



Sample Cooler

**Installation,
Operation,
and Maintenance**



750-286
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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 indicates a hazardous situation which, if not avoided, will result in death or serious injury.



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



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



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

NOTE: Information that requires special emphasis.

“SHALL”: This word is understood to be mandatory.

“SHOULD”: This word is understood to be advisory.

General Safety Precautions

Selection, Installation, and Use



Improper selection, installation, or use can cause personal injury or property damage. It is solely the responsibility of the user, through its 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 MSDS carefully and follow the instructions exactly.

Potential Equipment Hazards



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 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 de-pressurized, the contents have been drained, and the equipment is cool.

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



Freezing of fluids in either tube can lead to rupture of the tube wall and to coil failures. Take precautions to avoid freezing, such as draining the equipment when out of service or locating the equipment in an environment protected from temperatures below the freeze point of the fluids used.

1. General Description

A sample cooler is a small shell and coil heat exchanger. The sample to be cooled (or heated) flows through the tube side of the cooler. The cooling fluid, usually water, flows through the shell side of the cooler. A sample cooler is used to cool a sample from a process stream. Because the process stream is usually hot water or steam, sample coolers are used to cool the sample.

When high accuracy is desired, the sample must be cooled to exactly 77°F. The cooled sample is then taken to a laboratory for analysis or, in some cases, piped to in-line process instrumentation.

NOTE:

CB Sample Coolers are exempt from CE marking per Pressure Equipment Directive 97/23/EC. The vessels are below or equal to the limits set forth in Article 3, Sections 1.1, 1.2, 1.3, and section 2 as applicable, and are designed and manufactured in accordance with sound engineering practice. Specifically, the vessels meet the general requirements of the ASME Section VIII, Division 1 Boiler And Pressure Vessel Code. The nameplate will bear the name of Sentry Equipment Corp. and safety instructions will be included per Article 3, Section 3.

2. Installation



To ensure the safety of the operator and the optimal performance of this equipment, this equipment must not be installed or used in any manner other than that which is specified in this manual.

Prior to installing, removing or maintaining this equipment, ensure that the equipment is isolated from all connecting piping, the equipment is de-pressurized, the contents have been drained and the equipment is cool.

If cooling water valves are installed, a relief valve or 3-way valve must be provided (ref. Paragraph 5 below). Damage to the equipment may occur if a relief valve or 3-way valve is omitted.

1. Support the cooler by its bracket(s) (included with the cooler) using included nuts or by water lines only. Care should be taken to avoid any additional loading on either the tubes or the cooling water piping.
2. The cooling water should be softened and free of chlorides. Any hardness in the cooling water will result in scale build-up on the coil and a loss of heat transfer capacity. Chlorides can cause pitting or stress corrosion in stainless steel. If no source of acceptable cooling water is available, consult Sentry for a recommendation.

3. Provide a globe (not gate) valve in the cooling water outlet line for throttling purposes. Valve size must be the same as the cooling water outlet connection.
4. If isolation of the cooler is desired, provide a gate or ball valve (not globe) in the cooling water inlet line. Valve size must be the same as the cooling water inlet connection.
5. Install a relief valve in the cooling water line between the cooler and the outlet or the inlet valve. This protects against excessive shell side pressure in the event of (a) a leak in the high pressure tubing, or (b) an operator turning on the hot sample flow with both cooling water isolation valves closed, thus boiling the coolant and pressurizing the shell. As an option, a 3-way valve can be used on the inlet. It should be oriented so that the shell is open to drain when the cooling water is shut off.
6. A 90° bend or expansion loop must be provided in the hot sample line to the cooler. This allows the tubing to expand and contract with temperature changes without inducing stress at the point where the tube is welded to the cooler head.
7. Mount the cooler either vertically or horizontally (preferably vertical on high temperature lines).
8. Installation of a sample flow control valve in the sample line after the cooler is recommended. The valve should be a multi-turn type to allow for more precise flow control. The valve should be specified in accordance with the operating pressure and temperature of the sample.
9. Installation of a sample flow isolation valve in the sample line prior to the cooler is recommended. The valve should be specified in accordance with the operating pressure and temperature of the sample.



Table 1: Standard Sample Cooler Connections

Model	Sample Connections	Cooling Water Connections	
		Inlet	Outlet
SC-22	1/4" OD Tube	3/8" FNPT	3/8" FNPT
SC-42	1/4" OD Tube	3/4" FNPT	1/2" FNPT

3. Operation

Start-up and Operation

1. Fully open all cooling water valves before introducing sample to the cooler. Verify that minimum required cooling water flow is occurring. If cooling water is untreated, its temperature rise should not exceed 30°F (17°C) in order to minimize scaling. Be sure that the outlet temperature does not exceed 140°F (60°C).
2. When necessary, throttle cooling water flow by partially closing the globe valve on the cooling water outlet line. Any valve on the cooling water inlet line must always be fully open during operation.

NOTICE

Cooling water containing carbonates, rust, silt, organic matter or other contaminants can cause fouling, scaling and/or plugging and eventual failure of equipment.

Cavitation

NOTICE

Cavitation can cause damage and failure of equipment.

Cavitation results when localized boiling occurs on the surface of a coil. Vapor bubbles form on the coil surface and are swept into the main stream of the fluid where they immediately condense and collapse. Collapsing bubbles generate severe shock waves (i.e., vibrations) which can fatigue and ultimately fracture the tube(s).

Cavitation can be avoided by considering the following:

1. Cavitation is caused by:
 - a. Coolant flow rate is too low; fluid overheats to its boiling point.
 - b. Sample flow rate is too high; coolant overheats to its boiling point.
 - c. Coolant operating pressure is too low; fluid boils at a low temperature.
2. Cavitation can be prevented by:
 - a. Adjusting coolant and sample flow rates.
 - b. Increasing coolant pressure as high as possible — 50 psig (3 bar gauge pressure) minimum recommended for water.
3. If you hear vibration or rattling noises from the equipment, take corrective action immediately:
 - a. Coolant inlet valve is fully open.
 - b. Coolant flow is per design condition.
 - c. Coolant pressure is as high as possible.
 - d. Reduce sample flow rate.
 - e. Excessive coolant flow rate can cause vibration of the coil due the effects of vortex shedding, leading to coil failure. Reduce coolant flow rate to design condition. Coolant outlet temperature should not exceed 140°F. Reduce sample flow rate as necessary to achieve coolant flow and temperature limitations.
 - f. Coolant flow rate is throttled using the outlet valve only, not the inlet. This ensures that the coolant is at the higher pressure.

NOTICE

Incompatible fluid chemistry can cause corrosion and/or erosion and eventual failure of the equipment. Corrosion and failure can also occur when the equipment is installed in an adverse environment. It is the responsibility of the Purchaser or the Purchaser's Agent to ensure the materials of construction of the equipment are suitable for the fluid chemistry and environment where the equipment is to be used.

A source of corrosion to be considered in stainless steels is stress corrosion cracking. Stress corrosion cracking (SCC) in stainless steel is a complex phenomenon. If coolant being used is water, the limits noted below must be met to avoid premature tube failure. Adequate coolant flow combined with proper material selection (e.g., Inconel 625), will substantially extend the life of the sample cooler tube. Although material selection is critical, it may not eliminate problems.

Failure due to stress corrosion cracking can be minimized by:

1. Verifying the fluid chemistries and selecting the alternative materials of construction.
2. Reducing the operating temperatures by increasing the coolant flow rate.

Maximum Acceptable Chloride Levels in Cooling Water for 316 Stainless Steel (assuming low levels* of dissolved oxygen)	
Sample Temperature	Cooling Water Chloride Concentration
25 - 180°C	250 ppm
180 - 290°C	100 ppm
290 - 550°C	25 ppm

*approximately 0.1 ppm or below

4. Maintenance

Disassembly and Reassembly

1. For heavily scaled coolers, disassembly is made easier by first dissolving the scale. Remove scale by circulating an inhibited sulfamic acid cleaning solution through the cooling water side.
2. Replace used gaskets with new ones. After reassembly, pressurize shell and visually inspect for water leaks. Replace gaskets showing visible leaks. Keep spare shell gaskets on hand for this need.
3. During reassembly, tighten the bolts only enough so that shell side leaking does not occur. T Series coolers require approximately 35 ft-lbs torque. F Series coolers require approximately 45 ft-lbs torque. Over-tightening can cause gasket failure.



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