



Installation, Operation and Maintenance Manual NX Seal Cooler



1. INTRODUCTION

1.1 About this manual

This manual is intended to ensure a safe installation and operation of the NX seal cooler. All involved personnel shall be noticed of this instruction.

Note: Pressure equipment shall be operated with caution. Due to changed or unforeseen circumstances and conditions, dangerous/hazardous events can occur.

Before installation, the following shall be checked:

- Any possible damage due to transport or storage
- Cleanliness, required before operation
- Existence of the nameplate with correct inspection markings and design/test conditions

1.2 How to use this manual

Only trained and qualified personnel should use this manual. Refer to section 2.3. Inexperienced personnel should only work on this system under the supervision of a qualified person.

Before using this manual, make sure you have fully read and understood the safety section. If you are new to the system, pay particular attention to section 5, which describes the system in detail.

When maintaining the system, always make sure you follow the maintenance procedures. Pay particular attention to the alerts and icons.

1.3 Other supplied documentation

The Appendix contains the assembly drawings.



1.4 Conformity with standards and directives

The information in this manual conforms to the following standards and directives:

- PED 2014/68/EU

1.5 Use of alerts and icons

This manual uses “Notes”, “Cautions” and “Warnings” to alert you of important information and/or hazardous situations.

	<p>CAUTION The equipment, product or surrounding area can be damaged if the “caution” is not obeyed.</p>
	<p>WARNING Personnel can be (seriously) injured, or the equipment can be seriously damaged if the “warning” is not obeyed.</p>

The above icons are the general icons that are used for “Cautions” and “Warnings”. More specific icons are also used, depending on the type of hazard.

2. SAFETY


2.1 Hazards associated with the NX seal cooler

The following hazards can be present in the system:

- High pressure
- Dangerous chemicals
- Temperature (hot surfaces)
- Dangerous moving parts (during installation)

Notes:

- The cooler maximum surface temperature may comply with the ATEX temperature class when applicable.
- Supply of cooling water shall be guaranteed for heat removal of hot products.

	<p>WARNING HIGH PRESSURE: The cooling water line of the system is not protected against overpressure. If the return line is closed, a water line could burst.</p> <p>Make sure a pressure relief valve is installed in the cooling water line.</p>
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If the system has any external leaks, you must stop the system immediately and repair the leak.

2.2 General safety

When installing, operating and maintaining this system, pay particular attention to safety:

- Obey all applicable safety laws and regulations.
- Obey all plant regulations.
- Make sure that only trained and qualified personnel work on the system.
Refer to section 2.3.
- Read and understand each part of this manual.
- Follow the installation, operation and maintenance procedures exactly.
- Wear the relevant personal protective equipment (PPE). Refer to section 2.4.
- Never work alone if there is a possibility of an accident.
- Make sure that adequate safety equipment is installed in and around the work area: first-aid kits, safety showers (if applicable), fire extinguishers, escape routes, shutoff valves, etc.
- Make sure that personnel are fully trained on how to use the safety equipment.
A qualified first-aid specialist must always be available for each shift.
- Read the plant requirements for handling hazardous materials.

2.3 Trained and qualified personnel

Qualified personnel are people who have been authorized by those responsible for the safety of the plant to perform the necessary work, and who can recognize and avoid possible dangers. The following aspects determine the qualification of personnel:

- Appropriate training
- Relevant experience
- Knowledge of relevant standards and specifications
- Knowledge of accident prevention regulations
- Knowledge of plant regulations and operating conditions

2.4 Personal protective equipment


When operating or maintaining this system, make sure you wear the appropriate personal protective equipment: protective clothing, gloves, safety glasses, etc.



WARNING

HOT SURFACES: The system and surrounding surfaces might be hot. Take care when touching components. Wear the appropriate personnel protection equipment, according to plant regulations.


3. ENVIRONMENTAL CONSIDERATIONS

	<p>CAUTION You are required by law to dispose of waste products and end-of-life equipment, according to local regulations.</p>
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3.1 Disposing of waste products

Any waste products resulting from the use or maintenance of the system must be disposed of according to local environmental laws and regulations.

3.2 End-of-life equipment

	<p>WARNING DANGER CHEMICALS: Dangerous chemicals might be released during removal of the system. Wear personal protective equipment. Follow all safety and plant regulations.</p>
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	<p>WARNING HIGH PRESSURE: High pressure might be stored in the system. Before removing or re-installing the system, make sure the entire system has been de-pressurized (and drained if required).</p>
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Note: End-of-life equipment must be disposed of according to local environmental laws and regulations.

4. TRANSPORTATION AND STORAGE REQUIREMENTS

The following requirements apply to the NX seal cooler and all related equipment:

Transport and storage criteria	Requirements
Transportation	The system must be transported and stored in the unopened, original shipping box.
Suspect damaged during transportation	Systems that have been dropped, or have been subjected to heavy impacts, during transport must not be installed. An inspection in that case is strongly recommended.
Warehouse requirements	The warehouse must be dry and dust free. The system should not be exposed to: large temperature fluctuations, high humidity or radiation.
Long-term storage	After a storage period of one year, the system must be inspected for its “as new” properties.
Preserving installed systems	The preserving medium must not damage the installed system, for example, by fouling or attacking the components and mechanical seal. If you are not sure which preserving medium to use, contact Flowserve.

5. DESIGN OVERVIEW

5.1 Description

The Flowserve NX seal cooler is a shell and tube system used with single or dual mechanical seals. It utilizes a counter-flow pattern to enhance cooling efficiencies. The objective of the seal cooler is to lower the temperature of process or barrier fluid passing through the coil while cooling water passes through the case. It is designed for installations close to the seal where space is limited.

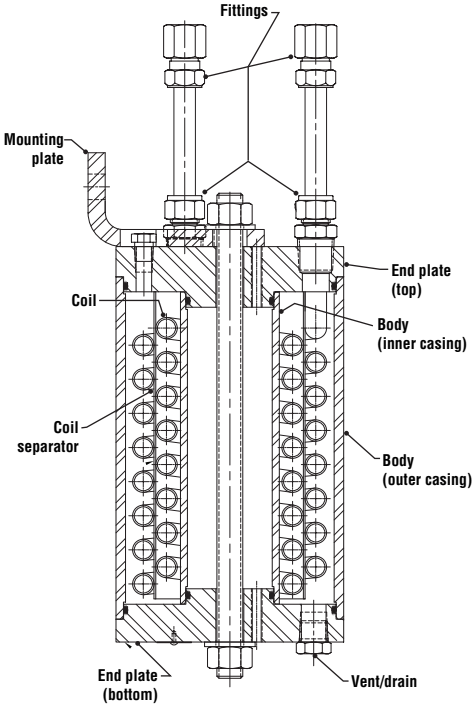


Figure 1: Vertical cross-sectional view

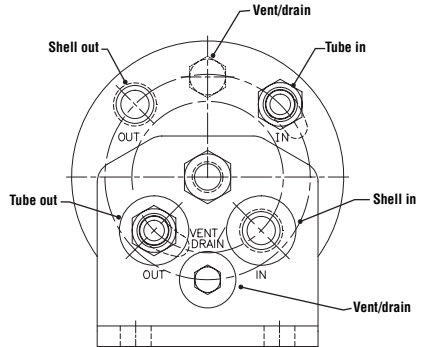


Figure 2: Top view

Note: The images of parts shown in these instructions may differ visually from the actual parts due to manufacturing processes that do not affect the part function or quality.

6. INSTALLATION

Before installing the system, inspect all components for damage. If any of the components are damaged, you should report this to your local Flowserve representative.

Position the NX seal cooler as close to the seal as possible. Make sure there is sufficient room for:

- Evacuation of the plant in case of an emergency (do not block walkways and emergency exits)
- Safe operation and maintenance of the system



WARNING

CRUSH HAZARD: Possible injury and/or trapped limbs. Take care to avoid being trapped or crushed between heavy moving objects.

6.1 Primary API piping plans

API Plan 21 provides cooling to the seal by flowing pump discharge fluid through a control orifice and into the seal cooler before entering the seal chamber. This piping plan is targeted for clean high-temperature fluids and hot water above 80°C (176°F) to improve vapor margins, meet secondary seal element temperature limits, reduce coking, and improve fluid lubricity.

API Plan 23 cools the seal chamber fluid by using a pumping device to circulate the seal chamber fluid through a seal cooler and back to the seal chamber. The circulated fluid is isolated from the pump impeller area by a throat bushing so that the seal cooler needs to cool only a small volume of fluid in the seal chamber heated by the seal faces and heat soak from the process side. This piping arrangement is the plan of choice for clean hot water services, particularly above 80°C (176°F) where water has low lubricity, and many clean hot hydrocarbons to improve vapor margins.

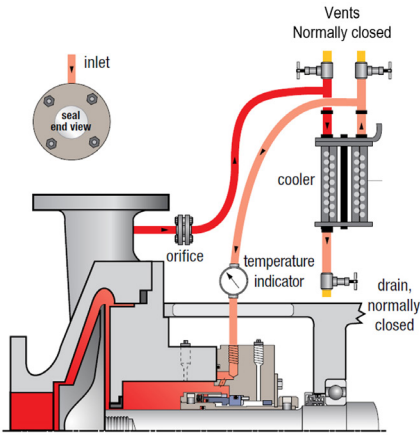


Figure 3: API Plan 21 configuration

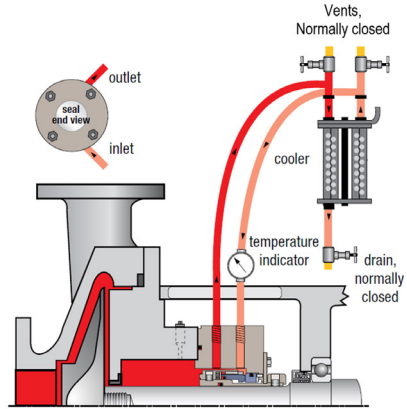


Figure 4: API Plan 23 configuration

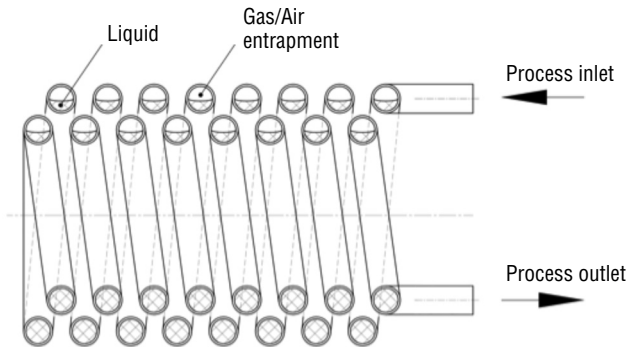
6.2 Mounting positions

The seal cooler can be mounted vertically or horizontally, and as close to the seal as possible. Vertical mounting is preferred for any closed loop system for venting purposes.

In a horizontal position, it is difficult to vent gas/air from a horizontal installation because the gas/air can become trapped within the upper turns of the cooling coil. A series of flush and bleed steps might be necessary in order to remove these trapped gases. See Figure 5 below.

The presence of trapped gas/air is more critical when using a Plan 23 seal flush or any closed loop system. Trapped gases that are entrained in the sealing fluid can collect in the seal cavity and thus impede flow to the seal cooler. This can ultimately cause the seal to overheat and fail due to a lack of lubrication.

It is strongly recommended that the seal cooler be mounted in a vertical position with process fluid connections on top whenever possible to ensure thorough venting and promote cooling efficiencies.



7. OPERATION

Only operate the NX cooler within the temperature and pressure limits shown on the assembly drawing.

When installing, ensure that the seal cooler, piping and vent locations provide complete venting of gas/air from both the coil and case systems. This requires the vents to be located at the highest point in each system.

Before startup, ensure that all piping is properly attached to the appropriate connections for both the coil and case systems to prevent fluid leaks and achieve expected cooler efficiencies.

Before startup, ensure that all the gas/air is vented from both the coil and shell systems to provide the system efficiencies expected and prevent a vapor lock condition.

At startup, ensure that the flush fluid flow and coolant fluid flow are set and stabilized at the prescribed flow rates determined for the application.

Do not allow the case system coolant fluid flow rate to be operated below minimum flow rates. Lower flow rates will encourage fouling, which reduces the seal cooler heat transfer capabilities. See table below for minimum required case side flow rate.

Cooler size	0.500	0.625	0.750
Minimum coolant flow	2.5 GPM (9.5 LPM)	3 GPM (11.4 LPM)	6.5 GPM (24.6 LPM)

Table 1: Minimum case side flow rate

Seal cooler performance should be monitored periodically. Baseline temperatures should be gathered soon after equipment commissioning. Target case side baseline temperature differential should be 11°C (20°F) or lower. Exceeding this differential temperature could result in a reduction of heat transfer and shell side fouling.

Note: For pressure and temperature limits, see the drawing included with the NX seal cooler.

Periodically, shell and tube side temperature differential should be monitored. With no change in process temperature and flow rate, coil side outlet temperature should not exceed 5.5°C to 11°C (10°F to 20°F) rise from baseline. With no change in cooling fluid temperature and flow rate, case side differential temperature should not vary significantly from baseline reading. A variation of 5.5°C to 11°C (10°F to 20°F) from the baseline indicates loss of heat transfer. Case side fouling could be a cause, and cooler cleaning should be considered.

8. MAINTENANCE

The NX seal cooler may only be disconnected by qualified personnel, in accordance with national regulations, the safety standards of the user, and in accordance with the user's operating procedures.

Before disconnecting the equipment, verify that:

- The equipment is at ambient temperature
- The equipment is not pressurized
- The equipment is drained

Process fluid may remain in tubes. Remove remaining fluid to adhere to site policy.



WARNING

DANGER CHEMICALS: Dangerous chemicals might be released during removal of the system. Wear personal protective equipment. Follow all safety and plant regulations.

- 8.1 Remove the seal cooler from service.
- 8.2 Remove all end fittings connected to the lengths of tubing protruding from the top of the cooler. Fitting ferrules and nuts cannot be removed from the primary lengths of protruding coil and should remain in place. Do not remove the fittings directly adjacent to the top end plate. Be sure to retain all fittings and mark them appropriately. This will minimize the likelihood of fitting leaks upon reassembly.
- 8.3 Remove the center bolt.
- 8.4 Carefully pry each end plate from the main cooler body. A $\frac{5}{16}$ in eyebolt can be inserted into each end plate to offer an adequate amount of leverage. Take care not to use too much force, which can result in coil stretch. The outer and inner cases can now be removed, which will expose the coiled tubing.
- 8.5 Clean the case and coils, taking care not to damage either.
- 8.6 Inspect all components for damage or corrosion and replace as needed. Secondary sealing components such as O-rings should always be replaced.
- 8.7 Reassemble the unit in reverse of disassembly. Center bolt torque required is 110 lbf-ft (149 N-m) for $\frac{3}{4}$ in bolt and 250 lbf-ft (338 N-m) for 1 in bolt. All fittings should be reassembled to the manufacturer's specifications.

8.8 Leak testing is recommended after assembly. Refer to end user specifications or procedures. Alternately, individual units can be returned to Flowserve for refurbishment and testing.

8.9 The inspection should include the following hold points as a minimum:

- Visual inspection of the interior and exterior of the system on corrosion, erosion, damages and cracking
- Random check of the wall thickness and verification against the design thickness
- Random checking of coating (when applicable)

Maintenance of the seal cooler shall be limited to touch-up of coating and cleaning methods that do not affect the mechanical integrity of the system.

Under no circumstances should the seal cooler be opened while it still contains any hazardous materials or when the internal pressure is above the local atmospheric pressure. Before opening the equipment, it must be brought to atmospheric pressure by venting it to a safe location.

9. APPENDIX

Cooler	Drawing Number	BOM
0.500 in standard	NX0500SA-STD	NX0500SA
0.625 in standard	NX0625SA-STD	NX0625SA
0.750 in standard	NX0750SA-STD	NX0750SA
0.750 in PED	NX0750SA-PED	NX0750SA-P



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