Original Instructions

Installation, Operation & Maintenance Manual

Sentry Single Helical Tube
Sample Coolers

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sentry-equip.com

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

SENTRY

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®	1. Automatic Sampling 2. Corrosion Monitoring 3. Manual Sampling 4. Sample Conditioning 5. Sampling & Analysis Systems 6. Replacement Parts (without expiration dates)	Eighteen months from date of shipment or twelve months from startup, whichever occurs first
Waters Equipment	1. Sampling & Analysis Systems 2. Replacement Parts (without expiration dates)	Twelve months from date of shipment

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

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.

Copyright

Limit of Liability

Sentry Equipment Corp, its employees, agents, and the authors and contributors to this document specifically disclaim all liabilities and warranties, express or implied (including warranties of merchantability and fitness for a particular purpose), for the accuracy, currency, completeness, and/or reliability of the information contained herein and/or for the fitness for any particular use and/or for the performance of any material and/or equipment selected in whole or part with the user of/or in reliance upon information contained herein. Selection of materials and/or equipment is at the sole risk of the user of this publication.

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.

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.

NOTICE

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

General Description

A Sentry® Single Helical Tube 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

Sentry Sample Coolers are exempt from CE marking per Pressure Equipment Directive 2014/68/EU. The vessels are below or equal to the limits set forth in Article 4, Sections 1(a), 1(b), 1(c), 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 4, Section 3.

Installation

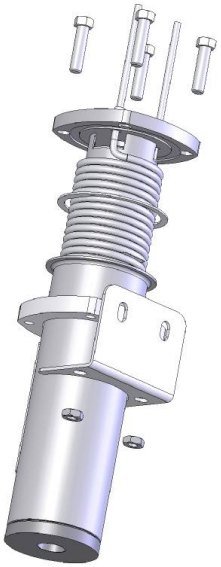
⚠ WARNING

To ensure the safety of the operator and the performance of this equipment is not impaired, 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.



Standard Sample Cooler Connections

Cooler Series	Sample Connections	Cooling Water Connections	
		Inlet	Outlet
TRB	1/4" OD Tube	3/8" FNPT	3/8" FNPT
TRW	1/4" OD Tube	3/8" FNPT	3/8" FNPT
TSR/TLR	1/4" OD Tube	3/4" FNPT	1/2" FNPT
FSR/FLR	3/8" OD Tube	3/4" FNPT	3/4" FNPT
FXR	3/8" OD Tube	3/4" FNPT	3/4" FNPT
WSW	1/2" OD Tube	1" FNPT	1" FNPT

Contact Sentry Equipment for connection information for non-standard coolers.

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 barg) 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.

Chloride Pitting Corrosion and Stress Corrosion Cracking

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 environment incompatible with the materials of the equipment. 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 chloride pitting or stress corrosion cracking. This mode of failure in stainless steel is a complex phenomenon because it is proportional to the concentration of chlorides, the sample temperature, dissolved oxygen concentration in the cooling water and, under some circumstances, the concentration of sulfates in the cooling water. Due to the unpredictable nature of failure, Sentry recommends the use of Inconel® (Alloy 625) sample tubing for the process tubing any time chlorides are present in the cooling water.

➲ NOTE

If chloride concentrations in the cooling water exceed 250 PPM, Sentry also recommends using Inconel® (Alloy 625) for the shell material.

Maintenance

Disassembly and Reassembly

➲ NOTE:

These instructions do not apply to the Sentry TRW cooler. The TRW cooler has a welded shell and cannot be disassembled for maintenance.

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.

Spare Parts List

Cooler Model	Qty Req'd	Gasket P/N*	Bracket P/N^
FR Series Coolers (FLR,FSR,FXR)	1	2-03800E	2-00165G
TR Series Coolers (TLR, TSR)	1	2-03800F	2-04297C
TRW Coolers	n/a	n/a	2-00164K bracket† 4-03543F clamp
TRB Coolers	2	2-00602B	Coolers with serial #'s 06700016A0279 and up use p/n 2-04297A. Serial #'s 06700016A0278 and down use p/n 2-04297B
TEB Coolers	2	2-00602B	Coolers with serial #'s 06700016B0031 and up use p/n 2-04297A. Serial #'s 06700016B0030 and down use p/n 2-04297B
TF, FF, TB, FB Series Coolers	Contact Sentry Equipment Corp Parts and Service Dept. for current options.		

* Gaskets are non-asbestos material.

^ Bracket quantity varies upon cooler set-up.

† When replacing a TRB cooler with a TRW-4222 on a Blowdown C-control assembly, use bracket part number 2-04297F in place of the bracket that comes with the cooler.

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.

APPENDIX A

Sample Cooler Troubleshooting

Objective
The checks below should help troubleshoot the cause of some common issues with coolers or connected components and restore proper operation of Sentry Single Helical Tube Sample Coolers.

⚠ WARNING

Before beginning work, identify isolation valves and other safety components within your specific system. Failure to do so can result in equipment damage and personnel injury.

Please reference Sentry components or sample system operation manuals for this information.

Check Points

1. Inspect sample cooler installation. This inspection should include:
    1. Cooling water headers and connections based on this IOM and the Sentry SWAS IOM
    2. Cooling water is within specifications for your specific design as supplied by Sentry Equipment. Key specifications are:
        a. Max and min flow rates
        b. Supply pressure
        c. Inlet temperatures
2. Hone in total sample flow. Sample flow should typically be around 800 ccm for steam samples and 1000-1200 cc/min for condensed liquid lines.
    1. If a sample line is routinely tripping a TSV (Thermal Shutoff Valve), this could indicate a loss of cooling water flow rate, a reduction in cooler performance, or excessive sample flow rate.
    2. Once a TSV trip is identified and resolved, the VREL/PCV-1 should be shut, the TSV reset and the VREL/PCV-1 adjusted. The VREL/PCV-1 should be then adjusted to return sample flow rate to normal operation in accordance with your system specifications.
3. Visually inspect the outside of the coolers for signs of excess heat and/or corrosion. This could include a browning label or excess build up on the connections. Hot spots can also be identified with the use of a thermal gun.
    1. If the shell of the cooler is discolored, the label is melted, there is evidence of a popping sound from the shell (see Cavitation section), or bubbles are seen in the cooling water sight gauge outlet (if applicable), the following issues could be occurring:
        a. Cooling water flow is too low
        b. Sample cooler is fouled or has scale build up inside
        c. Sample flow rate is beyond the capacity of the cooler
    2. To rectify excess heat, isolate the sample cooler from the sample and cooling water sides, drain and remove for inspection.
        a. If the issue is caused by cleanliness, clean the sample cooler as outlined in the guidelines of this IOM. Once cleaned and no tube leaks are observed, place back into service.
    3. External tube scaling can be rectified by following the cooler cleaning guidelines in this IOM.
    4. If issues can not be found visually, another sign of an internal tube failure is the loss of sample pressure into the cooling water. This results in higher coolant temperature across all samples on the same cooling header.
        a. If this is identified, the cooler should be isolated, drained, removed and pressure tested in accordance with Sentry document 18-04008B.
4. Cooling water velocities **SHOULD NOT** exceed recommended GPM specifications for your system design.
    1. Utilize cooler outlet valves to throttle cooling water flow to provide a bit of back pressure.
    2. If relief valves are present, make sure no cooling water is leaking to the relief header or drain.
5. Listen for any rattling within the cooler shell.
    1. If rattling is present, begin to throttle the outlet valves and monitor the sample temperature and flow. The sample temperature should not exceed 120° F (49° C) or the expected sample temperature on the cooler calculation sheet.

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