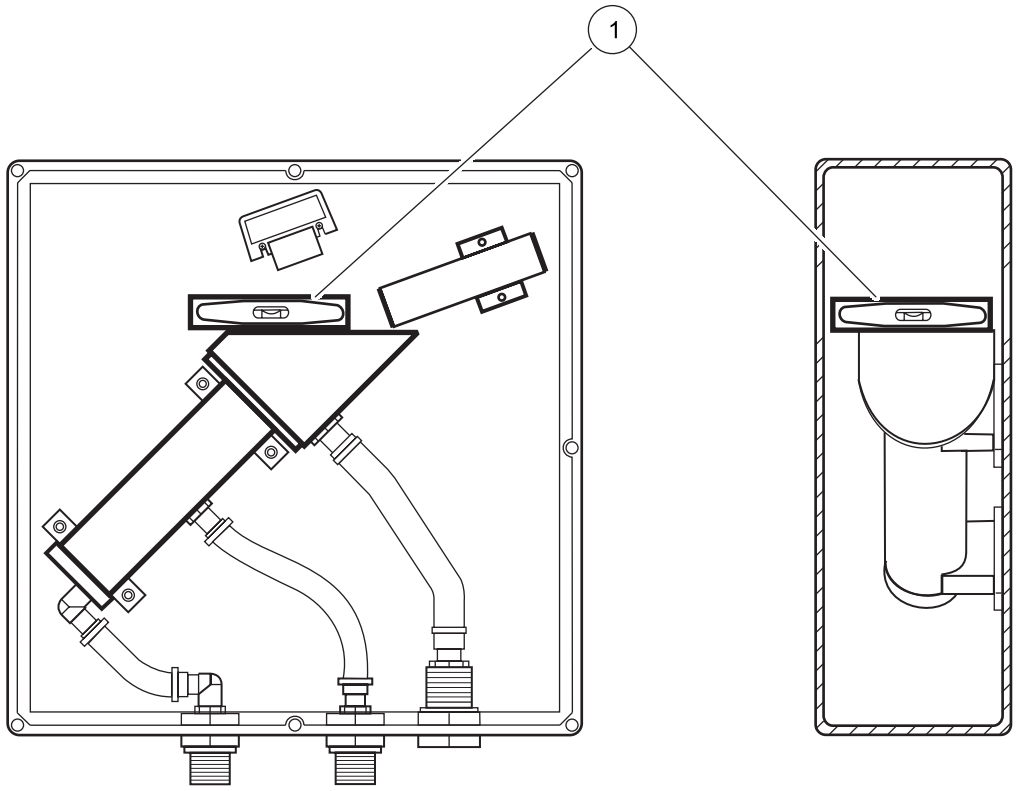

Figure 9 Instrument leveling

1	Level

3.3.4 Installing the optional heat exchanger

An optional heat exchanger (Cat. No. 48551-00) is available for the SS7 sc-HST (Figure 10 on page 20). The heat exchanger reduces sample temperatures that exceed the temperature requirements of the instrument. It can reduce sample temperatures of up to 100 °C but is not suitable for steam or super-heated water. A source of cooling water is required. The heat exchanger is made of 316 stainless steel and has ¾" MNPT pipe connections. The large plumbing connections help eliminate clogging.

- Allow adequate space below and to the right (latch) side of the sample unit to make hydraulic connections.
- See Figure 10 on page 20 for installation dimensions.
- See Figure 12 on page 22 for heat exchanger connections.

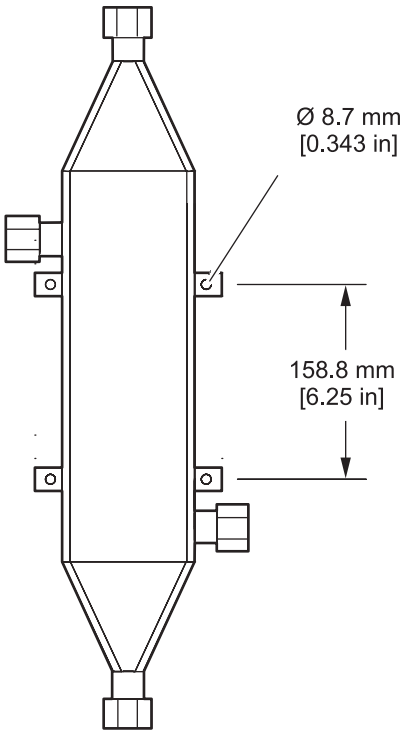

Figure 10 Heat exchanger dimensions

3.3.5 Installing the 3-way ball valves

CAUTION
Installation should be performed by qualified technical personnel to ensure adherence to all applicable electrical and plumbing codes.

Refer to the Auto Flush Kit Instruction Sheet (Cat. No. 46692-88) for complete installation instructions.

3.4 Installing a sample line

Sample lines diameter must be appropriate for the sample type. Choose a line size that minimizes lag time, but also minimizes plugging with solids.

- Route the sample line as directly as possible.
- Using long or large diameter sample lines will result in a significant lag time between actual process conditions and instrument measurements.
- When larger diameter sample lines or long distances are unavoidable, increase flow to the instrument and bypass excess flow to the drain or back to process.
- Install sample line taps into larger process pipes to minimize the chances of ingesting sediment from the pipe-line bottom or air bubbles from the top. A tap projecting into the center of the pipe is ideal. Figure 11 shows both good and poor methods of installing a sample tap.

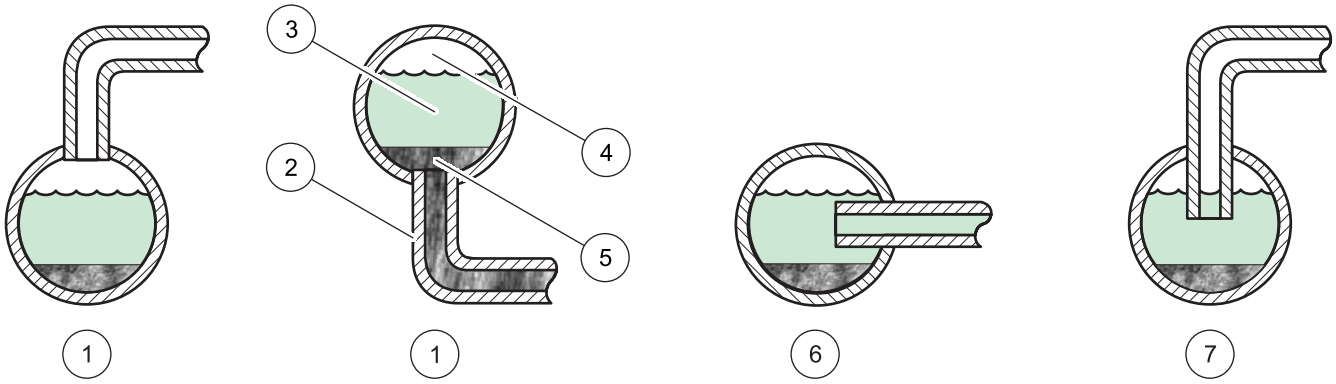

Figure 11 Sampling techniques

1	Poor	**5**	Sediment (typical)
2	Sampling line to sample unit	**6**	Good
3	Sample flow	**7**	Best
4	Air (typical)		

3.5 Connecting hydraulics

Note: *When connecting the hydraulics to the bottom of the unit, hold the ¾-in. bulkhead adapters on the inside of the enclosure with the door open.*

The sample in, body drain and overflow drain are connected to the instrument as shown in Figure 5 on page 13. The sample inlet port is fitted with a ¾" NPT female fitting with ¾" ID hose barb adapter fitting. A ball valve is supplied with the instrument to drain the turbidimeter body. Hose barb adapter fittings for sample in and both drain fittings are also supplied.

A Bubble Trap/Head Regulator (Cat. No. 46680-00) is recommended if the sample cannot be delivered bubble-free to the analyzer. The device may also be used as to dampen fluctuations in flow due to pulses from a pump and/or sample pressure.

Using the Bubble Trap/Head Regulator will increase response time to changes in sample concentration. The increase in response time may vary from 1–2 minutes at 2 L/min. For fastest response time, use the highest flow practical for sample conditions. Higher flows decrease the effectiveness of bubble removal. The need for fast response time and bubble removal must be balanced for optimum performance.

Install the Bubble Trap/Head Regulator so the overflow is at least five inches above the top of the sample unit enclosure (Figure 12 on page 22). However, installation height can vary based on local sample conditions and flow requirements. See the installation instructions supplied with the Bubble Trap/Head Regulator for more information.

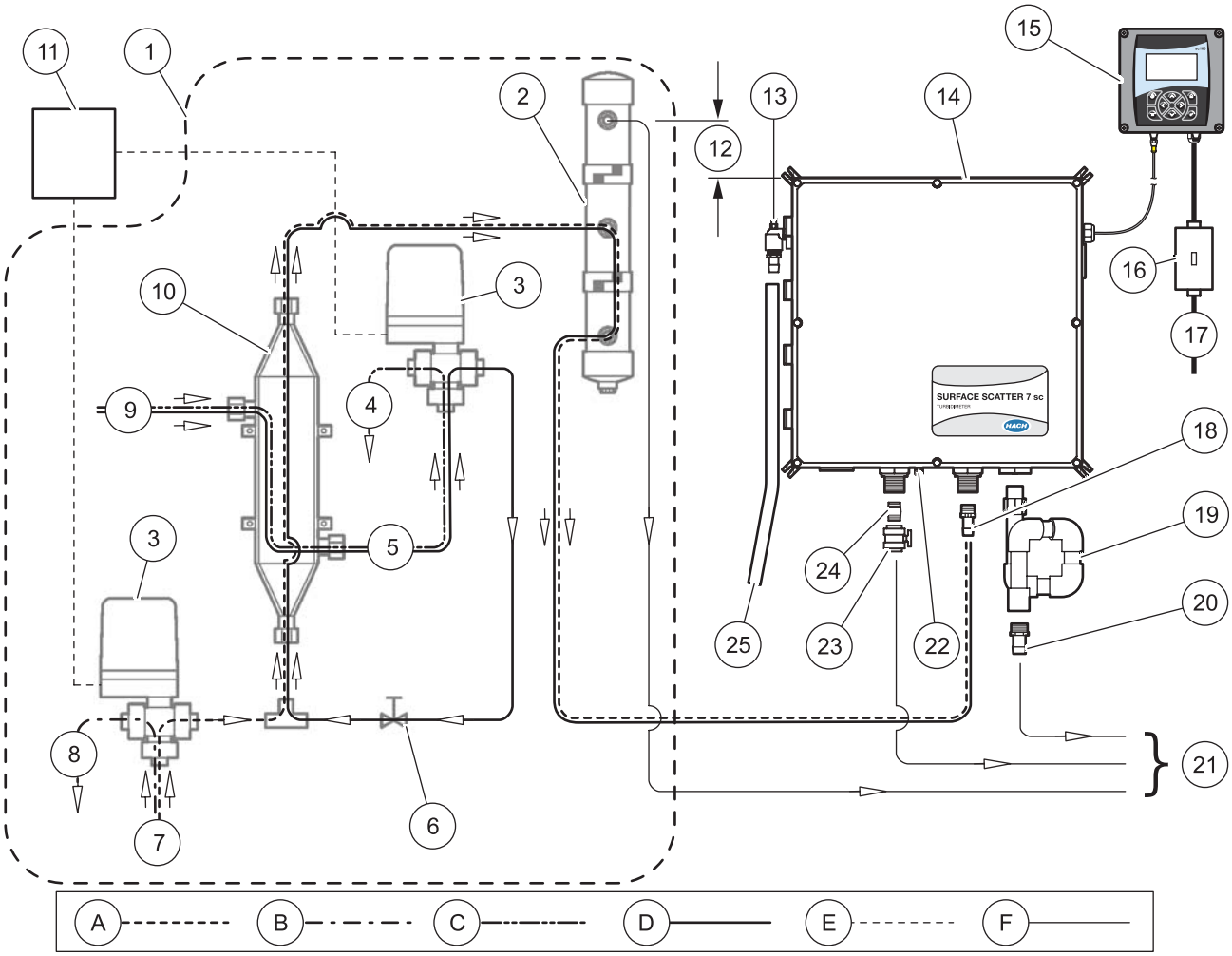

Figure 12 SS7 sc-HST plumbing diagram

1	Optional items	**14**	Sample unit
2	Bubble trap	**15**	sc100
3	3-way ball valve (Auto Flush Kit)	**16**	Customer supplied power on/off switch box (NEMA 4X) required for agency compliance
4	Cooling water to drain	**17**	Power in for sc100
5	Cooling water out	**18**	¾-in. NPT adapter (supplied)
6	Flow control valve	**19**	Drain Trap (Customer-supplied)
7	Sample in	**20**	1-in. NPT adapter (supplied)
8	Sample bypass during flush cycle	**21**	To drain
9	Cooling water in	**22**	¼-in. air purge fitting (50 SCFH instrument air max)
10	Heat exchanger	**23**	Ball valve (supplied)
11	Electrical box connection	**24**	¾-in. NPT nipple (supplied)
12	127 mm (5 in.) minimum	**25**	Customer supplied hose to drain
13	Customer supplied air for flow multiplier		

A	Sample during normal operation	**D**	Cooling water during auto flush
B	Sample bypass during auto flush	**E**	Electrical
C	Cooling water in normal operation	**F**	Drain

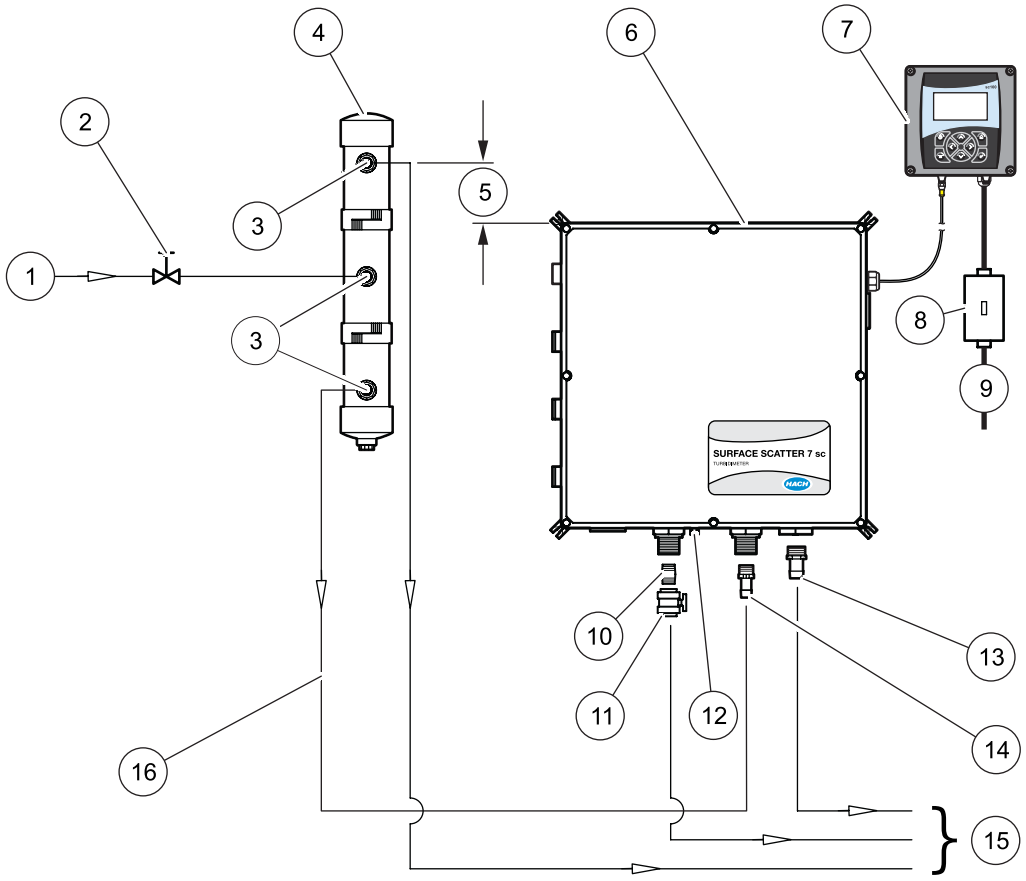

Figure 13 SS7 sc plumbing diagram

1	Sample in	**9**	Power in for sc100
2	Flow control valve (recommended)	**10**	¾-in. NPT nipple (supplied)
3	¾-in.NPT x ¾-in. ID Hose Adapter (supplied with bubble trap)	**11**	Ball valve (supplied)
4	Bubble trap (optional)	**12**	¼-in. air purge fitting (50 SCFH instrument air max)
5	127 mm (5 in.) minimum	**13**	1-in. NPT nipple (supplied)
6	Sample unit	**14**	¾-in. NPT nipple (supplied)
7	sc100	**15**	To drain
8	Customer supplied power on/off switch box (NEMA 4X) required for agency compliance	**16**	¾-in. ID hose (customer supplied)

3.6 Connecting the air purge fitting

Air purge helps control condensation and corrosive vapors within the sample unit and is recommended. Use dry instrument air only. See Figure 12 and Figure 13 for installation details.

3.7 Electrical installation

3.7.1 Wiring safety information

When making any wiring connections to the instrument, the following warnings and notes must be adhered to, as well as, any warnings and notes found throughout the individual installation sections. For more safety information refer to section 2.1 on page 9.

DANGER
Always disconnect power to the sc controller when making electrical connections.

3.7.1.1  Electrostatic discharge (ESD) considerations

Important Note: *To minimize hazards and ESD risks, maintenance procedures not requiring power to the analyzer should be performed with power removed.*

Delicate internal electronic components can be damaged by static electricity, resulting in degraded instrument performance or eventual failure.

The manufacturer recommends taking the following steps to prevent ESD damage to your instrument:

- Before touching any instrument electronic components (such as printed circuit cards and the components on them) discharge static electricity by touching an earth-grounded metal surface such as the chassis of an instrument or a metal conduit or pipe.
- To avoid static electricity buildup and to keep it discharged, wear a wrist strap connected by a wire to earth ground.
- To reduce static build-up, avoid excessive movement. Transport static-sensitive components in anti-static containers or packaging.
    - Handle all static-sensitive components in a static-safe area. If possible, use anti-static floor pads and work bench pads.

3.7.2 Connecting/wiring the SS7 sc or SS7 sc-HST to the sc100 controller

3.7.2.1 Attaching the SS7 sc with a quick-connect fitting

The SS7 sc/SS7 sc-HST cable is supplied with a keyed quick-connect fitting for easy attachment to the controller (Figure 14). Retain the connector cap to seal the connector opening in case the cable must be removed. The original six-foot cable may be extended by a maximum of 9.6 m (31.2 ft), see Replacement parts and accessories on page 51.

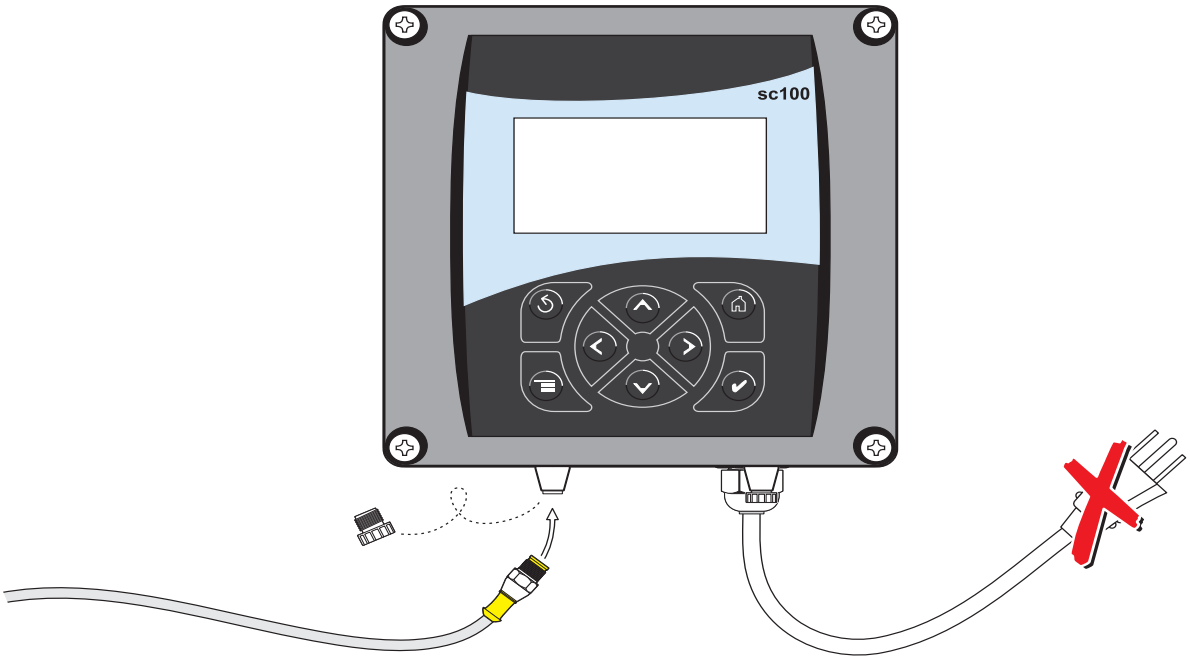

Figure 14 Attaching the SS7 sc/SS7 sc-HST using the quick-connect fitting

3.7.2.2 Hard-wiring the SS7 sc to the sc100 controller

1. Disconnect power to the controller if powered.
2. Open the controller cover.
3. Disconnect and remove the existing wires between the quick-connect and terminal strip J5 (Figure 15).
4. Remove the quick-connect fitting and wires and install the threaded plug on the opening to maintain the environmental rating.
5. Cut the connector from the SS7 sc cable.
6. Strip the insulation on the cable back 1-inch. Strip ¼-in. of each individual wire end.
7. Pass the cable through conduit and a conduit hub or a strain relief fitting (Cat. No. 16664-00) and an available access hole in the controller enclosure. Tighten the fitting.
8. Use of strain relief fitting other than Cat. No. 16664-00 may result in a hazard. Use only the recommended strain relief fitting to assure the continued NEMA 4X enclosure rating.
9. Reinstall the plug on the sensor access opening to maintain the environmental rating.
10. Wire as shown in Table 4 and Figure 15.
11. Close and secure the cover.

Table 4 Wiring the SS7 sc at terminal block J5

Terminal number	Terminal designation	Wire color
1	Data (+)	Blue
2	Data (–)	White
3	Service request	No connection
4	+12 V dc	Brown
5	Circuit common	Black
6	Shield	Shield (gray wire in existing quick disconnect fitting)

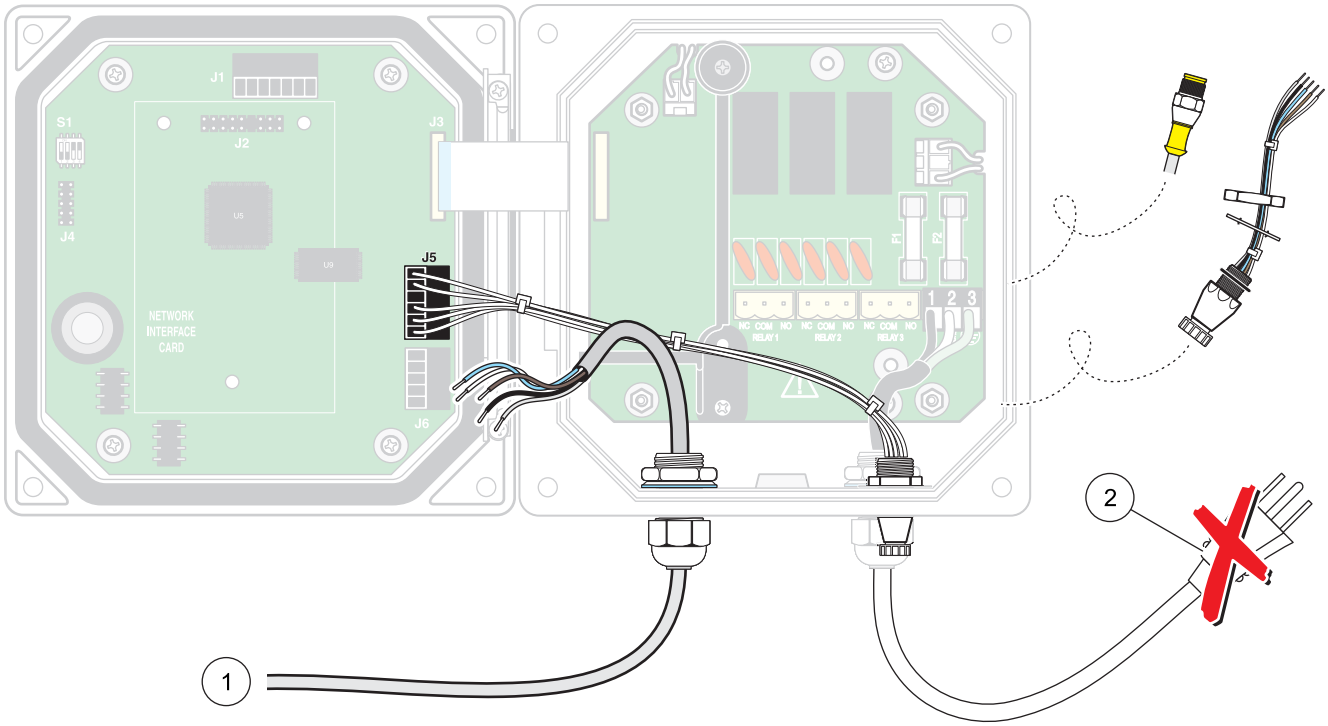

Figure 15 Hard-wiring the SS7 sc

1	From SS7 sc	**2**	Disconnect power

Section 4 System startup

4.1 General operation

1. Plug the SS7 sc/SS7 sc-HST into the unpowered controller by aligning the orientation tab on the cable connector with the channel in the controller connector.
2. Push in and turn the threaded collar to secure the connection. Tug gently to check the connection.
3. After all plumbing and electrical connections have been completed and checked, supply power to the system.
4. Ensure the sample unit door is securely latched when power is applied, since dark readings are measured at this time. If power is applied while the door is open, cycle the power with the door closed. The dark readings are measured again one hour after the power-up.
5. The first time a controller is powered up, a language selection menu will appear. Select the correct language from the displayed options.
6. Following language selection and upon power-up, the controller will search for connected sensors. The display will show the main measurement screen.

4.2 Starting sample flow

1. Start sample flow through the instrument by opening the sample supply valve.
2. Allow the turbidimeter to run long enough for the tubing and body to become completely wetted and the reading on the display to stabilize. One to two hours or longer may be required initially for complete stabilization.
3. Allow measurements to become stable through adequate conditioning before completing instrument settings or performing calibrations.

Section 5 Operation

5.1 Sensor setup

When a sensor is initially installed, the sensor name will be displayed. To change the sensor name refer to the following instructions:

1. From the Main Menu, select SENSOR SETUP and confirm.
2. If multiple sensors are attached to the controller, choose SELECT SENSOR>SS7 SETUP and confirm.
3. Select CONFIGURE and confirm.
4. Select EDIT NAME and edit the name. Confirm or cancel to return to the Sensor Setup menu

5.1.1 Configuring the bubble reject

Bubble Reject eliminates high measurements that are likely due to air trapped in the sample.

1. From the Main Menu, select SENSOR SETUP and confirm.
2. Highlight the appropriate sensor if more than one sensor is attached and confirm.
3. Select CONFIGURE and confirm.
4. Select BUBBLE REJECT and confirm.
5. Select YES or NO and confirm.
    - When NO is selected, all measurements within the Signal Average window will be averaged to determine the measured value.
    - Choosing YES eliminates a percentage of the high values and averages the remaining values to determine the measured value.

5.1.2 Configuring the signal average

The Signal Average function creates a running average of the previous 6, 30, 60 or 90 seconds or no averaging, depending on the selected signal average.

1. From the Main Menu, select SENSOR SETUP and confirm.
2. Highlight the appropriate sensor if more than one sensor is attached and confirm.
3. Select CONFIGURE and confirm.
4. Select SIGNAL AVG and confirm.
5. Select the signal average time interval and confirm.

5.2 Sensor data logging

The controller provides two data logs (one for each sensor) and two event logs (one for each sensor). The data logs store the measurement data at selected intervals. The event log stores a variety of events that occur on the devices such as configuration changes, alarms and warning conditions. The data logs are stored in a packed binary format and the event logs are stored in a CSV format. The logs can be downloaded through the digital network port, service port or the IrDA port. DataCom (Cat. No. 59256-00 or download from www.hach.com) is needed for downloading logs to a computer. If the datalogging frequency is set to 15 minute intervals, the instrument can continue to store data for approximately six months.

1. From the Main Menu, select SENSOR SETUP and confirm.
2. Highlight the appropriate sensor if more than one sensor is attached and confirm.
3. Select CONFIGURE and confirm.
4. Select the datalog interval (5 seconds, 30 seconds, 1 minute, 2 minutes, 5 minutes, 10 minutes, 15 minutes, 30 minutes, 60 minutes or 4 hours). Confirm.

5.3 Sensor diagnostics menu

SELECT SENSOR	
ERROR LIST	See section 7.1 on page 47.
WARNING LIST	See section 7.2 on page 47.

5.4 Sensor setup menu

SELECT SENSOR (if more than one sensor is attached)	
CALIBRATE	
PERFORM CAL	Calibration using 4000 NTU stock solution
VERIFICATION	Perform a verification, set the pass/fail criteria and view the verification history.
0 ELECTRONICS	Zero electronics
CAL HISTORY	View the last 12 entered calibrations. Confirm to move to the next history entry. See section 5.6 on page 36 for more information.
CONFIGURE	
BUBBLE REJECT	Choose Yes or No to enable/disable bubble reject. Default: Yes
SIGNAL AVG	Choose no averaging or specify the amount of time for signal averaging. Available options are: no averaging, 6 sec., 30 sec., 60 sec. or 90 sec. Default is 30 seconds.
MEAS UNITS	Select the appropriate measurement units to display. Choose from mg/L, NTU, FTU and NO UNITS. Default: NTU
EDIT NAME	Enter up to a 12-digit name in any combination of symbols and alpha or numeric characters. Confirm when the entry is complete. The name will be displayed on the status line above the measurement value on the main display. Default is SS7.
SET RESOLUTION	Set the number of significant digits to display. Default is one significant digit.
DATALOG INTRVL	Choose the amount of time between saving data points to the data log. Default: 15 min.; Options: 5 seconds, 30 seconds, 1 minute, 2 minutes, 5 minutes, 10 minutes, 15 minutes, 30 minutes, 60 minutes or 4 hours.

5.4 Sensor setup menu (continued)

DIAG/TEST	
INST STATUS	Displays the software and hardware versions.
SERIAL NUMBER	Displays the serial number of the sensor.
INT TEMP	Displays the internal temperature of the sensor electronics in °C.
DEFAULT SETUP	Restores the sensor factory default settings. Calibration is not affected.
POWER CHECK	Displays the electrical statistics for the sensor.
SERVICE MODE	Allows SS7 sc to be run in normal or service mode. Analog outputs can be in ACTIVE, HOLD or TRANSFER mode. Data logging is disabled. Protected by MAINTENANCE password.
SERVICE DIAG	Accessible with service password only.

5.5 Sensor calibration and verification

5.5.1 Standardization and calibration

DANGER
To become familiar with handling precautions, dangers and emergency procedures, always review the Material Safety Data Sheets prior to handling containers, reservoirs and delivery systems that contain chemical reagents and standards. Protective eye wear is always recommended when contact with chemicals is possible.

Note: *Due to the ease with which the calibration cylinder method calibration can be performed, better accuracy can be maintained by performing a calibration at monthly intervals instead of the standardization check. Periodic calibration with a formazin primary standard is recommended for best absolute accuracy.*

5.5.2 Calibration

The manufacturer recommends calibrating the Surface Scatter 7 sc instrument at least every three months or any time the light source is replaced or adjusted. If calibration is performed with a formazin standard, refer to section 5.5.2.1 on page 32.

1. From the Main Menu, select SENSOR SETUP and confirm.
2. If multiple sensors are attached to the controller, choose SELECT SENSOR>SS7 SETUP and confirm.
3. Select CALIBRATE and confirm.
4. Select PERFORM CAL and confirm. Select the available Output Mode (Active, Hold or Transfer) and confirm.
5. Enter the STD VALUE and confirm. Confirm to continue.
6. Follow the display prompt and place standard into the calibration cup. Close the sensor door and confirm to continue.
7. The TURB value displayed is the standard value determined using the gain from the previous calibration. Confirm to accept and continue with the calibration.

8. If no selection is made for a set period of time, the screen will prompt to remix the standard to avoid a change in the value of the standard.
   a. Open the SS7 sc and remix the standard.
   b. Close the door and confirm to continue.
9. Confirm to calibrate. When the calibration is completed successfully, confirm to accept the calibration.
10. Enter the initials of the user performing the calibration and confirm.

Note: *After confirmation of return to measurement mode, the instrument will equilibrate for 2 minutes before the output mode changes. Instrument measurements will show on the display, but the value will flash and a "OUT MODE WARN" warning will display until the 2-minute equilibration period is complete.*

5.5.2.1 Calibration cylinder method

A calibration cylinder and a 500-mL bottle of 4000 NTU formazin primary standard solution are included for convenient calibration of the SS7 sc. After the formazin standard is added to the cylinder, the instrument is set to the value of the standard.

1. Prepare the formazin standard solution at the desired NTU value. The 4000-NTU standard supplied with the instrument can be used at full strength and only requires mixing (by inverting the bottle repeatedly). If a dilution of the 4000-NTU standard is desired, the manufacturer recommends it be no lower than 300 NTU. Dilutions must be made just prior to use. Dilute formazin solutions are unstable and should be discarded when calibration is complete. Use filtered sample or demineralized water for dilution.
2. Turn off sample flow to the instrument and drain the turbidimeter body. Insert the calibration cylinder into the top of the body (Figure 16 on page 33).
   a. Select the PERFORM CAL menu entry and confirm.
   b. Select the Active, Hold or Transfer output mode and confirm.
   c. Edit the standard value and confirm.
3. Follow the display prompts and pour the formazin standard solution into the cylinder, allowing it to overflow. Only allow the solution to stand long enough to allow bubbles on or near the surface to dissipate.
4. Close the sample unit door tightly. Confirm to continue.
5. The TURB value displayed is the standard value determined using the gain from the previous calibration. Confirm to accept and continue with the calibration.
6. If no selection is made for a set period of time, the screen will prompt to remix the standard to avoid a change in the value of the standard.
   a. Open the SS7 sc and remix the standard.
   b. Close the door and confirm to continue.

7. Confirm to calibrate. When the calibration is completed successfully, the display will show GOOD CAL! and the new calibration gain value. Confirm to accept the calibration.
8. Follow the prompt and enter the initials of the user performing the calibration. Confirm.
9. The controller will prompt for NEW BASELINE. Confirm to establish a new baseline or press **BACK** to exit.
10. Remove the calibration cylinder from the body. The instrument is now calibrated.
11. Close the drain valve and restore the sample flow. If no verification is done, the display will prompt to return to measurement mode. Confirm to continue measurements.

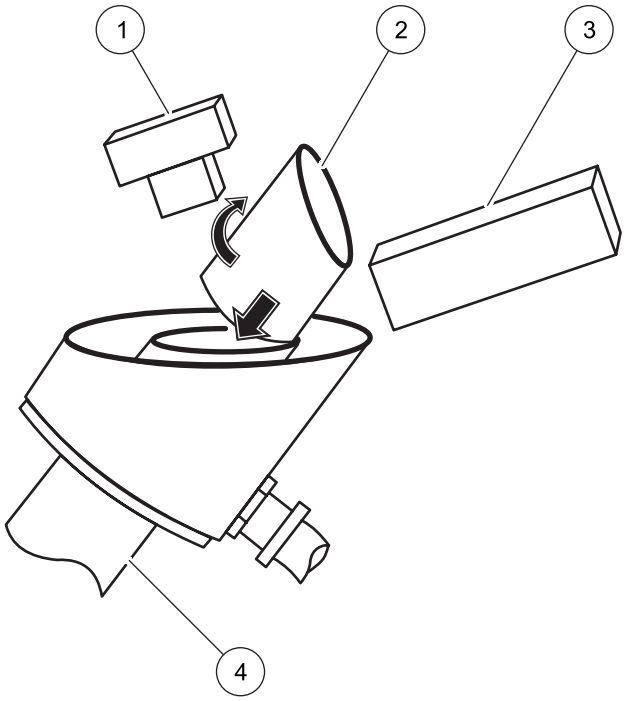

Figure 16 Installing the calibration cylinder

1	Detector assembly	**3**	Light source assembly
2	Calibration cylinder	**4**	Turbidimeter body

5.5.2.2 Comparison method

The comparison method transfers the calibration of a laboratory instrument to the on-line instrument and the practice is approved by the EPA and Standard Methods for the Examination of Water and Wastewater. Calibration by comparison should not be used if sample turbidity is less than 2 NTU.

Before performing this method, make sure the laboratory turbidimeter used is calibrated properly with primary turbidity standards according to manufacturer directions. Sample cells for the laboratory instrument must be free from dirt, fingerprints and scratches. For greater convenience, the laboratory instrument should be moved to a location close to the on-line unit(s) to be

calibrated. Take a grab sample from the on-line instrument drain or sample inlet line and immediately measure its turbidity in the laboratory instrument. If the on-line instrument reading is off by more than 5%, use the calibration procedure detailed in section 5.5.2 on page 31 to input the new standard value. If this calibration method is used, it is not necessary to use the calibration cylinder.

5.5.2.3 Calibration failure

If gain criteria for the calibration are not met, the screen will display BAD CAL! Confirm to repeat the calibration.

5.5.3 Setting the verification baseline

When the SS7 sc has been successfully calibrated, a baseline can be determined using standardization plates. The standardization plates are composed of opaque backing, a plate glass covering and a center filling of Gelex, a stable secondary turbidity standard. The standardization plates are not calibrated when shipped from the factory. The value of the plate is determined after calibration and stored internally in the SS7 sc. The calibration can be verified later by reading the plate value and comparing it to the value following calibration.

Important Note: *Always verify calibration with the same standardization plate that was used to establish the baseline. The manufacturer recommends assigning a serial number (up to 4 characters) to each plate. The serial number can be marked on the back of the plate.*

1. Perform a calibration (section 5.5.2).
2. Confirm to perform a baseline using a standardization plate.
3. The serial number for the last standardization plate used will appear on the display. Confirm to accept or enter the serial number of the plate to be used and confirm.
4. Follow the controller prompts:
   a. Remove the calibration cylinder and wipe off the top of the sample cylinder.
   b. Place the standardization plate on top of the sample cylinder so that the light beam strikes the center of the plate. Note the orientation of the plate and always place it in the same position when using it to check standardization.
   c. Close the door to eliminate stray light. Confirm to continue.
5. When the measured value becomes stable, confirm to establish an expected value for the plate.

   Note: *Future measured values will be compared to the stored expected value. If the established PASS criteria are not met, a new calibration should be performed.*

6. Open the SS7 sc to remove the plate. Restart the sample flow and close the door. Confirm to return the instrument to measurement mode.

Note: *After confirmation of return to measurement mode, the instrument will equilibrate for 2 minutes before the output mode changes. Instrument measurements will show on the display, but the value will flash and a "OUT MODE WARN" warning will display until the 2-minute equilibration period is complete.*

5.5.4 Instrument verification

Instrument verification is intended as a simple check to ensure SS7 sc functionality between calibrations. Verifications should be performed on a monthly basis using a manufacturer-provided standardization plate.

A verification directly after calibration is used to establish the baseline. Any verification afterwards, until the next calibration, that uses the same verification standard will reference the recorded value from the baseline verification as the "expected" value. In order for the verification to pass, the measured value should be within the limits set by the Pass/Fail Criteria of the baseline value.

Before starting the verification, read section 5.5.3.

1. From the Main Menu, select SENSOR SETUP and confirm.
2. If multiple sensors are attached to the controller, choose SELECT SENSOR>SS7 SETUP and confirm.
3. Select CALIBRATE and confirm.
4. Select VERIFICATION and confirm.
5. Select PERFORM VER and confirm.
6. The serial number on the standardization plate to be used for verification should match the serial number listed on the VALID SN screen. Confirm to accept the displayed serial number.

Important Note: *If the serial numbers do not match, a verification baseline (section 5.5.3) must be established before verification can be performed.*

7. Select the available Output Mode (Active, Hold or Transfer) from the list box and confirm.
8. Position the plate on top of the sample cylinder:
   a. Shut down the sample flow and wipe off the top of the sample cylinder.
   b. Place the standardization plate on top of the sample cylinder so that the light beam strikes the center of the plate. Note the orientation of the plate and always place it in the same position when using it to check standardization.
   c. Close the door to eliminate stray light. Confirm to continue.

9. When the displayed turbidity value is stable, confirm to select the measured reading. After confirming the reading:
   - GOOD VER! will be displayed if the verification is good, with an option to continue or to abort. Confirm to continue. Enter the operator initials and confirm.
   - BAD VER! will be displayed if the verification is bad, with an option to repeat or exit. To repeat the verification, confirm to return to the VALID SN screen (step 6).
10. Open the SS7 sc to remove the plate. Restart the sample flow and close the door. Confirm to return the instrument to measurement mode.

Note: *After confirmation of return to measurement mode, the instrument will equilibrate for 2 minutes before the output mode changes. Instrument measurements will show on the display, but the value will flash and a "OUT MODE WARN" warning will display until the 2-minute equilibration period is complete.*

5.5.4.1 Care of standardization plates

Clean standardization plates to remove fingerprints, dust and dirt.

- Clean plates using water and dry with a clean, lint-free cloth.
- Do not use abrasive cleaners or cleaning solvents.

Store the plates in a clean, dry place to prevent scratching or damage. Replace the plates if they become scratched or broken.

5.6 Calibration and verification history

The calibration and verification history logs contain information on the last 12 calibrations and the last 12 verifications. The calibration history log shows the gain value, the time and date of the calibration and the initials of the operator performing verification.

Note: *Restoring default settings from the DIAG/TEST menu will return the turbidimeter to its non calibration state (gain = 1.0) but it will not remove the previous calibration history from memory.*

The calibration history log is accessed from the Calibrate menu. The verification history log is accessed from the Verification menu (a submenu of the Calibrate menu).

Each verification history entry shows the serial number of the verification device, the value of the verification standard, the time and date of the verification and the initials of the operator performing the verification.

To view calibration history:

1. From the Main Menu, select SENSOR SETUP and confirm.
2. If multiple sensors are attached to the controller, choose SELECT SENSOR>SS7 SETUP and confirm.
3. Select CALIBRATE and confirm.
4. Select CAL HISTORY and confirm. The most recent calibration will be displayed on the screen.

5. Confirm to view the previous calibrations. After scrolling through all 12 histories, the display will return to the calibration menu level.

To view verification history:

1. From the Main Menu, select SENSOR SETUP and confirm.
2. If multiple sensors are attached to the controller, choose SELECT SENSOR>SS7 SETUP and confirm.
3. Select CALIBRATE and confirm.
4. Select VERIFICATION and confirm.
5. Select VER HISTORY and confirm. The most recent verification will be displayed on the screen.
6. Confirm to view previous verifications. After scrolling through all 12 histories, the display will return to the calibration menu level.

To view baseline history:

1. From the Main Menu, select SENSOR SETUP and confirm.
2. If multiple sensors are attached to the controller, choose SELECT SENSOR>SS7 SETUP and confirm.
3. Select CALIBRATE and confirm.
4. Select VERIFICATION and confirm.
5. Select BASELINE HIST and confirm. The most recent baseline, including the Gelex plate serial number and expected value, will be displayed on the screen.
6. Confirm to view previous verifications. After scrolling through all 12 histories, the display will return to the calibration menu level.

When the instrument is received from the factory, there will be one entry for the calibration and verification history information. As calibrations and verifications are performed, the history information will grow until there are 12 entries.

When the log is full, the newest entry is stored and the oldest entry in the log is deleted.

5.7 Operating the SS7 sc-HST

- If condensation forms in the enclosure, increase the air pressure (and flow) by increasing the air pressure setting of the pressure regulator for the flow multiplier.
- Make sure the bubble trap is working. Bubbles on the surface of the liquid will cause incorrect readings.
- If deposits accumulate inside the unit, wash the inside with warm water spray.
- The vent cover at the top of the turbidimeter body (Figure 6 on page 14, item 5) can be removed for cleaning if necessary. Loosen the light source before removing the cover. Check the alignment of the light after reinstalling the cover using the new alignment plate included in the kit (section 6.4.1 on page 40). Make sure the cover sits flat on top of the slant tube when installed.
- Calibrate the instrument using the calibration cup and formazin as described in section 5.5.2 on page 31.

Note: *Do not operate the instrument without the cover. Do not operate the instrument if the flow multiplier is not working.*

Section 6 Maintenance

DANGER
Only qualified personnel should conduct the tasks described in this section of the manual.

The nature of tasks described in this section of the manual requires individuals to be technically knowledgeable of the associated dangers. Burns, shock, eye damage, fire and chemical exposure may occur if this work is not done by qualified personnel. Always review appropriate Material Safety Data Sheets (MSDS) before working with chemicals.

6.1 Scheduled maintenance

Scheduled periodic maintenance requirements of the SS7 sc Turbidimeter are minimal. Standardization checks and calibration are the primary requirements. Several other activities should be performed on a regular basis, but the schedule for these may depend on the installation and sample.

6.2 Removing a sensor from the system

Prior to physically removing a sensor from the system, record all user defined settings such as relays, signal averaging, etc. Turn off power to the sc100 and SS7 sc, then disconnect the sensor at the controller.

6.3 Installing a sensor on the system

To return the system to normal operation following a software upgrade or sensor repair, perform the following procedure:

1. Detach all sensors from the sc100 controller.
2. From the Main Menu, press the **DOWN** key to highlight TEST/MAINT and confirm.
3. Use the **DOWN** key to scroll to SCAN SENSORS and confirm.
4. Remove attached sensors by selecting the corresponding serial number or select “All”.
5. **Power down the sc100 controller, then attach the sensor(s) to be used.**

   Note: *Clean sensors before installing on the system.*

6. Supply power to the sc100 controller. The system will initialize automatically.

6.3.1 Cleaning

Sediment may collect in the turbidimeter body and on the overflow weir. Algae may also form. The turbidimeter body should be drained and flushed—on a schedule determined by visual inspection—to remove accumulated sediment. Algae can be removed with a large bottle brush and a sterilizing solution such as dilute chlorine bleach.

Samples containing large amounts of settleable solids may cause frequent accumulation of solids in the turbidimeter body. To minimize cleaning frequency, the analyzer can be operated with the drain ball valve partially or completely open and the sample flow increased accordingly to provide continuous flushing of solids from the turbidimeter body. If the drain is left partially open, the ball valve supplied should be replaced with a valve designed for flow control. Operating the ball valve in a partially open position may damage the valve or cause plugging of the drain line.

When used in conjunction with the Auto-flush Kit (section 8.2 on page 51), the flush cycle feature may be used to operate a solenoid valve to divert sample and provide a periodic clear water flush.

The inside enclosure of the SS7 sc can be washed down with warm water spray if deposits accumulate inside the unit. The vent cover at the top of the SS7 sc-HST turbidimeter body can also be removed for cleaning as necessary.

Note: *Loosen the light source to remove or install the vent cover on the SS7 sc-HST. Use the alignment plate included in the unit to check the alignment of the light after installing the cover. Make sure the cover sits flat on top of the slant tube when installed.*

6.4 Unscheduled maintenance

Important Note: *Disconnect power to the instrument before removing any cover. To reduce the possibility of ESD damage to the equipment, avoid contact with electrical components. All replacement components must meet or exceed original equipment specifications to maintain applicable safety standards and certifications and ensure proper instrument performance.*

6.4.1 Lamp replacement

The lamp is located in the light source assembly block in the sample unit. It comes with attached leads terminated in a two-pin connector. The lamp is replaced as follows:

1. Set the power switch in the control unit to off. Disconnect power to the sc100 controller.
2. Open the sample unit door. Disconnect the lamp cable at the connector.
3. Remove the two screws that secure the lamp source assembly to the back plate. Remove the lamp source assembly (Figure 17).
4. Remove the four screws securing the end plate to the light source assembly housing. Remove the end plate with gasket, the notched spacer and the lamp.

5. Wipe the replacement lamp clean to remove any dust and fingerprints. Fingerprints left on the glass bulb can permanently damage the lamp. Install the lamp in the light source block.
6. Slide the notched spacer over the lamp cable with the notch away from the lamp base. Route the lamp cable through the notches. Install the lamp and spacer into the end of the housing with the spacer notch aligned with the notch in the housing.
7. Install the end plate using the two screws removed in step 3.
8. Install the assembled light source assembly in the sample unit using the two screws removed in step 2. Connect the lamp cable connector.
9. Using the alignment template supplied with the turbidimeter, verify that the light source assembly is positioned properly as follows:
    a. Be sure the lamp door is closed tightly. Apply power to the sc100 controller. Wait for the display to show the current turbidity reading before continuing.
    b. Install the calibration cylinder in the top of the turbidimeter body (Figure 16 on page 33).
    c. Place the alignment template on top of the calibration cylinder with the guide pin down and against the flat notch on the inside of the cylinder (Figure 18). The back edge of the template should be against the sample unit back plate.
    d. Check the position of the lamp image on the alignment template surface. It should fall on the target area so the center of the beam is centered between the lines (Figure 18).
    e. If the light source assembly needs adjustment, loosen the two mounting screws enough to adjust the position of the lamp image. Tighten when aligned properly.
10. Calibrate the instrument as described in section 5.5 on page 31.

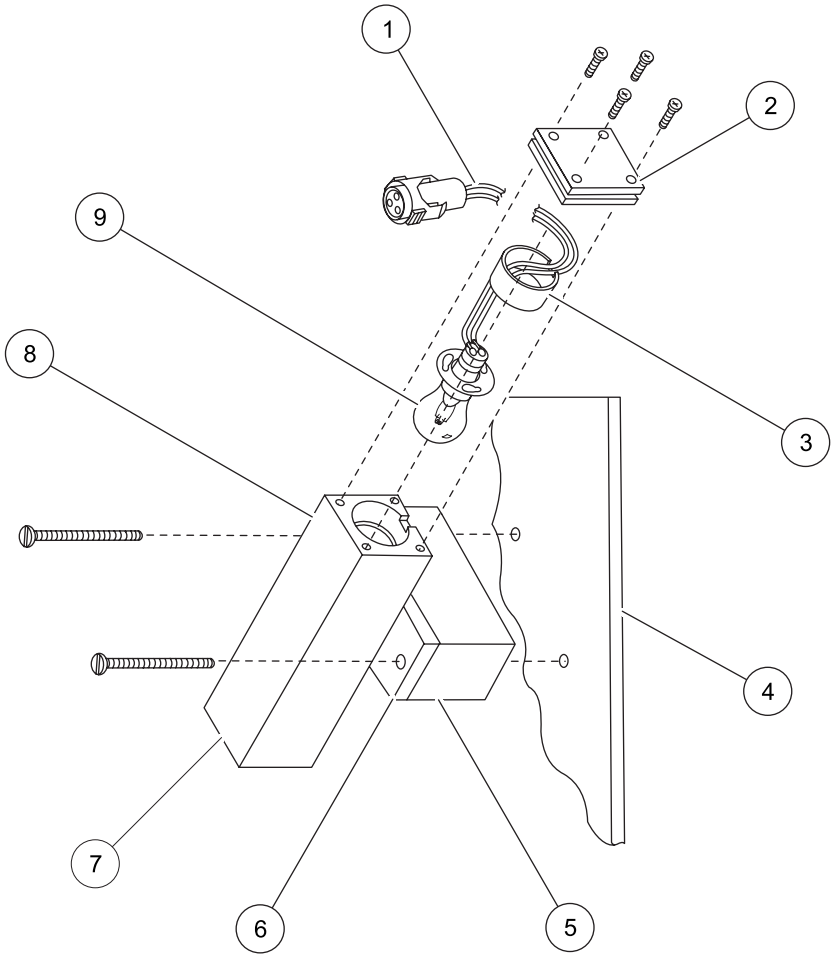

Figure 17 Lamp replacement

1	Lamp cable	**6**	Spacer
2	End plate	**7**	Housing
3	Notched spacer	**8**	Light source assembly
4	Back plate	**9**	Lamp
5	Base		

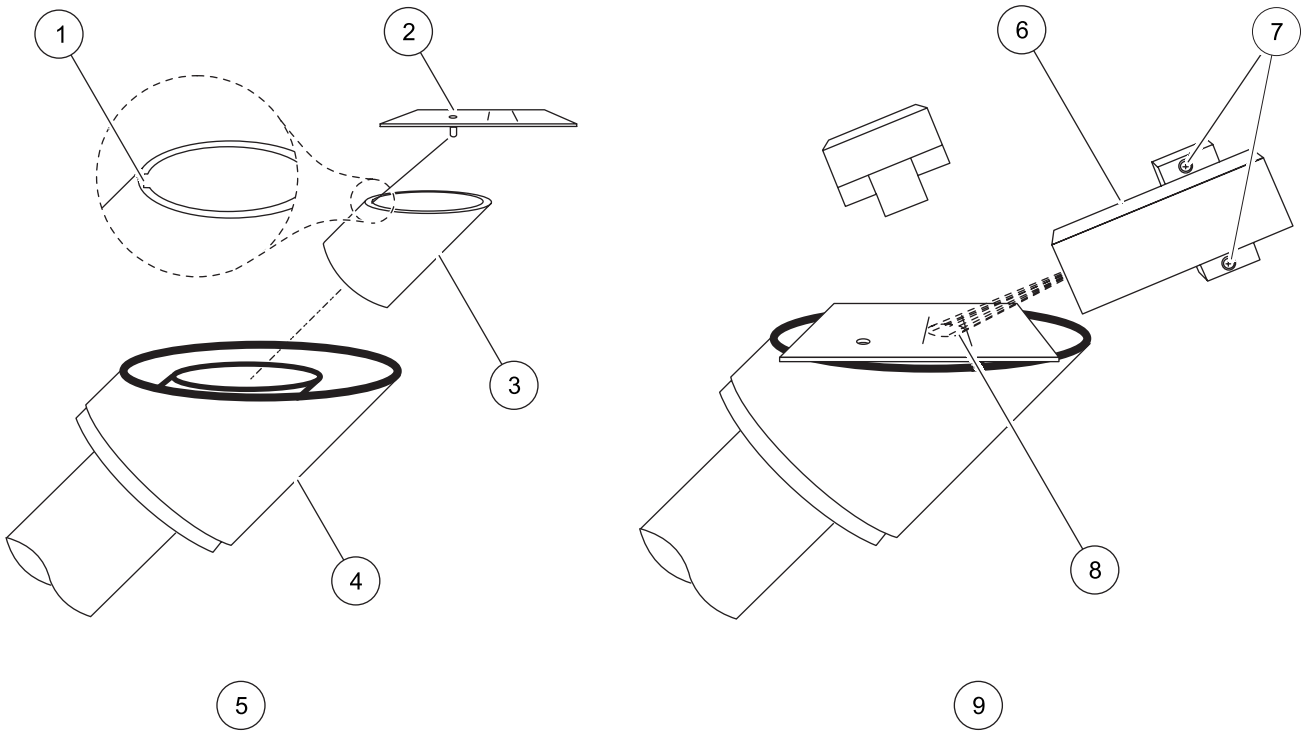

Figure 18 Alignment details

1	Flat notch	**6**	Light source assembly
2	Alignment template	**7**	Mounting screws
3	Calibration cylinder	**8**	Target area
4	Turbidimeter body	**9**	Adjust light source to align light beam in target area
5	Install calibration cylinder and alignment template		

6.4.2 Light source assembly maintenance

No maintenance of the light source assembly is normally necessary beyond changing the lamp. The lamp, several lenses, apertures and other components are located in the light source housing. If these components are removed for any reason, they must be installed exactly as they were removed. Placing any of the components in the wrong position or orientation can cause measurement errors and lack of alignment. Figure 19 illustrates the correct installation and orientation of the components. If difficulty is experienced in reassembly, contact Technical Support for assistance. Refer to Section 9 on page 53.

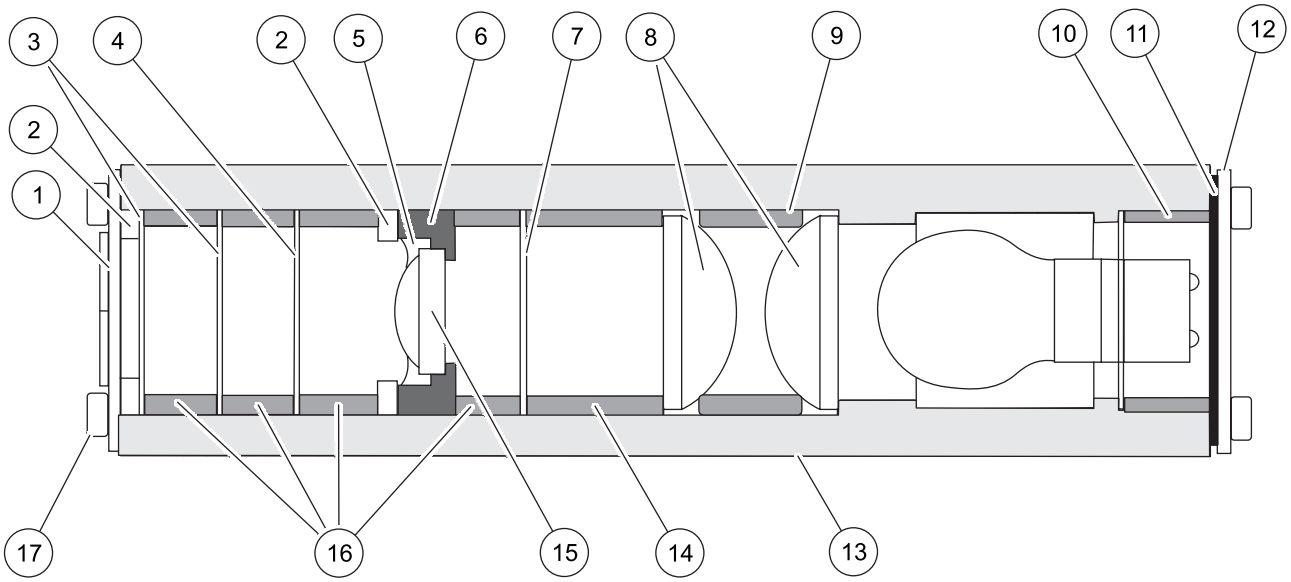

Figure 19 Light source assembly

1	Shield assembly (Cat. No. 45299-00)	**10**	Spacer, light source (Cat. No. 45039-00)
2	Wavy washer (2x) (Cat. No. 45042-00)	**11**	Gasket (Cat. No. 45033-00)
3	Medium aperture (Cat. No. 45044-00)	**12**	End plate (Cat. No. 45032-00)
4	Large aperture (Cat. No. 45045-00)	**13**	Body (Cat. No. 45027-00)
5	Retaining ring (Cat. No. 45041-00)	**14**	Large spacer (Cat. No. 45037-00)
6	Lens holder (Cat. No. 45040-00)	**15**	Small lens (Cat. No. 31465-00)
7	Small aperture (Cat. No. 45043-00)	**16**	Small spacer (4x) (Cat. No. 45038-00)
8	Large lens (2x) (Cat. No. 44114-00)	**17**	Screws (8x) (Cat. No. 5584-11)
9	Medium spacer (Cat. No. 45036-00)		

6.4.3 Detector assembly replacement

The detector assembly, listed as a replacement item in section 8.1 on page 51, is a sealed unit that is replaced entirely (Figure 20).

1. Write down the controller setup for all analog outputs and/or relays used with the SS7 sc.
2. Turn off the controller and disconnect it from power.
3. Disconnect the detector cable from the controller. Unscrew the nut (Figure 20, item 8) and remove it from the disconnected detector cable.
4. Open the SS7 sc enclosure door. Using a blunt object (¼-inch diameter or less, e. g. the blunt end of a pen) push on the bushing from the inside of the enclosure until it is free of the strain relief and clamping fingers. Remove the grommet from the detector cable.
5. Pull the detector cable through the strain relief. Open the cable clamps (Figure 20, item 3) and remove the cable.

6. Remove the two screws securing the detector assembly to the wall of the SS7 sc enclosure. Remove the complete detector assembly (Figure 20, item 1).
7. Use the two screws removed in step 6 to secure the new detector to the wall of the SS7 sc enclosure. Secure the cable with the cable clamps.
8. Thread the detector cable through the strain relief. Replace the split grommet (note the orientation in Figure 20) onto the detector cable. At the clamping fingers, rotate the grommet counter-clockwise while pushing the grommet back into place in the strain relief.
9. Thread the nut onto the detector cable and secure onto the strain relief.
10. Close the SS7 sc enclosure door. Attach the detector cable to the controller.
11. Apply power to the controller and turn it on. The controller will prompt the user that the SS7 cannot be found. The old detector serial number will be displayed.
12. Use the arrow keys to select the old detector serial number and remove it. The controller will then install the new detector assembly.
13. Establish the setup for all analog outputs and/or relays to be used with the SS7 sc. Use the settings recorded in step 1.
14. Calibrate the instrument (section 5.5 on page 31).

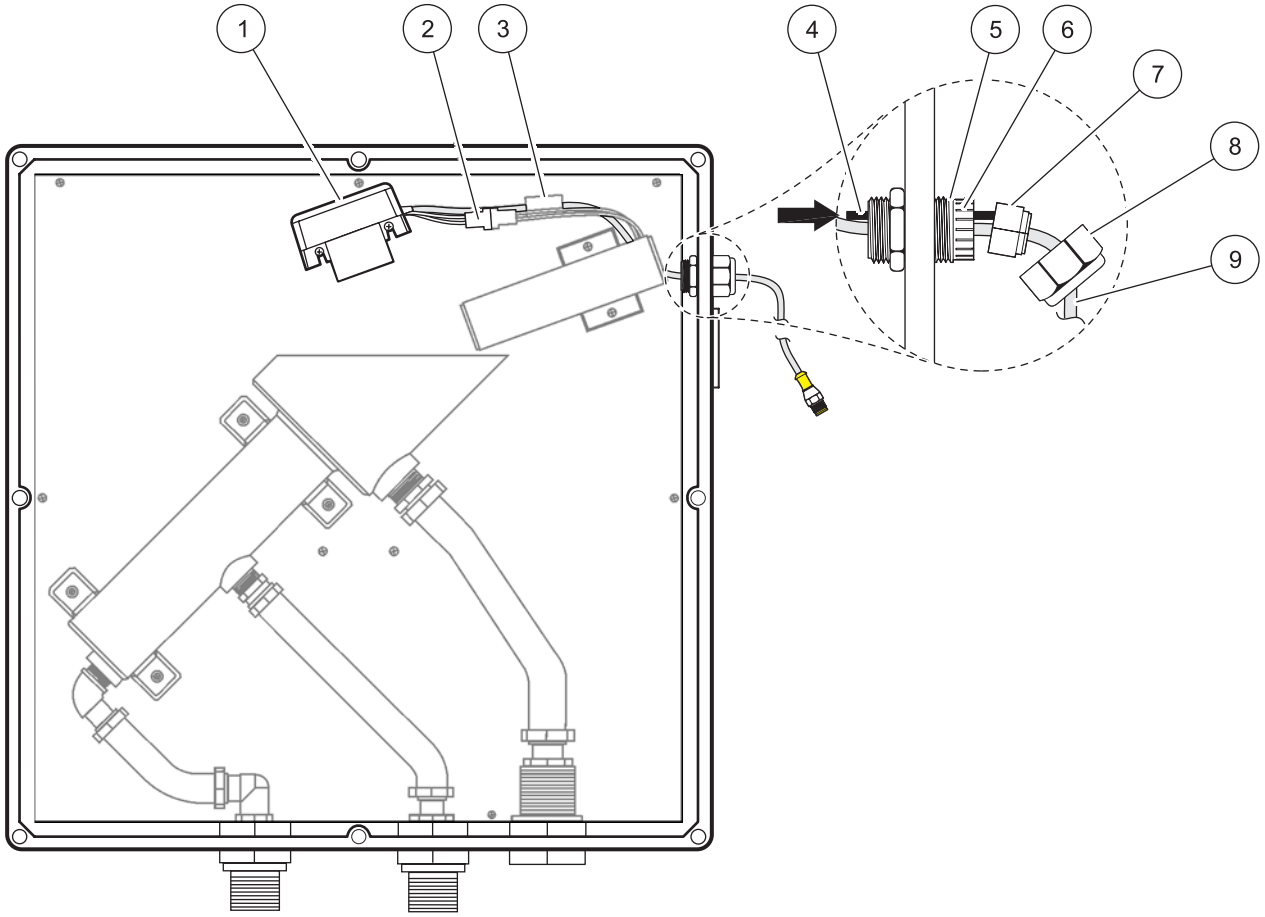

Figure 20 Detector assembly replacement

1	Detector assembly (Cat. No. 71221-00)	**6**	Clamping fingers
2	Light source assembly power connector	**7**	Bushing
3	Cable clamp	**8**	Nut
4	Blunt object	**9**	Detector assembly cable
5	Strain relief		

Section 7 Troubleshooting

7.1 Error Codes

Errors are indicated by a flashing measurement value and a flashing warning icon. Errors are defined in Table 5.

1. From the Main Menu, select SENSOR DIAG and confirm.
2. If multiple sensors are attached to the controller, choose SELECT SENSOR>SS7 SETUP and confirm.
3. Select ERROR LIST and confirm. All active errors will display.

Table 5 Error codes

DIsplayed error	Definition
ADC FAIL	The ADC has failed. Try cycling power. If cycling power does not work, replace the detector assembly (Cat. No. 71221-00).
LAMP FAIL	The light source has failed. See section 6.4.1 on page 40 for lamp replacement instructions.
FLASH FAIL	Datalog and event log will not work.

7.2 Warnings

Warnings are indicated by a flashing measurement value and a flashing warning icon. Warnings are defined in Table 6.

1. From the Main Menu, select SENSOR DIAG and confirm.
2. If multiple sensors are attached to the controller, choose SELECT SENSOR>SS7 SETUP and confirm.
3. Select WARNING LIST and confirm. All active warnings will display.

Table 6 Warning Codes

Warning Number	Displayed Warning	Definition/Resolution
1	DARK WARNING	Dark reading detects too much light. Close the SS7 sc enclosure and perform ZERO ELECTRONICS (under the CALIBRATION menu).
2	TEMP WARNING	Sensor head internal temperature is higher than specified. Contact the Technical Support Department. (> 70 °C)
3	DATA LOG FULL	Sensor data log is full. No additional data will be logged until sensor log is downloaded into controller memory.
4	EVENT LOG FULL	Sensor data log is full. No additional data will be logged until sensor log is downloaded into controller memory.
5	5 VOLT WARN	Monitored voltage is outside the range of 4.5–5.5 V.
6	VIN WARN	Monitored instrument input voltage from sc100 is outside the range of 9.08–14.3 V. Check cables. Make sure only one SS7 sc is connected to sc100 and if any other probe is connected it can only draw 4 watts maximum.
7	LAMP VOLT WARN	Monitored voltage is outside the range of 3.96–4.48 V.
8	LAMP CURR WARN	Monitored current is outside the range of 1.67–2.75 Amps.
9	OUTPUT MODE WARN	Activated when the sensor is not in normal measurement mode (such as when in calibration or verification mode).
10	AC UPDATE FAIL	The application code update failed.
11	EXT FLASH FAIL	External copy of the application code has failed. Self recovery should occur.

Table 6 Warning Codes (continued)

Warning Number	Displayed Warning	Definition/Resolution
12	INT FLASH FAIL	Internal copy of the application code has failed. Self-recovery should occur.
13	ENGLISH ONLY	English only device driver file. Update the device driver with the latest version.
14	VREF WARN	ADC voltage reference is out of specification.
15	SERVICE WARN	SS7 sc is currently in service mode

Table 7 presents sensor warnings displayed in the Event Log, possible causes and corrective actions.

Table 7 General Troubleshooting

Sensor Error or Warning	Possible Cause	Corrective Action
LAMP FAIL	Lamp burned out	Replace the lamp. See section 6.4.1 on page 40.
	Lamp unplugged	Restore connection
	+12 V connection loose at controller	Restore connection
	Dislodged lamp	Reinstall lamp
	Bad circuit board in turbidimeter head	Contact the Technical Support Department.
Low Readings	Detector coated/dirty	See section 6.3.1 on page 40. Contact the Technical Support Department.
	Lens coated/dirty	Clean the lens using isopropyl alcohol and a cotton swab.
	Obstructed light path	Remove obstruction
	See LAMP FAIL causes above	See LAMP FAIL corrective actions above
VIN FAIL	Loose connection at sc100	Tighten connection of cable at sc100
	SS7 sc to sc100 cable too long	Make sure that if an extension cable is used, only one is present and is no longer than 7 meters (approximately 30 feet).
	Fluctuation in voltage	Turn instrument power off and back on.
	Bad detector assembly	Replace detector assembly (Cat. No. 71221-00).
ADC FAIL	Fluctuation in voltage	Turn instrument power off and back on.
	Bad detector assembly	Replace detector assembly (Cat. No. 71221-00).
DARK WARNING	Light Leak—SS7 sc enclosure door is open during Power Up or Zero Electronics	Make sure the door is closed, then perform ZERO ELECTRONICS in the CALIBRATION MENU.
	Bad detector Assembly	Replace detector assembly (Cat. No. 71221-00).

Table 8 presents additional malfunctions which may not be recorded in the Event Log.

Table 8 Additional malfunctions not recorded in the event log

Symptom	Possible cause	Corrective action
Continuous underrange	The calibration standard was either improperly prepared or was unstable at the time the calibration was accepted.	Verify the accuracy of calibration standards and calibrate the instrument. See Low Readings in Table 7.
Continuous overrange	The calibration standard was either improperly prepared or was unstable at the time the calibration was accepted.	Verify the accuracy of calibration standards and recalibrate the instrument.
Erratic readings	Inadequate bubble removal from sample	Verify the accuracy of calibration standards and recalibrate the instrument. Increase the signal averaging time to a longer interval. Make sure the Bubble Reject feature is turned on. Slow the flow of sample into the instrument.
High readings	Dirty instrument Calibration standard was low Flow rate is too high causing bubbles	Clean the instrument. Check the value and expiration date on the calibration standard Verify the flow is within specifications Recalibrate the instrument.

7.3 Event codes

Events are automatically invoked to document major actions during normal instrument operation. Event codes are not displayed on controller and must be downloaded from the event log using Data Com software. Troubleshooting actions are provided in Table 7 on page 48.

Table 9 Event log list

Event	Event #	Data1	Data2	Data3
Bubble reject change	0	0 = OFF 1= ON	—	—
Signal avg	1	0 = 1, 1 = 6, 2 = 30, 3 = 60, 4 = 90	—	—
Data log interval change	2	0 = 5 sec, 1 = 30 sec, 2 = 1 min, 3 = 2 min, 4 = 5 min, 6 = 15 min, 7 = 30 min, 8 = 1 hr, 9 = 4 hr	—	—
Power on	3	—	—	—
Calibration	4	Std	Gain	Operator
Verification	5	Expected Value	Meas Value	Operator
Dark event	6	A/D counts	—	—
Temperature	7	Present	Min	Max
Volt warn	8	Vin	5V	Vref
Lamp warn event	9	Lamp V	Lamp I	—
A2D fail event	10	—	—	—
Lamp fail	11	Lamp V	Lamp I	—
Output mode change	12	0 = Normal, 1 = Active 2 = Hold, 3 = Transfer	—	—

Table 9 Event log list (continued)

Event	Event #	Data1	Data2	Data3
Baseline	13	Serial Number	Expected	Operator
AC update start	14	—	—	—
AC update done	15	—	—	—
AC update fail	16	—	—	—
AC internal fail	17	—	—	—
AC external fail	18	—	—	—
Flash erase	19	—	—	—
DD update	20	—	—	—
Service mode	21	0 = Off, 1 = On	—	—

Example of event log download using DataCom

15:00 01/09/06	BUBBLE REJECT	0	1			
1/9/2006 15:00	BUBBLE REJECT	0	0			
1/9/2006 15:00	SIGNAL AVG	1	2			
1/9/2006 15:00	SIGNAL AVG	1	1			
1/9/2006 15:00	DATALOG INTRVL	2	9			
1/9/2006 15:01	OUT MODE EVENT	12	1			
1/9/2006 15:01	CALIBRATION	4	2100	1.51	G7	
1/9/2006 15:01	BASELINE EVENT	13	7	2090.4	G7	
1/9/2006 15:02	OUT MODE EVENT	12	2			
1/9/2006 15:02	VERIFICATION	5	7	2090.4	2091.1	GS7

7.4 Data log

Measured data is automatically logged based on the setting of the data log interval. If, however, there is a calibration or verification being performed, the data log will be interrupted since the values of the measurements do not represent the normal process. The data log interval in the following example is set at 15 minutes.

Example of data log download using DataCom

Serial Number: FFFFFFFFFFFF

Device ID: 26

Manufacture ID: 0

Time	Channel 1
1/18/2006 12:15	2009.04
1/18/2006 12:30	2009.71
1/18/2006 12:45	2010.316
1/18/2006 13:00	2009.096

Section 8 Replacement parts and accessories

8.1 Replacement parts

Description	Cat. No.
Surface Scatter® 7 sc Installation Kit:	
Adapter, barb fitting, ¾” NPT to ¾” ID hose barb (2x)	40439-00
Adapter, barb fitting, 1” NPT to 1” ID hose	40372-00
Brush, cylinder, size 2	687-00
Calibration cup, SS7 sc	45021-00
Drain Valve	45073-00
Formazin Stock Solution, 4000 NTU, 500 mL	2461-49
Light Source Template	45076-00
Nipple, ¾” NPT	31551-00
Washer, ¼ ID x 1.00 OD (4x)	44173-00
Wall Mounting kit	44247-00
Light Source Shield Assemblies (2x)	45299-00
Detector Assembly	71221-00
Lamp Assembly, Surface Scatter 7 sc	45034-00
Manual	DOC026.52.00769
Quick Reference Document	DOC016.52.00769
Tubing Replacement Kit	46691-00

8.2 Accessories

Description	Cat. No.
Auto Flush Kit (120V)	46692-12
Auto Flush Kit (220V)	46692-22
Bubble Trap/Head Regulator	46680-00
Cable Extension for Sensor, 7.6 m (25 ft)	57960-00
DataCom (CD-rom)	59256-00
Formazin Stock Solution, 4000 NTU, 500 mL	2461-49
Heat Exchanger Unit (Sample cooler)	48551-00
Latch, replacement, SS6	44993-00
Manual, SS7 sc, English	DOC026.52.00769
Manual, SS7 sc, Chinese	DOC026.80.00769
Manual, SS7 sc, Japanese	DOC026.81.00769
Manual, SS7 sc, Korean	DOC026.84.00769
Power Cord, 125 VAC, 10A, 1.83 m (6 ft)	46306-00
Power Cord, 250 VAC, 10A, 1.83 m (6 ft)	46308-00
StablCal, 400 NTU, 500 mL	71216-49
Standardization Plate Kit, uncalibrated	23513-00
Sun Shield, sc100 Controller	LZ961.54
Upgrade Kit, Converting Standard SS7 sc to a SS7 sc-HST (High Sample Temperature)	45000-43

Section 9 Contact

HACH LANGE GMBH
Willstätterstraße 11
D-40549 Düsseldorf
Tel. +49 (0)2 11 52 88-0
Fax +49 (0)2 11 52 88-143
info@hach-lange.de
www.hach-lange.com

HACH LANGE LTD
Pacific Way
Salford
GB-Manchester, M50 1DL
Tel. +44 (0)161 872 14 87
Fax +44 (0)161 848 73 24
info@hach-lange.co.uk
www.hach-lange.co.uk

HACH LANGE LTD
Unit 1, Chestnut Road
Western Industrial Estate
IRL-Dublin 12
Tel. +353(0)1 46 02 5 22
Fax +353(0)1 4 50 93 37
info@hach-lange.ie
www.hach-lange.ie

DR. BRUNO LANGE GES. MBH
Industriestraße 12
A-3200 Obergrafendorf
Tel. +43 (0)27 47 74 12
Fax +43 (0)27 47 42 18
info@hach-lange.at
www.hach-lange.at

DR. BRUNO LANGE AG
Juchstrasse 1
CH-8604 Hegnau
Tel. +41(0)44 9 45 66 10
Fax +41(0)44 9 45 66 76
info@hach-lange.ch
www.hach-lange.ch

HACH LANGE FRANCE S.A.S.
33, Rue du Ballon
F-93165 Noisy Le Grand
Tél. +33 (0)1 48 15 68 70
Fax +33 (0)1 48 15 80 00
info@hach-lange.fr
www.hach-lange.fr

HACH LANGE SA
Motstraat 54
B-2800 Mechelen
Tél. +32 (0)15 42 35 00
Fax +32 (0)15 41 61 20
info@hach-lange.be
www.hach-lange.be

DR. LANGE NEDERLAND B.V.
Laan van Westroijen 2a
NL-4003 AZ Tiel
Tel. +31(0)344 63 11 30
Fax +31(0)344 63 11 50
info@hach-lange.nl
www.hach-lange.nl

HACH LANGE APS
Åkandevej 21
DK-2700 Brønshøj
Tel. +45 36 77 29 11
Fax +45 36 77 49 11
info@hach-lange.dk
www.hach-lange.dk

HACH LANGE AB
Vinthundsvägen 159A
SE-128 62 Sköndal
Tel. +46 (0)8 7 98 05 00
Fax +46 (0)8 7 98 05 30
info@hach-lange.se
www.hach-lange.se

HACH LANGE S.R.L.
Via Riccione, 14
I-20156 Milano
Tel. +39 02 39 23 14-1
Fax +39 02 39 23 14-39
info@hach-lange.it
www.hach-lange.it

HACH LANGE S.L.U.
C/Araba 45, Apdo. 220
E-20800 Zarautz/Guipúzcoa
Tel. +34 9 43 89 43 79
Fax +34 9 43 13 02 41
info@hach-lange.es
www.hach-lange.es

HACH LANGE LDA
Av. do Forte nº8
Fracção M
P-2790-072 Carnaxide
Tel. +351 214 253 420
Fax +351 214 253 429
info@hach-lange.pt
www.hach-lange.pt

HACH LANGE SP.ZO.O.
ul. Opolska 143 a
PL-52-013 Wrocław
Tel. +48 (0)71 342 10-83
Fax +48 (0)71 342 10-79
info@hach-lange.pl
www.hach-lange.pl

HACH LANGE S.R.O.
Lešanská 2a/1176
CZ-141 00 Praha 4
Tel. +420 272 12 45 45
Fax +420 272 12 45 46
info@hach-lange.cz
www.hach-lange.cz

HACH LANGE S.R.O.
Roľnícka 21
SK-831 07 Bratislava – Vajnory
Tel. +421 (0)2 4820 9091
Fax +421 (0)2 4820 9093
info@hach-lange.sk
www.hach-lange.sk

HACH LANGE KFT.
Hegyalja u. 7-13.
H-1016 Budapest
Tel. +36 (06)1 225 7783
Fax +36 (06)1 225 7784
info@hach-lange.hu
www.hach-lange.hu

HACH LANGE S.R.L.
str. Aviator Teodor Iliescu nr.37,
Sector 1
RO-011672, Bucuresti
Tel. +40 (0)21 2 08 95 78
Fax +40 (0)21 2 08 95 78
info@hach-lange.ro
www.hach-lange.ro

HACH LANGE
8, Kr. Sarafov str.
BG-1164 Sofia
Tel. +359 (0)2 963 44 54
Fax +359 (0)2 866 04 47
info@hach-lange.bg
www.hach-lange.bg

HACH LANGE SU ANALİZ SİSTEMLERİ LTD.ŞTİ.
Hilal Mah. 75. Sokak
Arman Plaza No: 9/A
TR-06550 Çankaya/ANKARA
Tel. +90 (0)312 440 98 98
Fax +90 (0)312 442 11 01
bilgi@hach-lange.com.tr
www.hach-lange.com.tr

HACH LANGE D.O.O.
Fajfarjeva 15
SI-1230 Domžale
Tel. +386 (0)59 051 000
Fax +386 (0)59 051 010
info@hach-lange.si
www.hach-lange.si

HACH LANGE E.Π.E.
Αυλίδος 27
GR-115 27 Αθήνα
Τηλ. +30 210 7771700
Fax +30 210 7480122
info@hach-lange.gr
www.hach-lange.gr

Section 10 Limited warranty

HACH LANGE GmbH warrants that the product supplied is free of material and manufacturing defects and undertakes the obligation to repair or replace any defective parts at zero cost.

The warranty period for instruments is 24 months. If a service contract is taken out within 6 months of purchase, the warranty period is extended to 60 months.

With the exclusion of the further claims, the supplier is liable for defects including the lack of assured properties as follows: all those parts that, within the warranty period calculated from the day of the transfer of risk, can be demonstrated to have become unusable or that can only be used with significant limitations due to a situation present prior to the transfer of risk, in particular due to incorrect design, poor materials or inadequate finish will be improved or replaced, at the supplier's discretion. The identification of such defects must be notified to the supplier in writing without delay, however at the latest 7 days after the identification of the fault. If the customer fails to notify the supplier, the product is considered approved despite the defect. Further liability for any direct or indirect damages is not accepted.

If instrument-specific maintenance and servicing work defined by the supplier is to be performed within the warranty period by the customer (maintenance) or by the supplier (servicing) and these requirements are not met, claims for damages due to the failure to comply with the requirements are rendered void.

Any further claims, in particular claims for consequential damages cannot be made.

Consumables and damage caused by improper handling, poor installation or incorrect use are excluded from this clause.

HACH LANGE GmbH process instruments are of proven reliability in many applications and are therefore often used in automatic control loops to provide the most economical possible operation of the related process.

To avoid or limit consequential damage, it is therefore recommended to design the control loop such that a malfunction in an instrument results in an automatic change over to the backup control system; this is the safest operating state for the environment and the process.

Section 11 Certification

Hach Company certifies this instrument was tested thoroughly, inspected and found to meet its published specifications when it was shipped from the factory.

The **Model sc100 with SS7 sc or SS7 sc-HST Sensor** has been tested and is certified as indicated to the following instrumentation standards:

Product Safety

UL 61010A-1 Listed by ETL (cETLus safety mark)
CSA C22.2 No. 61010.1 Certified by ETL (cETLus safety mark)
Certified by Hach Co. to EN 61010-1 Amds. 1 & 2 (IEC1010-1) per 73/23/EEC, supporting test records by Intertek Testing Services.

Immunity

This equipment was tested for Industrial level EMC per:

EN 61326 (EMC Requirements for Electrical Equipment for Measurement, Control and Laboratory Use) **per 2004/108/EC EMC:** Supporting test records and compliance certification by Hach Company.

Standards include:

IEC 1000-4-2:1995 (EN 61000-4-2:1995) Electro-Static Discharge Immunity (Criteria B)
IEC 1000-4-3:1995 (EN 61000-4-3:1996) Radiated RF Electro-Magnetic Field Immunity (Criteria A)
IEC 1000-4-4:1995 (EN 61000-4-4:1995) Electrical Fast Transients/Burst (Criteria B)
IEC 1000-4-5:1995 (EN 61000-4-5:1995) Surge (Criteria B)
IEC 1000-4-6:1996 (EN 61000-4-6:1996) Conducted Disturbances Induced by RF Fields (Criteria A)
IEC 1000-4-11:1994 (EN 61000-4-11:1994) Voltage Dip/Short Interruptions (Criteria B)

Additional immunity Standard/s include:

ENV 50204:1996 Radiated Electro-Magnetic Field from Digital Telephones (Criteria A)

Emissions

This equipment was tested for Radio Frequency Emissions as follows:

Per **2004/108/EC** EMC: **EN 61326:1998** (Electrical Equipment for measurement, control and laboratory use—EMC requirements) Class “A” emission limits. Supporting test records by Hewlett Packard, Fort Collins, Colorado Hardware Test Center (A2LA # 0905-01) and certified compliance by Hach Company.

Standards include:

EN 61000-3-2 Harmonic Disturbances Caused by Electrical Equipment

EN 61000-3-3 Voltage Fluctuation (Flicker) Disturbances Caused by Electrical Equipment

Additional Emissions Standard/s include:

EN 55011 (CISPR 11) Class “A” emission limits

Canadian Interference-causing Equipment Regulation, IECS-003, Class A

Supporting test records and compliance certification by Hach Company.

This Class A digital apparatus meets all requirements of the Canadian Interference- Causing Equipment Regulations.

Cet appareil numÈrique de la classe A respecte toutes les exigences du RËglement sur le matÈriel brouilleur du Canada.

FCC PART 15, Class “A” Limits

Supporting test records and compliance certification by Hach Company.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense. The following techniques of reducing the interference problems are applied easily.

1. Disconnect the Controller from its power source to verify that it is or is not the source of the interference.
2. If the Controller is connected into the same outlet as the device with which it is interfering, try another outlet.
3. Move the Controller and SS7 sc sensor away from the device receiving the interference.
4. Reposition the device receiving the interference.
5. Try combinations of the above.

Appendix A Modbus register

Tag Name	Register #	Data Type	Length	R/W	Description
TURB	40001	Float	2	R	Measured turbidity value
TURB INT	40003	Unsigned Integer	1	R	Integer turbidity value
TURB INT X 100	40004	Unsigned Integer	1	R	Integer turbidity * 100
SENSOR NAME	40005	String	6	R/W	Sensor name or location
BUBBLE REJECT	40011[1]	Unsigned Integer	1	R/W	Bubble reject status (0=OFF; 1=ON)
SIGNAL AVG	40012[1]	Unsigned Integer	1	R/W	Signal average (0=1; 1=6sec; 2=30sec;3=60sec;4=90sec)
DATALOG INTRVL	40013[1]	Unsigned Integer	1	R/W	Datalog interval (0=5sec;1=30sec;2=1min;3=2min;4=5min;6=10 min;7=15min;8=30min;9=60min, 10=4hr)
RESOLUTION	40014	Unsigned Integer	1	R/W	Maximum number of decimal places (0=xxxxx, 1=xxxx.x, 2=xxx.xx)
P/F CRITERIA	40015[1]	Unsigned Integer	1	R/W	Pass / Fail criteria for verification. (1 to 10 percent)
TURB UNIT	40016	Unsigned Integer	1	R/W	Turb units (0=mg/L:7=NTU;42=FTU)
SERVICE MODE	40018[1]	Unsigned Integer	1	R/W	Used to determine if the instrument is in the service mode (0 = disabled; 1= enabled)
SERIAL NUMBER	40021	String	6	R	Instrument serial number
CODE VERSION	40027	Float	2	R	Software version
DD Firmware	40029	Unsigned Integer	1	R	Device driver firmware version
DD CONTENT	40030	Unsigned Integer	1	R	Device driver content version
HW VERSION	40031	Unsigned Integer	1	R	Hardware version of pc board
TEMP	40032	Float	2	R	Temperature measurement in Celsius
DARK	40034	Unsigned Integer	2	R	Dark turbidity A/D counts.
RAW TURB	40036	Float	2	R	Turbidity value with dark offset and gain applied.
TURB COUNTS	40038	Unsigned Integer	2	R	Turbidity A/D counts
TEMP MAX	40040	Float	2	R	Maximum temperature
TEMP MIN	40042	Float	2	R	Minimum temperature
LAMP V	40044	Float	2	R	Lamp voltage
LAMP CURR	40046	Float	2	R	Lamp current (amps)
Plus 5V	40048	Float	2	R	Plus five volt measurement
INPUT V	40050	Float	2	R	Input voltage (~12V)
VREF	40052	Float	2	R	Voltage reference measurement (2.5V)
CAL GAIN	40067	Float	2	R	Calibration gain factor - used to convert A/D counts to turbidity
INITIALS	40083	String	2	R	Initials used for the latest calibration
LAST CAL DATE	40085	Time2	2	R	Time of the latest calibration
CAL VALUE	40087	Float	2	R	The standard value used for the latest calibration

[1] In order to write to these tags, write 46478 to register 49938

Appendix B Theory of operation

B.1 SS7 sc principle of operation

The Surface Scatter 7 sc Turbidimeter is a sensitive and precise instrument designed to measure the light scattered by particles suspended in the sample fluid. The sample flows up through the turbidimeter body at a rate between 1 and 2 liters per minute (¼ to ½ gallon per minute). As the fluid spills over the top of the turbidimeter body, a stable, flat surface of fluid forms and becomes the measuring surface.

Because there is no contact between the fluid being analyzed and any of the optical surfaces, the instrument can monitor even highly turbid samples without frequent cleaning. Electrically and mechanically, the Surface Scatter 7 sc Turbidimeter has been constructed to ensure reliable operation in adverse environments.

The lamp, powered by a regulated voltage source, provides a high intensity beam of light that is adjusted to strike the fluid surface at an angle. Most of the light striking the surface of the fluid is either reflected into the upper left hand corner of the cabinet and absorbed, or refracted down into the turbidimeter tube (Figure 4 on page 12). A small amount of the light is scattered by the particles suspended in the fluid. Light scattered at 90 degrees from the incident beam is detected by the detector assembly. The electronic signal generated by the detector assembly is directly related to the concentration of particles suspended in the fluid.

Directing the light beam at the fluid surface at an angle and placing the detector assembly directly over the point where the light enters the fluid is a very important design feature. Because the light is scattered at or near the surface, only a minimum amount of scattered light is absorbed by the fluid before it reaches the detector assembly. Therefore, the amount of light scattered will increase with increasing turbidity, regardless of how high the turbidity becomes. This allows the instrument to measure very high, as well as very low, levels of turbidity.

B.2 SS7 sc-HST principle of operation

The SS7 sc-HST instrument is designed for high temperature samples, or in applications where a significant difference between the sample temperature and the ambient temperature causes condensation and fogging in the unit. The SS7 sc-HST functions in the same manner as the SS7 sc, but accommodates samples of higher temperature and a moist air removal system has been added.

The moist air removal system contains an air flow multiplier that creates a vacuum to draw moisture away from the sample tube and remove the moisture from the enclosure. The moisture removal system requires the customer to provide a source of air pressure, such as compressed air, shop air, or an on-site air compressor. The air line is connected to the top of the flow multiplier (Figure 5, item 1).

Be Right™