

Original Instructions

Installation, Operation & Maintenance Manual

Sentry XC Boiler Blowdown System Heat Exchangers

S-SW-IOM-0243-3 8-16



COMPANY WITH
QUALITY SYSTEM
CERTIFIED BY DNV GL
= ISO 9001 =

 **SENTRY**

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Do not install, maintain, or operate this equipment without reading, understanding, and following the appropriate Sentry Equipment Corp instructions. Otherwise, injury, damage, or both may result.

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Note

The information contained in this document is subject to change without notice.

Safety Information

Please read the entire manual before attempting to unpack, set up, or operate this product. Pay careful attention to all Warnings, Cautions, and Notes. Failure to do so could result in serious personal injury and/or equipment damage.

Use of Hazard Information

If multiple hazards exist, the signal word corresponding to the greatest hazard shall be used.

Definitions

DANGER

DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

CAUTION, used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to personal injury.

NOTE

Information that requires special emphasis.

TIP

Alternate techniques or clarifying information.

SHALL: This word is understood to be mandatory.

SHOULD: This word is understood to be advisory.

General Safety Precautions

Product Selection, Installation, and Use

WARNING

Improper selection, installation, or use can cause personal injury or property damage. It is solely the responsibility of users, through their own analysis and testing, to select products suitable for their specific application requirements, ensure they are properly maintained, and limit their use to their intended purpose.

Follow proper local, state, and federal regulations for proper installation and operational requirements.

Always use caution and common sense when working with any chemical. Read the product label and Material Safety Data Sheets (MSDS) carefully and follow the instructions exactly.

Potential Equipment Hazards

WARNING

Hot surfaces! This equipment may have very hot surfaces. If an operator contacts a hot surface, injury may occur. Use protective clothing to prevent injury. If other equipment comes in contact with a hot surface, damage to the equipment may occur. Ensure the area around this equipment is kept clear to prevent this damage from occurring.

High pressures! This equipment may contain fluids at very high pressures. Prior to installing, removing, or maintaining this equipment, ensure that the equipment is isolated from all connecting piping, the equipment is depressurized, the contents have been drained, and the equipment is cool.

Installation

The Sentry® XC Boiler Blowdown System can be mounted any place convenient to the cold water make-up line, usually near the feed water heater or receiver. Locate the blowdown system so that the internal expansion tube assembly can be withdrawn from the handwheel end of the proportional control valve without breaking the make-up piping and so that the tube bundle of the exchanger can be removed. Be sure the handwheel and thermometer are conveniently placed. Install any separately packed piping manifolds, pressure gauges and the thermometer according to the diagrams.

Make-up Piping. Break into the make-up line and install two (2) tees with a valve between them. From these two (2) tees, install two (2) shut-off valves and then pipe the water to the top connection on the handwheel end and from the bottom connection on the other end back to the make-up line. The make-up connections can be bushed down, but not smaller than the main make-up piping.

Blowdown Piping. Use extra heavy pipe one size larger than the blowdown system. Connect to the continuous blowdown connection on boiler to the connection as indicated on the diagrams. Connect the blowdown outlet connection to an open sewer connection so that the blowdown may be observed. Do not place any valves in this line to the sewer.

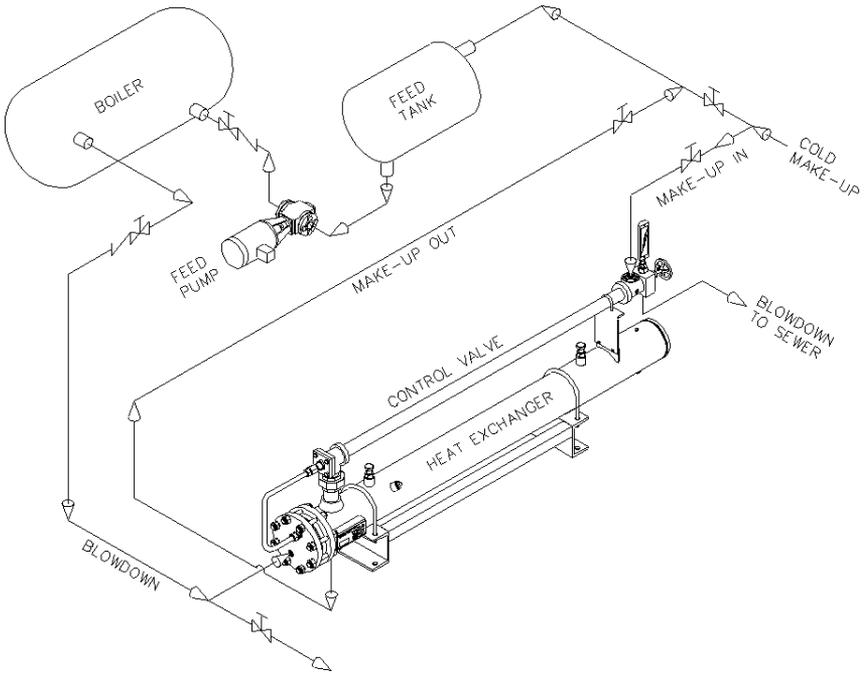
NOTICE

Do not install any flow regulating valves in blowdown line between the boiler and blowdown system. Installation of isolation valves is acceptable.

No Continuous Blowdown Connection on Boiler. Install an extra heavy coupling or use any existing connection so that it is on the opposite side or as far away from the feed water inlet as possible. The best elevation is 4" below the low water level. If in doubt ask the boiler manufacturer about the best location.

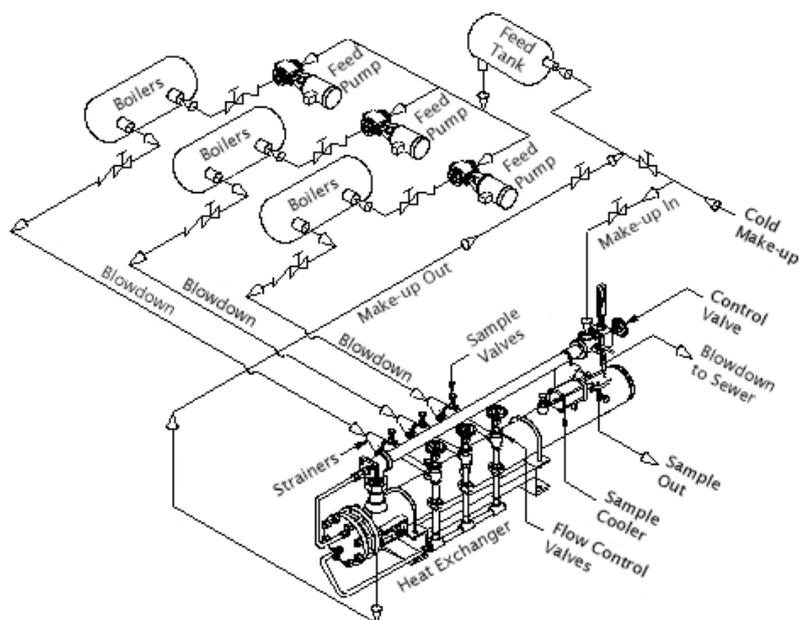
XC for Single Boilers. Note that all of the make-up is diverted through the shell of the blowdown unit. Be sure that the piping is large enough to handle the make-up water required. Place the discharge blowdown connection to the sewer so that it is easy to take a sample and easy to measure the rate of flow. This blowdown is cool. The unit is controlled by adjusting the handwheel and observing the thermometer, so see that they are conveniently placed.

Figure 1. Model No. X43-C through X89-CK



XCM for Multiple Boilers. These XCM's are the same as the XC Systems, except they are provided with a flow control valve manifold and a sample cooler. Each XCM should be associated with only one feed tank and its make-up line and all of the boilers connected to that feed tank. All of the boilers must operate at approximately the same pressure. Consult the factory for possible exceptions. From each boiler, connect a separate blowdown line to each strainer and flow control valve. The blowdown must enter the side of the flow control valve and discharge at the bottom. These flow control valves are intentionally installed backward for longer service.

Figure 2. Model No. X43-CM through X89-CKM



Operation

Models X43-C to X89-CK for Single Boilers

The level of dissolved solids or specific conductance should be adjusted to prevent foaming, priming, scaling, etc. Information can be obtained from your water treatment firm(s) on the required level to maintain and the preferred testing method. If you do not have the proper equipment to make these tests to determine the condition of your boiler water, we suggest that you purchase a portable conductivity meter to determine how much you should blow down. If your boiler tests too high, blowdown more. If it tests too low, reduce the amount of blowdown.

To adjust the amount of blowdown, open or close the handwheel on the thermometer end of the blowdown unit. Turning the handle slightly counter clockwise will increase blowdown as the valve opens; turning the handwheel clockwise will reduce the amount of blowdown. The thermometer in the control unit gives an indication as to the relative flows of the make-up and blowdown. It will aid you in adjusting the handwheel. If you need more blowdown, open the valve enough so the thermometer reads, say 5°F (3°C) higher in steady operation and vice-versa.

The step-by-step instructions for starting the blowdown unit are:

1. Open the two (2) customer supplied make-up water isolation valves to allow the make-up water to flow through the heat exchanger shell.
2. Close the customer supplied by-pass valve in the make-up water line to force all of the make-up water through the shell.
3. Open or close the handwheel on the control valve to adjust the temperature of the blowdown to approximately 27°F (15°C) above the make-up water for X4C units, 21°F (12°C) for X6C units, or 18°F (9°C) for X8C units. This temperature reading must be made when the unit has reached steady state. Check the concentration of the boiler water every few hours until a trend is noted upward or downward. If the trend is towards too high a concentration, open the handwheel slightly, $\frac{1}{8}$ to $\frac{1}{4}$ of a turn. You will note that the blowdown from the unit may flow heavily at times or not at all at other times. This is normal as this is the way the make-up flow is occurring. After several weeks of operation you will find a control point to maintain your boiler concentration and a simple daily check from then on should assure you of a properly blown down boiler.

Models X43-CM to X89-CKM for Multiple Boilers

The XCM's will be operated exactly as the XC's above, but in addition require the balancing of the flow control valves for the load being carried by each of the boilers.

Proceed with the start up of this unit exactly in the same manner as the single boiler units above with the Tasco Flocontrol Valves set in the half open position. The Tasco Flocontrol Valve openings must be set in accordance with the approximate load that each boiler is taking. This balancing should be done, however, so that the average valve openings are always one-half. If there are two valves and one is set at a $\frac{1}{4}$ opening, the other should

be set at $\frac{3}{4}$ opening. If there are three valves and one is set $\frac{1}{2}$ open and another $\frac{3}{4}$ open, the third one should be about $\frac{1}{4}$ open. After several days of operation you should be able to balance the boilers so that they all reach approximately the same test. Under known conditions, however, you will want to anticipate variations. For example, if a boiler is to be shut down for several days or months because it is not required, you can turn off the flow control valve from that boiler. Remember the automatic control should be adjusted to hold the average settings of the boilers in question and the hand flow control valve should balance according to the loads that the various boilers carry.

NOTE

XCM System will maintain consistent solids control for a boiler system having a make-up valve that closes and opens slowly as the water level rises and falls. A snap action valve should be avoided if possible – to avoid the possibility of having to frequently readjust the proportional control valve.

NOTICE

Avoid vibration, erosion and corrosion which are the typical causes of type XC System failures

Avoid Flash Steam In The Blowdown Water

Flash steam destroys the heat exchangers, valves and piping. Even a small amount of flash steam in the blowdown lines between the boiler and the XC will result in excessive water-steam velocities. For example, an 11 psig (0.7 bar-g) pressure loss in water at 138 psig (9.5 bar-g) and 360°F (182°C) will generate only 0.73% of flash steam. However, this small amount of steam will increase the velocity in the blowdown lines by 230%.

Excessive velocity destroys heat exchanger, valves and piping by causing:

- a. Erosion failure
- b. Vibration which fatigues and ultimately fractures exchanger bundles.
- c. Vibration which results in stress corrosion cracking of the exchanger bundles

Prevent flash steam in the blowdown line between boiler and XC System by:

- a. Using only wide-open gate or plug isolation valves between the boilers and the XC.
- b. Using extra heavy blowdown piping one size larger than the XC inlet connection.
- c. Set the flow control valves (for the multiple boiler XCM System) so that the average valve opening is always at one-half (see page two of SD 1730). Flow control valves set in this manner will not generate flash steam.
- d. Do not insulate the blowdown piping. A small amount of blowdown cooling is necessary to compensate for the line friction loss.

Avoid Excessive Tubeside and Shellside Water Velocities

To prevent damaging vibration and erosion, do not exceed the flow rates listed below.

Model	Max. Blowdown Flow Rate	Max. Make-up Water Flow Rate
X43	2 gpm (7.6 lpm)	48 gpm (182 lpm)
X46	4 gpm (15.1 lpm)	48 gpm (182 lpm)
X66	9 gpm (34.1 lpm)	130 gpm (492 lpm)
X69	14 gpm (53.0 lpm)	130 gpm (492 lpm)
X89	22 gpm (83.3 lpm)	180 gpm (681 lpm)

Do Not Allow Make-up Water to Be Heated Above 140°F to avoid:

- a. severe shellside scaling of the XC Heat Exchanger
- b. liberated dissolved gases which corrode and erode the exchanger, valves, piping and deaerator inlet.

Maintain and adjust the proportional control valve so it will properly proportion makeup to blowdown – to stop overheating of makeup. Replace damaged rubber diaphragms (of the proportional control valve) because undamaged diaphragms are essential for the proper operation of the proportional control valves.

Avoid Contaminating the Make-up with Chloride Ions from Water Treatment Systems

This can cause stress corrosion of stainless steel tubes in the XC Heat Exchanger.

Water treatment systems (Zeolite softeners and demineralizers) are regenerated with sodium chloride and hydrochloric acid. If not adequately back-washed before returning to service, these systems will heavily contaminate the make-up water with chloride ions. Chloride ions, together with the low pH water from the treatment systems may cause stress corrosion of the stainless steel tubing of the XC heat exchanger, resulting in premature failure.

The water treatment system operator should measure the output water (using conductivity meters, cells, etc.) to verify that a regenerated system is adequately back-washed before returning the water treatment system to service.

Maintenance

NOTICE

Properly maintain and adjust the proportional control valve so it will proportion makeup to blowdown – to stop overheating of make-up. Overheated make-up results in (a) severe shell-side scaling of the heat exchanger and proportional control valve and (b) liberated dissolved gasses that corrode and erode the exchanger, valves, piping and deaerator inlet.

A proper preventative maintenance program includes yearly overhauling and cleaning of the exchanger and proportional control valve. Failure to do so can result in scaling equipment beyond salvaging. Replacement of the diaphragm every two years or sooner as needed is recommended.

Disassembly and Reassembly

Close blowdown and makeup water valves before disassembly.

Proportional Control Valve

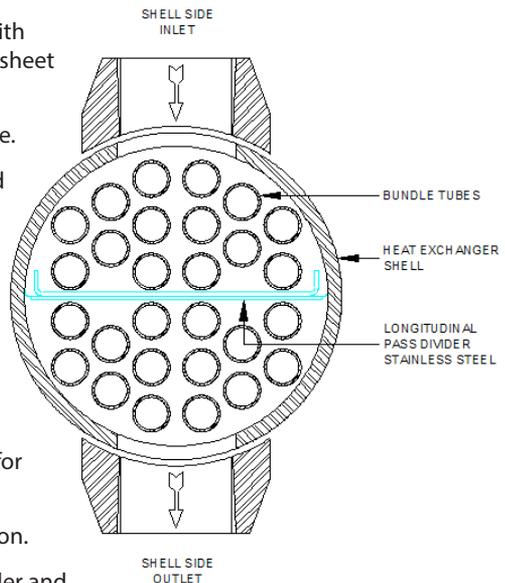
- Remove handwheel block bolts.
- Remove block assembly by separating it at the diaphragm.
- Remove valve plunger.
- Loosen diaphragm from the shell flange.
- Unscrew the valve seat from the expansion tube.
- Remove diaphragm.
- Break unions in blowdown inlet line and move piping out of the way.
- Unscrew pipe nut.
- Protect the threaded end (blowdown inlet) of the expansion tube with a wooden block.
- Loosen tube with light hammer blows.
- Remove tube toward the handwheel end of the the valve.
- After overhaul, reassemble in opposite manner.
- Properly align gaskets and diaphragm during reassembly.

Except for replacement of the diaphragm, the above procedure is not routine maintenance.

Heat Exchanger

Shellside scaling is typically the cause of any required maintenance. Descaling may be chemical and in-place by circulating inhibited acid through the shellside. Operator should contact a water treating chemical supplier for appropriate descaling procedures, agents and apparatus.

1. Disassemble the exchanger
 - a. Disconnect blowdown piping.
 - b. Remove head bolts, head, pass divider and their gaskets.
 - c. Back off the bundle antivibration hold down bolts on the shell. Pull out the tube bundle. Use a straight pull when removing the bundle – to avoid damaging the longitudinal pass dividers.
2. If the shellside is severely scaled:
 - a. Loosen the bundle free by prying with several bars inserted between tube sheet and shell flange.
 - b. Use a block and tackle to pull bundle.
 - c. Pre-soak the shellside with inhibited acid.
3. Reassemble in opposite fashion.
 - a. As the tube bundle is reinserted, position the seals (of the longitudinal pass divider) in the upward direction (toward shellside inlet) per diagram.
 - b. Typically, new gaskets are required for reassembly.
 - c. Torque bolts hand tight in star fashion.
 - d. Insure alignment of head, pass divider and shell flange and all gaskets.
 - e. Tighten again in star fashion.
 - f. Tighten head bolts first, then tighten bundle hold-down bolts $\frac{1}{4}$ turn past snug



Overhaul And Repair/General Cleaning

Normal cleaning includes removal of scale and rust from the proportional control valves and the exchangers. The tubesides (blowdown water side) typically do not collect scale or foreign matter. A fouled tubeside may be cleaned chemically (inhibited acid) or mechanically with manual or rotary bristle brushes (take care not to damage U bends), and with water flushing.

Shellside fouling may be removed chemically (inhibited acid) or mechanically (scraping, wire brushing, light sandblasting, etc.).

Do Not Descale With Muriatic Acid (Hydrochloric Acid)

This can cause stress corrosion of stainless shell tubes in the XC heat exchanger. Use an inhibited sulfamic acid boiler descalant (or similar product) in accordance with the manufacturer's recommended procedures.

Proportional Control Valves

- Replace worn or damaged rubber diaphragms (Undamaged diaphragms are essential for proper operation of proportional control valves).
- Reseat the valve as necessary by lapping with a coarse valve grinding compound and a clockwise – counterclockwise rotary motion.
- Replace worn or damaged flange gaskets.

Heat Exchangers

Make visual examination for suspected leaks in an assembled exchanger as follows:

1. Install a temporary ring flange in place of the head – so that tube ends are exposed
2. Pressurizing the shellside (max. 250 psig [17.3 bar] water or max. 50 psi [3.5 bar] air). If pressurizing with air, use a bubble leak detector solution to detect leaks.
3. Repair minor leaks by one or more of the following actions:
 - a. Rerolling leaking tube-to-tubesheet joints.
 - b. Welding holes in tubes and U bends with stainless steel filler rod.

Extensive damage may require returning the exchanger to the factory for repair

Other Valves – V-Port Flow Control, etc.

Contact valve manufacturer for instructions regarding cleaning, reseating and repair parts.

↻ NOTE

Flow control valves are intentionally installed backwards. This arrangement provides greater valve life and does not affect performance.

Parts List

Common Parts for C, CL CK, and CB Controls

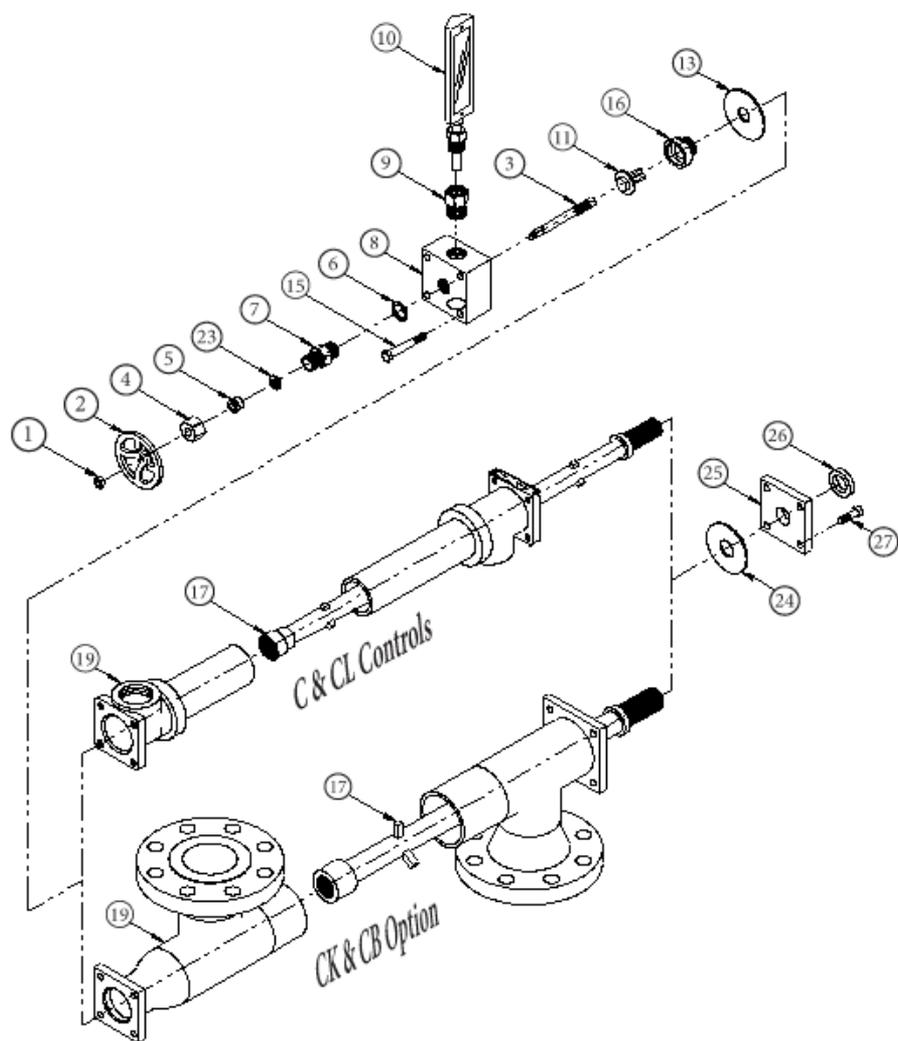
Item No.	Description	Part No.
1	Handwheel Jam nut	4-00404A
2	Handwheel	4-00403A
3	Stem	2-00356A
4	Packing Nut	2-00353A
5	Packing Gland	2-00354A
6*	Gasket, Front	2-00367A
7	Bonnet	2-00355A
9	Bushing – Thermometer	2-00357A
10	Thermometer	4-01097A
23	Packing: 1/8" Square Teflon Impregnated	1-00217B

Specific Parts for C, CL, CK and CB Controls

Item No.	Model	Description	Part No.
8	C, CL	Control Block Body	2-00407A
	CK		2-00409A
	CB		2-00408A
11	C, CL, CK CB	Valve Plunger	2-00380A
			2-00381A
13*	C, CL, CK CB	Diaphragm	2-00351A
			2-00352A
15 27	C, CL CK, CB	Bolts, standard hardware; purchase locally	4-01011V
			4-01011M
16	C, CL, CK CB	Valve Seat	2-00375A 2-00376A
17	Any	Expansion Tube Assembly <i>(Provide model and serial number from nameplate)</i>	
19	Any	Shell Assembly <i>(Provide model and serial number from nameplate)</i>	
24*	C, CL CK CB	Gasket, Rear	2-00612A
			2-00364A
			2-00657A
25	C, CL CK CB	Flange Plate	2-00410A
			2-00419A
			2-00412A
26	C, CL CK CB	Tube Lock Nut	4-01270A
			2-00384A
			2-00383A

* Recommended Spare Part

Figure 3. C, CL, CK and CB Controls



Heat Exchanger Parts

Model Numbers		X43 X46	X66 X69	X89
Diameter		4"	6"	8"
Item No.	Description	Part No.	Part No.	Part No.
1	Head	2-00294A	2-00295A	2-00297A
2*	Head Gasket	2-00277B	2-00278B	2-00280B
3	Pass Divider for Tube Side	2-00299A	2-00300A	2-00302A
4*	Tube Sheet Gasket	2-00286B	2-00287B	2-00288B
13*	Flange Gasket	2-00282B	2-00283B	2-00284B
17	Packing Gland	2-00274A	2-00274A	2-00274A
18	Jam Nut	4-01062A	4-01062A	4-01062A
19	Hold down/anchor bolt	4-01067C	4-01067C	4-01067C
20	Bolting SA193B7 or SA194 Gr. 7 type hardware or equivalent must be used. Purchase locally.			

* Recommended Spare Part

Heat Exchanger Model No.	Item 5: Tube Bundle Part No.	Item 16: Shell Part No.
X43	6-00093A	6-00084A
X46	6-00094A	6-00085A
X66	6-00095A	6-00086A
X69	6-00096A	6-00087A
X89	6-00099A	6-00650A

Figure 4. Type X Heat Exchanger

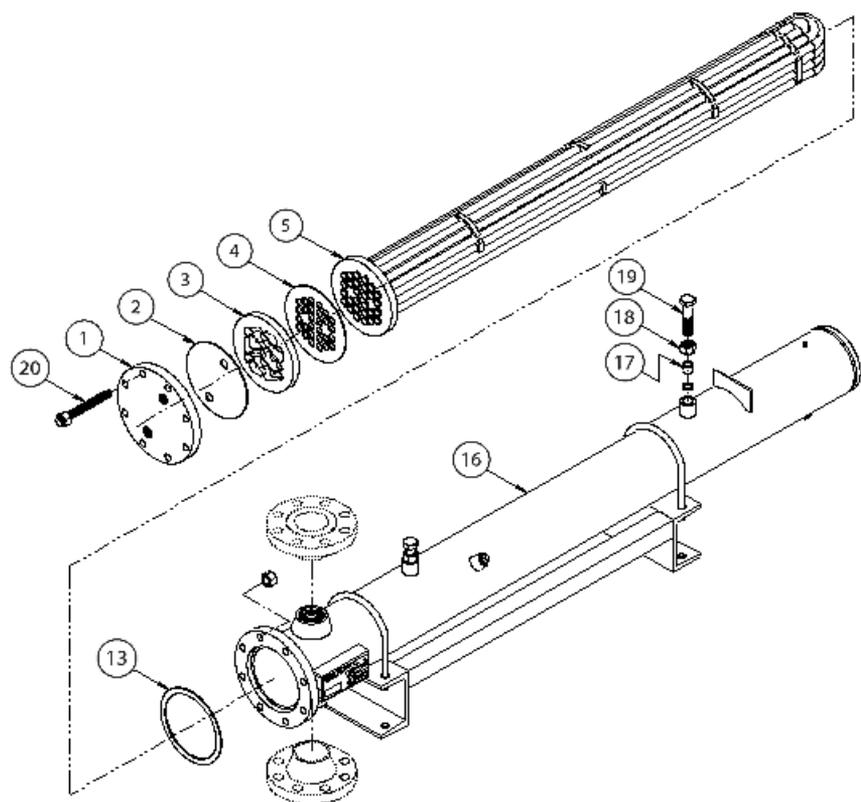
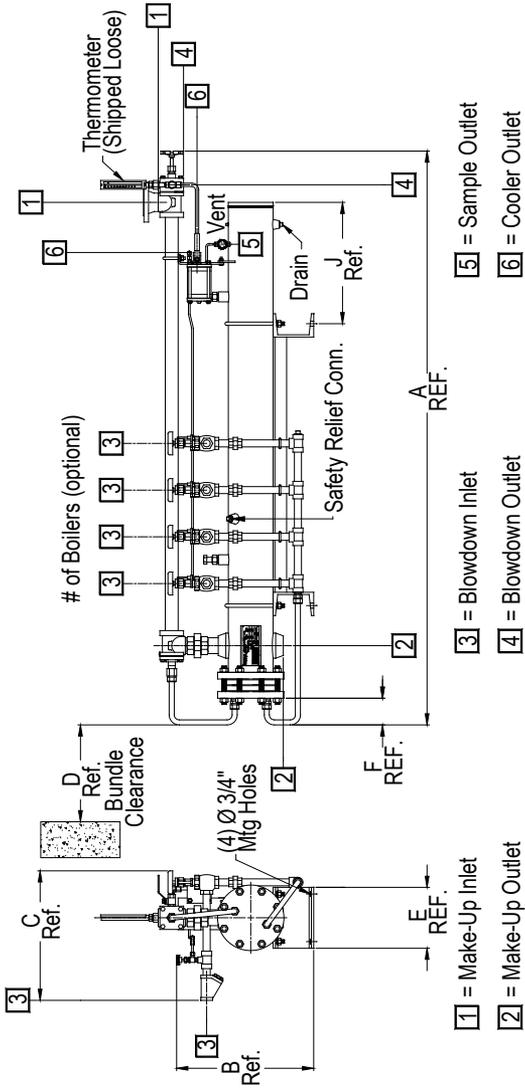


Figure 5.



Model	Max # of boilers	Dimensions - Tolerance is $\pm 1/2$ " except as noted										Connections - FPT					
		A	B	C	D	E	F	J	1	2	3	4	6				
X43-CM	3	53"	18.38"	18.5"	28"	7"	4"	9.31"	1 1/2	1 1/2	3/4	3/4	1/4				
		134.6cm	46.7cm	47cm	71.1cm	17.8cm	10.2cm	23.7cm									
X46-CM	4	80"	18.38"	18.5"	64"	7"	4"	23.31"	1 1/2	1 1/2	3/4	3/4	1/4				
		203.2cm	46.7cm	47cm	162.6cm	17.8cm	10.2cm	59.2cm									
X66-CLM	5	82.5"	20.38"	18.5"	64"	9.12"	4"	23.5"	2	2	3/4	3/4	1/4				
		209.5cm	51.8cm	47cm	162.6cm	23.2cm	10.2cm	59.7cm									
X69-CLM	5	125.5"	20.38"	18.5"	100"	9.12"	4"	33.5"	2	2	3/4	3/4	1/4				
		318.8cm	51.8cm	47cm	254cm	23.2cm	10.2cm	85.1cm									
X89-CKM	6	126"	24.38"	18.5"	100"	11.12"	4"	32.31"	3	3	3/4	1	1/4				
		320cm	61.9cm	47cm	254cm	28.2cm	10.2cm	82.1cm									

Standard Warranty

Sentry Equipment Corp (“Seller”) warrants products manufactured by it and supplied hereunder (“Products”) to be free from defects in workmanship and, to the extent materials are selected by Seller, to be free from defects in materials, in each case for a period as defined in the table below:

Brand	Product Line	Warranty Period
Sentry®	<ul style="list-style-type: none">▪ Steam & Water Sampling Products and Systems▪ Solid & Powder Sampling Products and Systems▪ Gas Sampling Products and Systems▪ Liquid & Slurry Sampling Products and Systems▪ Pipeline Integrity Products	Eighteen months from date of shipment or twelve months from startup (whichever occurs first)
Waters Equipment	Steam & Water Sampling Products and Systems	Twelve months from date of shipment

To view the full warranty, go to www.sentry-equip.com/warranty.

Customer Support

With proven sampling expertise since 1924, Sentry products and services provide business operations the critical insights to optimize process control and product quality. We deliver true representative sampling and analysis techniques to customers around the globe, empowering them to accurately monitor and measure processes for improved production efficiency, output, and safety. Standing behind our commitments, we are determined to tackle any application, anywhere.

We know that running an efficient operation isn’t easy. It requires thorough, careful analysis of controlled, real-time data achieved through reliable, accurate, and repeatable process monitoring and measuring. By effectively conditioning, sampling, and measuring gas, liquid, slurry, powder, solids, steam, or water within their production environments, our customers obtain the critical insights they need to control and optimize their processes.

Yet, controlling your processes also means reliable customer support throughout the life cycle of your equipment.

- Customer Service—General information, warranty claims, order management.
- Installation Service—For systems that require specialized expertise upon installation.
- Technical Support—Troubleshooting, training, and technical manuals.
- Field Service & Retrofits—When a problem needs immediate attention.
- Replacements Parts & Consumables—Order your replacement parts and consumables.
- Sentry ProShield Services—Select from four ProShield Guardian service plans providing different levels of support to protect your large system investments with regularly scheduled maintenance.

To learn more, go to www.sentry-equip.com/support.

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