GRISWOLD FILTRATION

SBC INSTALLATION OPERATION & MAINTENANCE

Record Information About Your System

1. Date Purchased ______________________________________
2. Date Installed ____
3. Serial Number _______________________________________
4. Local Representative _________________________________

For assistance:
Please call your Local Representative or the Factory Help Line: (951) 278-8992

1525 E. Sixth St.., Corona, CA. 92879
Phone: (951) 278-8992 Fax: (951) 735-0798
www.griswoldfiltration.com

GF-1025-G2
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INTRODUCTION

For over 45 years Griswold Controls has set the standard for innovative and quality products for HVAC and Irrigation applications. From the original 100% stainless steel cartridge for automatic flow controls to the Automizer™, the first combination actuated control ball valve with automatic flow limit controls; Griswold Controls is the leader in HVAC technology for flow control. Griswold Controls focuses on the needs of the industry, offering flow control solutions that are innovative, versatile and that fit the applications.

Griswold Filtration was formed to continue the Griswold tradition of innovation and provide leadership in the area of Physical Water Treatment. Griswold Filtration offers engineers and building managers new solutions to the troublesome problems of sand and debris removal, calcium carbonate scale formation, bacterial growth and heat exchanger corrosion in cooling water systems. Griswold Filtration is dedicated to developing environmentally friendly physical water treatment methods. We also understand that there sometimes is no “perfect solution” to water problems. Our engineers are able to help provide the best combinations of physical and chemical means to solve cooling water problems with the least impact on the environment.

The SBC is the result of many years of testing and listening to customer’s needs. The SBC makes use of complex frequency modulated signals to control the development of Scale and Bacteria in cooling water systems. With the SBC you will enjoy the benefits of a cleaner, more efficient system without the use of dangerous and expensive chemicals. The SBC uses only electrical power and has no consumable items to replace, making it a truly lower cost solution. Please follow the instructions in this manual to ensure maximum performance and years of trouble free service.

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CHAPTER 1: REQUIRED READING

ICON KEY
Valuable Information
Technical Tip
Important Warning

Before attempting to install or start up your new SBC water treatment system please read this section first.

This manual will indicate valuable information, technical tips and important warnings by the placement of an icon in the page border. Please pay special attention to these highlighted sections.

CHECK YOUR NEW EQUIPMENT

The basic SBC System consists of two items:
1. Reaction Chamber
2. Driver Enclosure

Please inspect all equipment for physical damage before attempting installation. If damage is discovered, please call Griswold Filtration.

POWER REQUIREMENTS

Disconnect-Breaker

The power requirement for your system is detailed below the serial number on the sticker located at the bottom of the Driver/Controller. All systems are fitted with a versatile internal power supply that can accept any voltage between 100 to 240 VAC at 50 to 60 Hz. A breaker with ON / OFF switch is supplied inside the Driver panel should you choose to turn OFF system power for servicing without unplugging the unit.

Proper operation of the SBC cannot be assured without an accurate water analysis.

pH should always be tested in the Field, not in the laboratory..

MAKEUP WATER ANALYSIS

Before any SBC System is put into service an accurate analysis of the makeup water must be provided to the factory. This analysis will be used to determine the initial setpoints for the automatic blowdown system. Also it will be used to calculate the maximum practical cycles of concentration the system can safely achieve.

The required parameters with appropriate units are as follows:

1. pH (Standard	2. Conductivity	3. Calcium Hardness	4. Total Hardness
5. p-Alkalinity	6. m-Alkalinity	7. Chloride	8. Sulfate
9. Phosphate	10. Iron	11. Silica	

CONDUCTING MATERIAL WARNING

The SBC Reaction Chamber consists of four powerful induction coils. As a result, no metal objects, wire, metallic labels, or metallic paint should be allowed to remain in contact with the blue outer jacket of the Reaction Chamber. To do so will de-tune the SBC, could cause high coil temperatures and damage to the SBC or surrounding equipment. To prevent possible problems:

1. All supports and hangers should be made of non-conducting material.
2. All Metallic piping, support structures and control boxes should be no closer than 4 inches from the Reaction Chamber, unless pre-authorized by Factory.

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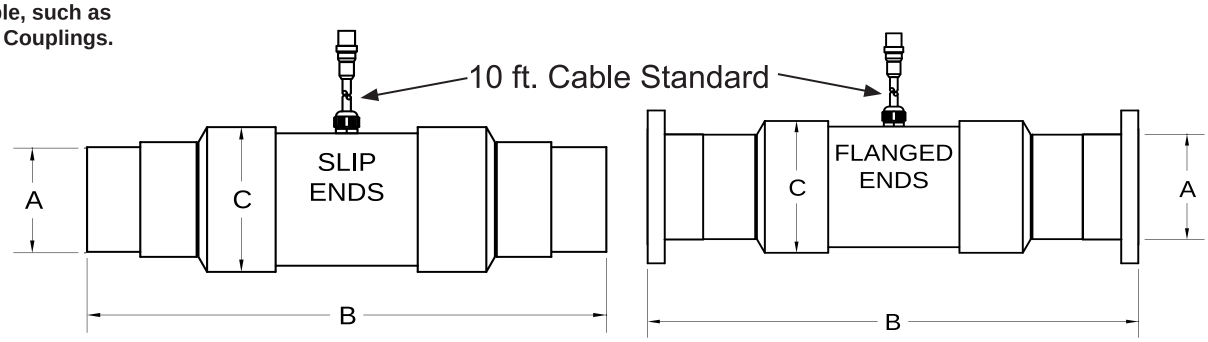
CHAPTER 2: INSTALLATION

Fiberglass pipe can be special ordered to allow for higher temperature and pressures.

Optional end connections are available, such as Straub Couplings.

The Reaction Chamber consists of a spool piece fabricated of Schedule 80 PVC or Fiberglass pipe. A series of coils are wound around the outside of the pipe and are sealed against the weather by a plastic outer blue jacket. The standard 10 foot umbilical cable is permanently attached to the reaction chamber.

SBC REACTION CHAMBER SPECIFICATIONS



MODEL	MAT'L.	"A" NOM. PIPE SIZE In. (mm)	"B" In. (mm)			"C" COIL Max. O.D. In. (mm)	WEIGHT LB. (KG)	
			PVC SLIP	FRP SLIP	150# FLG.		SLIP	150# FLG.
SBC-2000	Sch. 80 PVC, CPVC or Sch. 40 Fiber-glass (FRP)	2 (51)	23.69 (602)	23.50 (597)	24.00 (610)	5.03 (128)	9 (4.0)	10 (4.5)
SBC-3000		3 (76)	29.50 (749)	29.5 (749)	30.00 (762)	7.13 (181)	12 (5.4)	14 (6.4)
SBC-4000		4 (102)					29 (13.2)	32 (14.5)
SBC-5000		5 (127)	35.25 (895)	35.50 (902)	36.00 (914)	9.25 (235)	42 (19.1)	49 (22.2)
SBC-6000		6 (152)					46 (20.9)	55 (24.9)
SBC-8000		8 (203)	39.25 (997)	39.25 (997)	40.00 (1016)	11.50 (292)	92 (41.7)	105 (47.6)
SBC-10000		10 (254)	46.63 (1184)	47.25 (1200)	48.00 (1219)	13.27 (337)	132 (59.9)	155 (70.3)
SBC-12000		12 (305)	54.75 (1391)	55.25 (1403)	56.00 (1422)	14.53 (369)	156 (70.8)	190 (86.2)
SBC-14000		14 (356)	63.00 (1600)	63.25 (1607)	64.00 (1626)	16.55 (420)	191 (86.6)	230 (104.3)
SBC-16000		16 (406)	70.50 (1791)	71.25 (1810)	72.00 (1829)	18.54 (471)	224 (101.6)	270 (122.5)
SBC-18000		18 (457)	79.50 (2019)	79.25 (2013)	80.00 (2032)	20.54 (522)	258 (117.0)	310 (140.6)
SBC-20000		20 (508)	78.50 (1994)	87.25 (2216)	88.00 (2235)	24.54 (623)	291 (132.0)	350 (158.8)
SBC-24000		24 (610)	81.00 (2057)	95.25 (2419)	96.00 (2438)	28.62 (727)	357 (161.9)	431 (195.5)

Lengths are ± 0.25" (6 mm)
Reaction Chamber Meets NEMA 4 Specifications
See Page 2 for Temperature and Pressure Ratings

FIGURE 2: Reaction Chamber dimensions and weights.

CUT LENGTH

Double-check the cut length (Dimension B in Figure 2) before cutting the pipe and installing the Reaction Chamber. Ensure exact measurement to include the mating flanges and gaskets.

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Please advise factory if temperature extremes are expected.

OPERATING TEMPERATURE

The Reaction Chamber inner pipe and flanges are Schedule 80 PVC and are rated for a maximum operating temperature of 140°F. The materials of construction can withstand these temperatures, but the pressure rating must be de-rated as the temperature increases above 90°F. See Figure 3 for de-rating information.

FREEZE PROTECTION

Heat tracing should not be applied directly to the Reaction Chamber. Nonmetallic insulation may be used. Please contact Factory for approval of insulation.

DRIVER OPERATING TEMPERATURE

The SBC Driver will operate correctly under a wide range of temperatures (14°F - 120°F).

OPERATING PRESSURE

Standard SBC Reaction Chambers are fitted with ANSI 150# PVC Flanges. ***Note: Pressure must be de-rated as system water temperature increases. See Figure 3.

WARNING

To avoid possible damage to the Reaction Chamber, never attempt to tighten the Reaction Chamber to threaded connections by gripping and rotating the Coil Sleeve or Umbilical Connector. All rotational force used to tighten the pipe fittings must be applied directly to the flow-through pipe only.

DIRECTION OF FLOW

The Reaction Chamber is marked with an arrow indicating direction of flow. Reversed installation will negatively affect system performance.

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PVC Schedule 80 Pipe Temperature Derating

Max. Working Pressure in PSIG (metric units see note below) per Given Temperature °F (°C)

Size: in.	70 (21.1)		80 (26.7)		90 (32.2)		100 (37.8)		110 (43.3)		120 (48.9)		130 (54.4)		140 (60.0)	
(mm)	Slip	Flange	Slip	Flange	Slip	Flange	Slip	Flange	Slip	Flange	Slip	Flange	Slip	Flange	Slip	Flange
2 (51)	400	150	352	150	300	150	248	150	200	135	160	110	120	75	88	50
3 (76)	370	150	326	150	278	150	229	150	185	135	148	110	111	75	81	50
4 (102)	320	150	282	150	240	150	198	150	160	135	128	110	96	75	70	50
5 (127)	290	150	255	150	218	150	180	150	145	135	116	110	87	75	64	50
6 (152)	280	150	246	150	210	150	174	150	140	135	112	110	84	75	62	50
8 (203)	250	150	220	150	188	150	155	150	125	125	100	100	75	75	55	50
10 (254)	230	150	202	150	173	150	143	143	115	115	92	92	69	69	51	50
12 (305)	230	150	202	150	173	150	143	143	115	115	92	92	69	69	51	50
14 (356)	220	150	194	150	165	150	136	136	110	110	88	88	66	66	48	48
16 (406)	220	150	194	150	165	150	136	136	110	110	88	88	66	66	48	48
18 (457)	220	150	194	150	165	150	136	136	110	110	88	88	66	66	48	48
20 (508)	220	150	194	150	165	150	136	136	110	110	88	88	66	66	48	48
24 (610)	210	150	185	150	158	150	130	130	105	105	84	84	63	63	46	46

CPVC Schedule 80 Pipe Temperature Derating

Max. Working Pressure in PSIG (metric units see note below) per Given Temperature °F (°C)

Size: in.	70 (21.1)		80 (26.7)		90 (32.2)		100 (37.8)		110 (43.3)		120 (48.9)		130 (54.4)		140 (60.0)	
(mm)	Slip	Flange	Slip	Flange	Slip	Flange	Slip	Flange	Slip	Flange	Slip	Flange	Slip	Flange	Slip	Flange
2 (51)	400	150	400	150	368	150	340	150	300	145	260	135	228	125	200	110
3 (76)	370	150	370	150	340	150	315	150	278	145	241	135	211	125	185	110
4 (102)	320	150	320	150	294	150	272	150	240	145	208	135	182	125	160	110
5 (127)	290	150	290	150	267	150	247	150	218	145	189	135	165	125	145	110
6 (152)	280	150	280	150	258	150	238	150	210	145	182	135	160	125	140	110
8 (203)	250	150	250	150	230	150	213	150	188	145	163	135	143	125	125	110
10 (254)	230	150	230	150	212	150	196	150	173	145	150	135	131	125	115	110
12 (305)	230	150	230	150	212	150	196	150	173	145	150	135	131	125	115	110
14 (356)	220	150	220	150	202	150	187	150	165	145	143	135	125	125	110	110
16 (406)	220	150	220	150	202	150	187	150	165	145	143	135	125	125	110	110
18 (457)	220	150	220	150	202	150	187	150	165	145	143	135	125	125	110	110
20 (508)	220	150	220	150	202	150	187	150	165	145	143	135	125	125	110	110
24 (610)	210	150	210	150	193	150	179	150	158	145	137	135	120	120	105	105

CPVC Schedule 80 Pipe Temperature Derating

Size: in.	150 (65.6)		160 (71.1)		170 (76.7)		180 (82.2)		190 (87.8)		200 (93.3)	
(mm)	Slip	Flange	Slip	Flange	Slip	Flange	Slip	Flange	Slip	Flange	Slip	Flange
2 (51)	180	100	160	90	128	80	100	70	88	60	80	50
3 (76)	167	100	148	90	118	80	93	70	81	60	74	50
4 (102)	144	100	128	90	102	80	80	70	70	60	64	50
5 (127)	131	100	116	90	93	80	73	70	64	60	58	50
6 (152)	126	100	112	90	90	80	70	70	62	60	56	50
8 (203)	113	100	100	90	80	80	63	63	55	55	50	50
10 (254)	104	100	92	90	74	74	58	58	51	51	46	46
12 (305)	104	100	92	90	74	74	58	58	51	51	46	46
14 (356)	99	68	88	60	70	70	55	55	48	48	44	44
16 (406)	99	68	88	60	70	70	55	55	48	48	44	44
18 (457)	99	68	88	60	70	70	55	55	48	48	44	44
20 (508)	99	68	88	60	70	70	55	55	48	48	44	44
24 (610)	95	68	84	60	67	67	53	53	46	46	42	42

Fiberglass Sch. 40

	275 (135)	
Size: in. (mm)	Slip	Flange
2 (51)	625	150
3 (76)	375	150
4 (102)	300	150
5 (127)	250	150
6 (152)	250	150
8 (203)	250	150
10 (254)	200	150
12 (305)	200	150
14 (356)	175	150
16 (406)	150	150
18 (457)	125	125
20 (508)	125	125
24 (610)	125	125

NOTES:	
1	All flanges supplied are ANSI 150#
2	Straub Couplings are available for slip end connections
3	Gage Pressure in Bars = 0.069 X PSIG

FIGURE 3: Pipe Pressure De-rating with Temperature

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REACTION CHAMBER PLACEMENT GUIDELINES

Install the SBC per the guidelines below to assure best performance.

Note: Conductive Material Warning

Damage may occur if conductive materials are in contact or within 4 inches of the Reaction Chamber. Pre-authorization from Factory is required for all installations requiring close contact with metal.

1. Normal turbulent flow such as generated by elbows, control valves and the discharge from pumps should not be a problem with the SBC. Please consult Factory if planning to install on the inlet side of a centrifugal pump.
2. Reaction Chamber locations for Cooling Towers and Evaporative Coolers.
   a. Primary location is in the return line to the tower, and if present, before any tower by-pass loops. Check with factory for guidance on all proposed by-pass systems.
   b. Secondary location is before the heat exchanger/chiller.
   c. Remember that the flow must be in the direction of the arrow on the side of the Reaction Chamber.
3. The Reaction Chamber is sealed against water so there are no rain precautions.
4. No harm will come to the system if water in the piping is allowed to run dry while the SBC is turned on.

Flows should be greater than 2 fps to assure proper cleaning of tubes in heat exchangers.

MODULATING HEAT EXCHANGERS - CAUTION

Regarding Heat Exchangers – It is imperative that Griswold Filtration be notified if any heat exchangers will be used in very low flow conditions. If cooling water flow is reduced in order to control temperature, the velocity inside the heat exchanger must not be allowed to go low enough that particles start falling out of solution. Should this happen, particles could build up inside and plug the exchanger. Normally, flows in excess of 2 feet per second are adequate. To determine 2 feet per second from gpm use the following formula:

Minimum gpm = 4.9 x Pipe Size (inches) x Pipe Size (inches)

Example 4 inch pipe

Minimum gpm = 4.9 x 4 x 4

Minimum gpm = 78.4 for 4" pipe

Perform a bucket test at heat exchanger outlet or use a flow meter to verify the required minimum flow rate.

PROPER SUPPORT REQUIRED

When installing a PVC Reaction Chamber on steel piping, the steel piping must be firmly anchored and braced to prevent the Reaction Chamber from bearing any of the weight of the steel piping. Care must be exercised to assure that the PVC Reaction Chamber not be subjected to torsion forces, water hammer or other stresses. Reaction Chambers 6" and larger should have an additional non-conducting hanger near the center of the Reaction Chamber.

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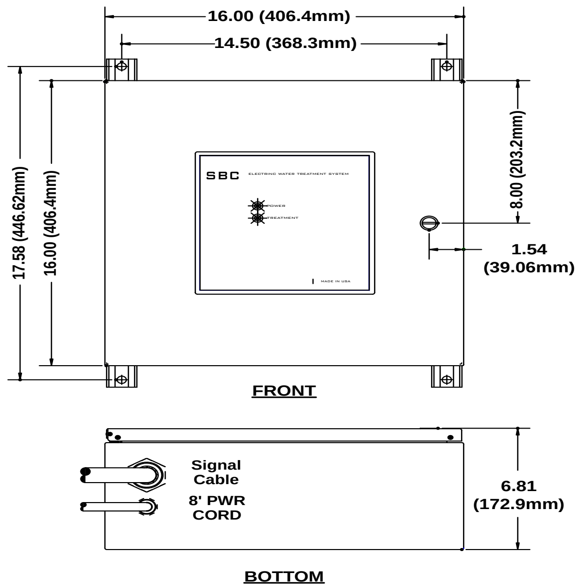
SBC Driver (SBC 2000-24000)



SPECIFICATIONS	
Enclosure	NEMA 4
Weight	40 Lb (18.1 Kg)
Voltage	100-240 VAC
Hertz	47- 63 Hz
Power Consumption	<100 Watts
Temperature	
SBC Driver	14°F to 120°F (-10°C to 49°C)

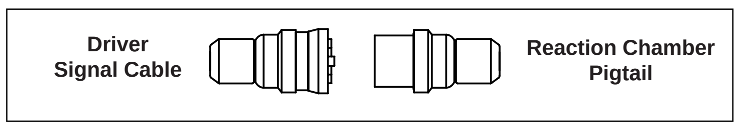


FIGURE 4: SBC Driver

DRIVER PLACEMENT

The Reaction Chamber has a short one foot pigtail with a waterproof connector permanently attached. A standard 10 foot signal cable is factory installed and fed through a weatherproof gland at the bottom of the Driver Box. The signal cable is terminated with a mating waterproof connector and should be attached to the Reaction Chamber pigtail and locked in place by twisting the connector collar. The Driver must be installed within 10 feet of the Reaction Chamber unless an optional longer Signal Cable is provided by the factory. Driver components are housed in a NEMA 4 enclosure that weighs approximately 40 pounds. The enclosure should be mounted securely to a wall or rack that is not subject to vibration (See Figure 4). For outdoor installations in hot climates, it is recommended that the Driver be located in a shady area.

IMPORTANT
The Signal Cable cannot be lengthened or shortened without voiding the SBC warranty. Longer or shorter Signal Cables must be ordered from the factory.

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DRY CONTACT ALARM RELAY

All SBC models are fitted with a dry contact alarm relay mounted at the upper Right hand corner of the Driver circuit board. A connection to the Building Management System and Cooling Tower Controls should be made to this relay. Interlocks should be provided to prevent Tower operation without the SBC providing water treatment. This relay is normally closed when the SBC is operating properly. Connections to the relay should not exceed 5 amps at up to 30 volts DC or 10 amps at up to 250 volts AC (See Figure 5).

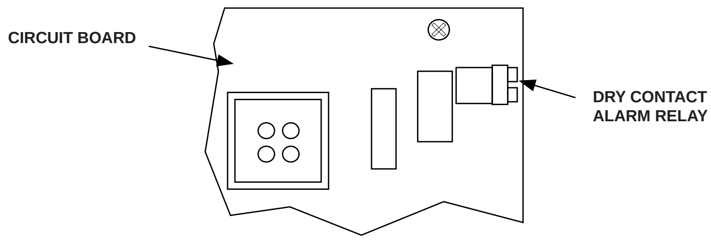

FIGURE 5: Alarm Relay connection location on Driver board.

POWERING THE DRIVER

SBC systems require between 2.5 and 5 amps of current to operate, depending on size and input voltage. The amp rating is marked on the serial number sticker located on the bottom of the Driver panel. All systems are fitted with a versatile internal power supply that can accept any voltage between 100 to 240 VAC and 50 to 60 Hz. The standard 8 foot long power cord is fitted with a molded 15 amp 110 VAC plug.

If you choose to run the system on 220 VAC then simply cut off the male 110 VAC plug and wire:
Black = Hot Leg
White = Hot Leg
Green = Ground

TREATMENT INDICATOR LIGHT

All SBC systems are fitted with a Green LED display light marked “Treatment” located on the door of the Driver panel. This light is for quick reference that the system is generating a signal and applying it to the Reaction Chamber. The presence of a system error or failure of a coil to transmit signal properly will result in the light turning off. If the light is off, the operator must assume that no treatment is occuring and take proper steps to correct the situation.

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CHAPTER 3: OPERATION

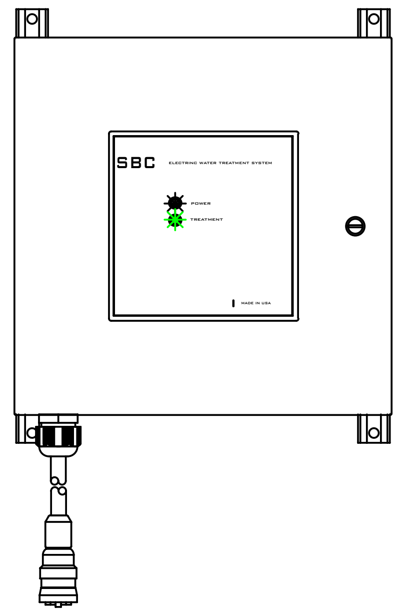
SBC START-UP

NEW SYSTEM CLEANING & PASSIVATION

New piping and cooling system installations should be cleaned to remove all dirt, oils, mill-scale and construction debris. The complete system should be flushed and cleaned in accordance with the cooling tower manufacturer's recommendations. For galvanized steel basins, follow the cooling tower manufacturer's recommendations for the passivation. Failure to do so could result in equipment damage and voiding of the Tower Warranty. See Chapter 4 sub paragraph, "New System Cleaning & Passivation", for additional information.

STARTING SBC

The SBC provides a strong signal to the water and is easy to use. Please follow the instructions below to assure trouble free operation:



1. Insure that the Reaction Chamber pigtail is firmly connected to the Driver Box Signal Cable before applying any power.

2. Open Driver door and switch the Circuit Breaker to the **ON** position, close door and apply power. The Blue Power LED should turn on.

3. The Green Treatment LED will flash during the Auto-Seek™ that is initiated each time power is applied to the SBC. Once Auto-Seek™ has completed (in about 20 seconds), the Treatment LED will stop flashing and remain lit.

4. Anytime the SBC loses power the Driver will initiate a new Auto-Seek™ upon restoration of power.

5. If the Treatment LED goes off, the alarm relay will open and the unit will no longer be providing proper water treatment. If the Blue Power LED is on, then there is power to the Driver, so check to see if the Signal cable has been cut or disconnected from the Reaction Chamber.

6. Contact the Factory at (951) 270-1776 or your local Representative if you have any questions or need assistance.

AUTO-SEEK™ FUNCTION

The SBC has a unique Auto-Seek™ feature. Each installation will have differences regarding the nearness of other metal objects. These differences can detune the signal, decreasing its signal strength. The Auto-Seek™ feature gives the SBC the ability to correct the tuning of the coils to provide for maximum signal while the water is flowing in each uniquely plumbed system. This feature is fully automatic and requires no operator involvement. Every time power is applied to the unit, the automatic Auto-Seek function will be initiated, as described in the **Starting SBC** Section above.

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CHAPTER 4: INITIAL OPERATION & MONITORING

Please Contact your local Griswold Filtration Representative when you are ready to begin operation of this equipment for startup assistance. Griswold Filtration recommends a 90-day stabilization program be preformed after installation.

TRANSITIONING TO CHEMICAL-FREE WATER IN COOLING TOWERS

When the SBC unit is installed on an existing tower to replace the traditional chemical treatment program, comply with the suggested procedures for transitioning.

NOTE: Galvanized towers require passivation after acid cleaning. See Galvanized Towers and "White Rust" on page 13

TOTALLY DRAINED SYSTEM

The preferred method for system transition to full chemical-free water treatment is to clean the tower and fill by circulating a safe, biodegradable descaler such as DesCaLIR CT™ made by The Greenway Group. After the system has been completely descaled, it should be drained and washed down with a pressure washer. After cleaning has been completed, the system is filled with fresh chemical-free water. Set the automatic blowdown controller to the conductivity setting recommended by Griswold Filtration based upon the required makeup water analysis (See "Makeup Water Analysis", Chapter 1). The system is now ready for the SBC unit to be turned on.

OPERATING SYSTEM

When the system cannot be conveniently drained or stopped for cleaning, the SBC may be started with the water treatment chemicals still present. Turn off all chemical pumps and remove biocide baskets or floaters. Set the automatic blowdown controller to the conductivity setting recommended by Griswold Filtration based upon the required makeup water analysis (See Makeup Water Analysis Chapter 1).

SYSTEM DESCALING

If there is a significant amount of existing scale in the system, there will be a period of time where this pre-existing scale will start to fall out of the fill and/or dislodge from the pipes. During the descaling period, it is important to inspect strainers and the hot deck of the tower frequently and clean if necessary. This process can take several weeks to complete, so please be patient. The system is getting cleaner and more efficient.

INSTALLATION ON ONE COOLING CELL AT A TIME

If reasons prohibit installing all needed SBC units at a time, please continue to use regular chemical treatment until all the required equipment has been installed. After installation is complete, then follow one of the methods above to start up the system.

NEW SYSTEM CLEANING & PASSIVATION

CLEANING COOLING SYSTEMS AND TOWERS

New pipe and cooling system installations should be cleaned to remove all dirt, oils, and construction trash. The complete system should be flushed with clean water, cleaned with a chemical cleaner buffered to maintain pH between 6.5 and 8.0 as recommended by the cooling tower manufacturer, and flushed again with clean water.

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IRON PIPE RUST PREVENTION

NOTE: Chillers and Heat Exchangers can be subject to rusting if stored wet. See "Cooling Tower/System Lay-up" Section.

1. If the piping system is filled for testing and then is to remain idle for a few weeks or months during construction, it must be treated with an appropriate corrosion inhibitor at a concentration to create a protective film on all surfaces. This will require that the inhibitor be circulated for at least 24 hours. If required, Griswold Filtration will help identify a good inhibitor.
2. There is no need to drain the inhibitors from the system before startup of the SBC system and cooling tower. The inhibitors will be slowly removed from the system by normal blow down as the system cycles up to start providing calcium carbonate based corrosion protection.
3. If the tower is to remain idle for long periods of time, corrosion inhibitors must be used in the tower water to prevent generalized corrosion, or the tower must be drained of all water. See Cooling Tower/System Lay-up in Chapter 5 for more details.

GALVANIZED TOWERS AND "WHITE RUST"

To make steel more resistant to corrosion, many times the surface is sealed with a layer of zinc. This zinc-coated steel is called galvanized steel. When the galvanized steel comes from the factory it is bright and shiny and has only a very thin factory chromate layer to provide corrosion protection. In a water environment, if the conditions are not regulated carefully, this chromate layer will be replaced with a porous form of zinc carbonate (white rust). This "white rust" is a white, fluffy or waxy appearing deposit. It is porous and will allow for continued corrosion to occur under the deposit. If proper conditioning of the surface is done, a tough, non-porous dull-gray protective "basic zinc carbonate" layer will form. Griswold Filtration recommends that the following procedures be performed to prevent "white rust" and add significantly to the life of the tower wetted parts:

1. **Natural Passivation Using pH Control**
   a. Tower pH needs to be maintained in the range of 7.7 – 8.0 (no higher than 8.2) through blow down control for 6 to 8 weeks of operation.
   b. The calcium hardness and alkalinity should be 100 - 300 ppm during this time.
   c. If the makeup water's pH is naturally higher than 7.5, it might not be possible to passivate the tower without the use of chemicals. The goal of adding acid to the water is to maintain a pH under 8.3 for the time needed to form the protective surface coating.
2. **Chemical Passivation**
   a. Chemical Passivation rapidly forms a protective coating using chemicals to accelerate the process. Griswold Filtration does not recommend the use of Chemical Passivation alone to protect a tower from "white rust".
   b. Usually chemical treatment will include inorganic phosphate maintained at a high level for 60 days. Care must be exercised to prevent the formation of calcium phosphate scale. Check with Griswold Filtration for details based on your actual water chemistry.
3. **General guidelines**
   a. The system must start out clean.
   b. Galvanized surfaces must be carefully inspected for scratches, dents, corrosion or other damage to the coating. Any physical damage to the zinc coating must be repaired by the use of zinc-rich paint before Passivation.
   c. If a chemical cleaner is used, it must be buffered to maintain pH between 6.5 and 8.0.
   d. The pH level must be monitored closely during the Passivation process.

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e. Once the Passivation is completed, it is permanent and should not need to be re-conditioned unless the pH of the system is allowed to run less than 6.5 or greater than 9.0.

BADLY FOULED OPERATING SYSTEMS

Aggressive efforts will be required during descaling to insure proper operation of the System. To avoid system problems, comply with the following:

1. Check strainers and clean as required.
2. Check and clean hot deck or spray heads.
3. Check basin, all low flow areas and clean as required.

Note: *Chemical descaling can be a viable alternative to the above during this period of massive descaling.*

FACTORY SUPPORT

Prior to start-up, Griswold Filtration through its local Representative will perform a make-up water analysis. The designated service contract provider or alternate service provider will be present during initial start-up, will perform a 2 week check-up and verify advertised performance at 90 days. Any additional visits will be as required. During these visits they will verify the following:

1. The system blowdown equipment is properly set and functioning.
2. The SBC system is turned on and working properly.
3. Chemical analysis shows that pH, Conductivity, Chloride and Cycles of Concentration are in the expected range.
4. On Cooling Towers and Evaporative Condensers the total Planktonic bacteria will be checked by Dip Slide, Standard Methods Heterotrophic Plate Count or ASTM D6530.

ONGOING RESPONSIBILITIES:

We strongly recommend the customer complies with the routine maintenance schedule in Table 1. If the customer is unable or unwilling to perform the required tests, they should contract outside assistance. **FAILURE TO DO REQUIRED TESTING AND MONITORING CAN RESULT IN DAMAGE TO COOLING EQUIPMENT.**

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CHAPTER 5: NORMAL OPERATION & MONITORING

Even though the SBC system offers a very simple and reliable way to take care of cooling water, it cannot be expected to work properly without any monitoring or attention.

COOLING TOWER OPERATION

The formation of microscopic seed crystals composed of calcium carbonate is important to the proper operation of the SBC. Therefore, the makeup water must NOT be softened.

PREVENTION OF CALCIUM CARBONATE SCALE

A cooling tower that is equipped with an SBC water treatment system will develop no new calcium carbonate scales on the surfaces of pipes, chillers or heat exchangers. The calcium carbonate that is in solution is very unstable. When the water passes through the SBC Reaction Chamber, it is exposed to a complex, alternating electrical field that causes a small amount of the dissolved calcium carbonate to fall out of solution forming microscopic crystal clusters. These clusters continue to grow preferentially in the presence of higher temperatures in the system instead of laying down surface scale. The crystals finally get large enough that they fall to the bottom of the tower basin. This crystal sludge is easily removed along with other sucked in debris by a sweeper type separator system like the Tower Sentry.

CAUTION REGARDING LOW VELOCITY FLOW

Calcium carbonate forms as microscopic seed crystals in the SBC treated tower water; therefore these seed crystals must travel fast enough to be "swept" through any and all heat exchangers, or chiller bundles. If the flow is too slow through the heat exchangers, or chiller bundles, the seed crystals can settle and continue to grow. While the resulting large crystal clusters do not normally adhere to surfaces, they can still settle and pack into low flow areas. Please advise the Factory if you believe that you might have low or no flow operation of your system. Normally, flows in excess of 2 feet per second are adequate. Refer to Chapter 2, sub section "Reaction Chamber Placement Guidelines", sub paragraph "Modulating Heat Exchangers-Caution" for the example to determine the required gpm.

SCALE FLAKE FORMATION

Scale flake formation can be due to several factors:

1. Water is being allowed to evaporate to dryness in the fill due to low flow conditions or the hot deck drains are plugged with debris.
2. Pre-existing scale is falling out of the fill due to use of the SBC.

If scale flakes are presenting a problem with filters, take the following actions:

1. Aggressively check and clean all filters and strainers.
2. Check for low flow conditions or plugged holes in the tower water distributor.
3. Call the factory for additional assistance.

NOTE: Hard water is required for the SBC system to provide corrosion protection. Very low cycles or soft water can result in higher than normal corrosion rates.

CORROSION CONTROL

The SBC does not directly prevent or protect equipment and piping from corrosion. The SBC system will provide the typical user with corrosion protection by elimination of some of the major causes of corrosion such as biofilm and oxidizing biocides. In addition, by allowing users

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to operate the evaporative loop above the saturation point that normally results in scale formation, the natural corrosion inhibiting properties of calcium carbonate can be utilitzed. To assure proper system corrosion protection the system water should have a Puckorius Scaling Index (PSI) of 6.2 or lower.

LOWERING OF PARTICLE SURFACE CHARGE

Particles and bacteria floating in the water stay suspended because of naturally occurring surface charges (Zeta Potential). These suspended solids cause the water to become turbid or cloudy. When these particles travel through the alternating electrical fields generated by the SBC, some of this surface charge is removed. As a result, the particles start to agglomerate and settle. This helps remove bacteria from the water and causes a lowering of overall turbidity.

LOWERING OF TOTAL BACTERIA COUNT

The SBC is very effective at keeping the total bacteria population of the cooling system very low. The Total Heterotrophic Bacteria Count (TBC) in the bulk water as measured by Standard Methods 9215B or ASTM D6530 should not exceed the 10,000 CFU/ml (Colony Forming Units per milliliter). The Cooling Technology Institute recommends this limit as an indicator of good tower hygiene to prevent outbreaks of Legionella. In the SBC controlled tower, normal bacteria counts will be between 1,000 to 2,000 CFU/ml or less.

BIOFILM ELIMINATION

The SBC is very effective against existing and potential biofilm formation. As a result, after the unit has been in operation for several weeks, there should be no slimy feeling biofilm in the bottom of the tower basin.

CAUTION REGARDING HIGH BACTERIA COUNTS

An SBC system started where there is existing biofilm will cause high bacteria counts due to the biofilm breaking up and releasing additional bacteria into the water. This is a temporary condition. With a stabilized system, any spike in bacteria, requires one to inspect the tower for sources. High bacteria counts can also be due to sampling error, laboratory error or recent tower wash downs. Always retest to confirm high bacteria numbers.

ALGAE IN AND OF ITSELF IS NOT A WARNING SIGN

Only when algae are associated with an active slime layer, biofilm, and a high total bacteria count can it be considered a warning of a biologically active condition. Algae growth that is thin and associated with a low total bacteria count (under 10,000 CFU/mL) is NOT an indicator of biologically active or dangerous conditions. Total bacteria counts are the only reliable indicator of biological activity, not the presence or absence of algae.

SPECIAL NOTES ABOUT ALGAE

Algae are rootless plants that require sunlight and minerals to grow. In typical cooling tower systems the algae form a symbiotic relationship with the bacteria normally found in the cooling tower. The algae provide shelter, food and oxygen for the bacteria. The bacteria provide food and protective biofilm to assist the algae. As a result, the algae experiences healthy growth and is incorporated into a slimy, thick mass.

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In many systems where the SBC is installed, after only a few weeks of operation the preexisting algae in the system will die. This is normal due to the SBC's excellent ability to keep the bacteria count very low. This takes away a very important source of food for the algae. The algae are shocked by this sudden removal of bacteria and biofilm and subsequently die.

In areas of the country where 1 – 3 ppm of phosphate is found in the makeup water, or the air has large amounts of pollen, flour dust, or just plain dirt, algae may reappear. Normally the algae will not cause any system related problems and can be considered only an aesthetic issue.

Even so, there might be some conditions where an operator believes that no amount of algae can be tolerated because of what public perceptions might be. If this is the case, then a chemical solution is a viable choice.
If there is no slime, if the heterotrophic plate count is under control, and if the algae are not interfering with tower performance, it may be simpler to let the algae remain until your normal routine cleaning.

SPECIAL NOTE ABOUT LEGIONELLA

Legionella bacteria are present in virtually all raw water and is found in soil and in the air. The risk of human infection is related to many factors such as temperature, mist formation, likelihood of breathing the mist, individual immune system characteristics, and others.

BEST PRACTICE FOR LEGIONELLA PREVENTION

1. Follow all guidelines and regulations for cooling system design and operation that are applicable to your local government regulation entity, business or industry protocol, and company policy.
2. Follow cooling system manufacturer guidelines for cooling system cleaning and maintenance.
3. Maintain the best possible drift elimination to minimize human exposure to drift.
4. A clean, biologically inactive tower minimizes the risk of "Legionella Amplification," a process where Legionella activity is greatly increased by interaction with other organisms in the cooling tower water.
   a. Blown in dust can provide nutrients that promote the growth of bacteria. This dirt and debris should be removed frequently by manual cleaning or continuously with side stream filtration.
   b. Total Bacteria Count (TBC) (planktonic bacteria), as measured by Heterotrophic Plate Count performed by a certified laboratory is the best measure of biological activity. Counts less than 10,000 CFU/ml are considered satisfactory. Sampling and measuring the TBC should be done monthly, or more frequently, if the conditions warrant it (See Table 1).
   c. Absence of a slime layer that can be felt or is visible upon inspection is good evidence of a clean, biologically inactive tower.
5. If at any time there is the possibility of actual cases of Legionella, follow approved Government guidelines for Legionella sampling, testing and tower disinfection.

LEGIONELLA DISCLAIMER

Griswold Filtration cannot, through the use of this product or any other means, eliminate the presence of Legionella in water systems or control the potential risk factors for human infection. Because these risks are ever present and beyond our control, Griswold Filtration disclaims any responsibility for damages resulting from the presence of Legionella bacteria in a water system.

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AUTOMATIC BLOWDOWN CONTROL

Griswold Filtration requires all SBC installations be equipped with automatic blow down control based upon conductivity measurement.

REFER TO TABLE 1: SBC COOLING TOWER MAINTENANCE SCHEDULE FOR SUGGESTED TESTING FREQUENCY.

KEY MEASUREMENT PARAMETERS

The water in a cooling tower or evaporative condenser needs to have the following parameters measured on a regular basis (Refer to Table 1) to assure proper performance: pH, Conductivity (to check status of the blow down controller), Chloride (for Cycles of Concentration calculation), and Total Bacteria Count (should be less than 10,000 CFU/ml). To provide the benefits of non-chemical treatment, the SBC needs to be operated in water that will precipitate calcium carbonate (water softeners should not be used). Griswold Filtration will assist by providing the appropriate initial blowdown settings based on water chemistry derived from the "pre start-up water test" of the makeup water.

CONTROLLING SYSTEM pH

If the pH of the tower is too low then raise the blowdown set point. On the other hand, if the tower pH is too high, then blowdown needs to be increased by lowering the blowdown set point. The factory can provide the recommended pH range for the specific tower being used.

SYSTEM MONITORING

Although the SBC system is very forgiving of neglect, in order to protect your equipment from possible damage, you must do regular water tests. For cooling towers, conductivity and pH need to be checked at least on a weekly basis. It is essential that the calibration and proper operation of the automatic blowdown be checked and calibrated, if needed each week. The Total Bacteria Count and chloride tests are required on a monthly basis. If a local laboratory is unavailable, Griswold Filtration will advise on the required test kits needed (See Table 1).

REMEMBER – WATER TREATMENT ONLY OCCURS WHEN WATER FLOWS THROUGH THE SBC REACTION CHAMBER.

COOLING TOWER LONG TERM LAY-UP

WINTER ISSUES

Each plant will have its own specific requirements for winter cooling. Some will simply drain the system. Others will keep the system on wet standby. Still others might use "Free Cooling" with, or without, circulating water through the tower. No matter what plan for winter operation is used, the operator needs to be aware of the potential problems that can occur due to inadequate preparation.

DRY LAY-UP

Follow the cooling tower manufacturer's procedures for "dry lay-up". Since there will be no water in the system, there is no requirement for water treatment. In this situation the SBC should be de-energized and the conductivity probe needs to be removed and cleaned per the manufacturer's recommendations.

A drained system with iron pipe will sometimes exhibit a condition called "iron throw" when started up. As the pipe dries out, the normal thin iron oxide layer becomes brittle. When the system is filled and started up the flakes of rust can dislodge from the pipe, blocking filters and plugging holes in the hot deck of the cooling tower. This problem will rapidly clear up with operation and is generally more of a nuisance than a corrosion problem. Still, care must be taken to clean all strainers and remove and large flakes that obstruct the drain holes in the hot deck until the system has been flushed out.

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WET LAY-UP

Follow the cooling tower manufacturers procedures for “Wet Lay Up”. If not done properly, wet lay-up can suffer problems with corrosion, microbial growth, and particulate fouling. Water circulation through the entire system, including any standby chillers, plate and frame heat exchangers and the SBC must be accomplished for 5 - 15 minutes every 0ne to three days (depending on water quality). The circulation rate need must be enough to provide a minimum of 2 feet per second flow through the chiller tubes.

NO WATER FLOW THROUGH THE SBC = NO WATER TREATMENT.

WET LAY-UP CONDUCTIVITY ISSUES

During wet lay-up, the water must remain above the calcium carbonate saturation point (PSI of 6.2 or lower) to provide proper corrosion protection. If your system includes filtration with automatic timer-based purge cycles, the timers will need to be reset to prevent the conductivity from dropping too low. Also, if leaks or maintenance requires water to be lost and replaced with fresh water, the conductivity might drop. If the conductivity goes below saturation, the following action should be taken:

- Operate the system under load until the water can be cycled up to the proper conductivity level.
- If operating the system pumps is unacceptable due to electrical cost, etc, then one should add traditional chemical corrosion inhibitors and biocides to protect the system.

Note that any continued uncontrolled water losses may affect corrosion protection.

SHORT TERM TOWER AND AUXILIARY EQUIPMENT LAY-UP

Many chiller plants will have redundant towers and chillers that need to be able to be switched online quickly to provide additional cooling capacity during hot weather. The difficulty with this arrangement is that during the times of no water flow there is no active SBC water treatment occurring.

REQUIRED WATER CIRCULATION

The SBC prevents scale by producing microscopic seed crystals. The salts with inverse solubility, such as calcium carbonate, will cause the seed crystals to preferentially grow in the hot chiller tubes instead of laying down a scale deposit. To prevent settling of mud, silt and seed crystals in the chiller tubes where they can fuse together, a flow of at least 2 feet per second needs to be maintained through the tubes at all times.

RESIDUAL EFFECTS

There are measurable residual effects with the SBC treated water that will last for a number of hours after the water has been treated (the exact time limit has not been determined). Shutting the system off for a few hours will not be harmful. The problems with shutdown do not arise unless the time of no flow is extended to several days.

GENERAL GUIDELINES FOR SHUTTING DOWN AND STARTING

1. When shutting down equipment be sure to leave the system water flowing long enough to allow the chiller to completely cool down. This might not be an automatic function of the chiller controller, but it is essential in order to keep a clean system. Allowing the chiller to completely cool down will help stop continued growth of seed crystals that have settled in the tubes and prevent formation of scale deposits.
2. When starting up equipment, be sure to start water flow first to allow fresh water to sweep out any seed crystals, mud or other debris from the chiller tubes before heat is applied. The equipment safety interlocks will usually require water to be circulating. We wish to see that the delay in starting is long enough to allow freshly treated water to travel to the

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chiller before it is started. This will prevent the possible fusing of deposits in the tubes before they are completely flushed out.

ALTERNATING EQUIPMENT AND WEEKEND SHUTDOWNS

- **0 – 3 days:** No additional actions required.
- **4 – 30 days:** Do one of the following:
    - Initiate water circulation with SBC treated water for 5 - 15 minutes every one to three days (depending on water quality). Water flow must have a minimum of 2 feet per second velocity through the tubes. Failure to circulate water frequently enough can result in the formation of biofilm and higher than normal corrosion rates.
    - Drain the stagnant system and leave empty (the use of an appropriate corrosion inhibitor might be necessary, see equipment manufacturers instructions for dry lay-up).
    - Locally add small amounts of chemicals to inhibit corrosion and biofilm production to laid-up equipment.
- **31 days or more:** Follow the long term lay-up procedures outlined in the SBC IOM or suggested by the equipment manufacturer.

NOTE:
Alternate procedures may be required if evidence of significant corrosion, scale formation, or biofilm formation are noted.

STAGNATE WATER ISSUES

STANDBY CHILLERS CAN SUFFER FROM STAGNATE WATER IF THEY DO NOT HAVE WATER CIRCULATED THROUGH THEM ON A REGULAR BASIS.

When the water is not circulated through the entire system, several problems can result. These problems include localized corrosion, biofilm and scale formation.
Differential oxygen cell corrosion results when the water becomes stagnant. The dissolved oxygen levels throughout the system are no longer uniform due to non-circulation of the water.

No water flowing through the SBC equals no water treatment; therefore, large masses of biofilm can form. This can cause operational problems by clogging strainers when water circulation is restored.

Scaling can occur on the ends of the copper tubes in a chiller or heat exchanger if there is no water circulation for long periods of time. This scale will tend to reduce when normal operations are restored.

If proper care is not taken to prevent stagnant water in the chiller, it will be normal to see localized corrosion “carbuncles” and thin scale on the inside of the head and on the tube sheet.

CIRCULATION RECOMMENDED TO PREVENT STAGNATE WATER PROBLEMS

The best practice would be to circulate the water through the entire system, including any standby chillers, plate and frame heat exchangers and the SBC units at intervals that will maintain proper water quality.

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CHAPTER 6: ROUTINE MAINTENANCE

WARNING – ELECTRIC SHOCK HAZARD

Power to the SBC must be disconnected or unplugged before opening the Driver panel door, performing any maintenance, or cleaning the cables and connectors for the SBC Reaction Chamber.

The SBC System does not require routine maintenance other than occasional inspection of the Reaction Chamber Cable and Power Cord. There are no ventilation openings to be cleaned or filters to replace with this system.

INSPECTION PROCEDURES

1. Inspect the Power Cable for visible damage that might affect the SBC safety and operation. Make certain that there are no cuts on the insulation or exposed wires.
2. Inspect the SBC Signal Cable for visible damage that might affect the SBC safety and operation. Make certain that there are no cuts on the insulation or exposed wires.
3. Inspect the SBC Signal Cable connector at the Reaction Chamber Pigtail unit for tightness of connection.
4. Inspect the Driver Panel to ensure that it is firmly secured to its mountings.

CLEANING

The SBC normally does not require cleaning. If the outer surface of the Driver Panel or Reaction Chamber is dirty and requires cleaning, then clean the outside with a mild detergent and wipe dry with a Soft Cloth.

The Driver enclosure is NEMA 4 (weather tight), but care should be exercised when using high-pressure water spray. The use of solvents and harsh cleansers should be avoided.

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TABLE 1: SBC COOLING TOWER OPERATOR MAINTENANCE SCHEDULE

ACTION	PERSON RESPONSIBLE	DATE	
SBC EQUIPMENT			
Check LED indicators to ensure that the system is on and operating properly.			Daily
Visually inspect all wetted tower components for mineral deposit, algae, corrosion, discoloration of water, or odors associated with biological contamination.			Weekly
BLOWDOWN SYSTEM			
Check water in system for "set" conductivity. Calibrate conductivity probe			Weekly or as required by manufacturer
Check automatic blowdown system to make sure it is operative.			Weekly
Clean all sensor and probes associated with the automatic blowdown system			As Directed
GOOD GENERAL PRACTICES			
Inspect tower for dead insects, animals or debris that promotes bacteria growth.			Weekly
Inspect tower hot deck or condenser spray heads for blockage.			Monthly
Flush basin and dispersion pan of debris.			Quarterly
Clean entire system.			Annually
Inspect and clean protective finish of the tower. Paint if necessary with appropriate rust-inhibiting paint per manufacturer's instructions.			
After extended shutdown periods, clean all debris from the system, including: tower, pan, system piping, heat exchanger, and remote sump holding tanks. Drain systems and refill with fresh clean water.			Extended Shut Downs
REQUIRED ANALYSIS			
Conductivity of Makeup and Tower Water (verify reading on Conductivity Controller)			Weekly
pH of Tower Water			
Chloride of Makeup and Tower Water			Monthly
TBC			

If you need help obtaining water testing kits please contact:
Griswold Filtration at (951) 270-1776

CHAPTER 7: GLOSSARY OF TERMS

ASTM: American Society for Testing Materials. Formulate standard procedures for sampling and evaluation purposes.

Blowdown: The removal of concentrated water for the purpose of controlling the total solids concentration in the recirculating water.

Calcite: A naturally occurring form of calcium carbonate (CaCO3). It is the mineral normally found in hard surface scale found in water systems. In crystalline form, calcite can also include limestone, chalk, and marble.

CFU/ml: Colony-forming units per milliliter. The normal unit used to measure total bacterial count (TBC).

Calcium carbonate: A compound (CaCO3) found in nature as the minerals calcite and aragonite; commonly found in water, plant ashes, bones, and shells.

Conductivity: The transfer of thermal or electrical energy along a potential gradient. This principle is used to estimate the quantity of ions in a water sample (the more ions present, the better the water sample will conduct electricity). Conductivity is measured in units of micro-Siemens per centimeter (µS/cm) or the equivalent micro-mho per centimeter (µmho/cm).

Cooling tower: A structure used to cool water by exposing it to ambient air. Typically, water enters the top of the tower and flows over a series of cascading plates or screens while air is drawn through the structure with fans.

Cycles of concentration (COC): COC is defined as the ratio of the volume of makeup water to the volume of water removed by blowdown and drift [Makeup / (Blowdown + Drift)]. Since all soluble minerals in the makeup water will be in the blowdown water, an accurate way to measure COC is by the ratio of such a mineral in the blowdown to the same mineral in the makeup. Typically, Chloride ion concentration is used for COC calculations [ppm Chloride tower / ppm Chloride makeup]. Conductivity ratios are often used as a quick-and-easy method to measure blowdown efficiency. This method is NOT appropriate with the SBC since a portion of the Calcium Carbonate crystallizes, lowering the concentration of ions in solution (and lowering conductivity). Looking at the ratio of soluble ions such as chloride or sulfate is a better method for determining COC.

De-ionized water: It is water that is free of positively or negatively charge atoms.

Drift: Cooling tower water that is carried out with the airflow. This water contains all of the chemicals and minerals in the tower water.

Hard water: Hard water is water that contains scale-forming impurities. The magnitude of water hardness is dependent on the concentration of dissolved calcium and/or magnesium compounds.

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HPC: The Heterotrophic Plate Count. (HPC) is an EPA-approved method (SMEVWV 9215B) for measuring Total Bacteria Count (TBC).

Ion: An atom or group of atoms that carries a positive or negative charge as the result of having lost (positive charge) or gained (negative charge) one or more electrons.

Legionella: A waterborne bacteria that can cause a type of pneumonia by infection if inhaled into the lungs.

Makeup water: Water that must be added to the system to replace water which has evaporated, gone to drain, lost, etc.

mg/L: Milligrams per litter (see ppm)

MIC: Microbial-influenced corrosion.

Microbe: A microorganism or germ.

pH: A scale whose values range from 0 to 14, with 7 representing neutral, numbers less than 7 increasing acidity, and numbers greater than 7 increasing alkalinity.

PID: Precipitation Induction Device. A PID is a broad classification of water-treatment methods under which the SBC is included.

ppm: Parts per million is used as a volumetric measurement of very small quantities. The common unit of milligrams per liter (mg/L) is equivalent to ppm.

Precipitate: A solid substance separated from a solution or suspension by chemical or physical change.

PVC: Polyvinyl chloride; used for plastic pipe.

Scale: Solid deposits on heat transfer surfaces caused by impurities in hard water.

TBC: Total bacteria count, typically measured in colony forming units per milliliter (CFU/ml).

TDS: Total dissolved is a water quality parameter defining the concentration of dissolved organic and inorganic chemicals in water. After suspended solids are filtered from water and water is evaporated, dissolved solids are the remaining residue. TDS is typically measured in parts per million (ppm).

NOTES:

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