

Air Coolers

ANC Cooler Series

Finned Pipe Air Cooler Series

ANQ Cooler Series



Figure 1:
ANC cooler series



Figure 2:
ANQ cooler series

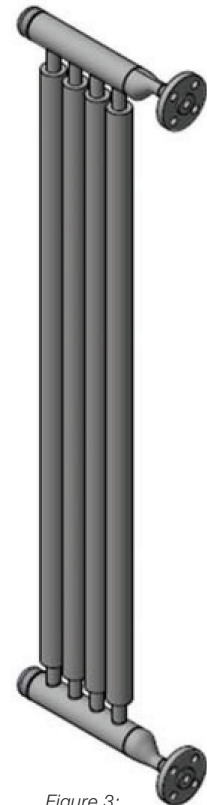


Figure 3:
Finned tube cooler series

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1. Introduction

1.1 About this manual

This manual (which is intended for operating, maintenance, and supervisory personnel) provides information on installing, operating, and maintaining the Air Coolers.

Installation in accordance with the following instructions will contribute to long and trouble-free operation of the assembly.

1.2. How to use this manual

Before using this manual, make sure you have fully read and understood the safety section, which can be found in chapter 2. If you are new to the Air Cooler, pay attention to section 4, which describes the Air Cooler in detail.

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 qualified personnel.

In this manual the term “main equipment” refers to the system that contains the medium that needs to be cooled. Typically, there is a mechanical seal in the closed loop.

When maintaining the Air Cooler, always make sure maintenance procedures are followed. Pay particular attention to the alerts and icons.

The Air Cooler may only be used for its main purposes as described in this manual. No adjustments can be made without the approval of Flowserve.

Changes, modifications, repairs or use under conditions deviating from the design specifications without prior permission of Flowserve will make the declaration of conformity and the nameplate invalid.

1.3. Other supplied Documents

The Appendix contains the assembly drawings.

1.4. Use of Alerts and Icons

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

Note: “Notes” inform you of important additional information.

CAUTION	
	The equipment, product or surrounding area can be damaged if the “caution” is not obeyed.

WARNING	
	Personnel can be (seriously) injured, or the equipment can be seriously damaged if the “warning” is not obeyed.

DANGER	
	Personnel can be (seriously) injured if the “danger” sign is not obeyed.

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

WARNING	
	HIGH PRESSURE: High pressure might be stored in the cooler. Before removing or re-installing the assembly, make sure the entire system has been de-pressurized (and drained if required).

2. Safety

2.1. Types of hazardous exposures

The following hazards can be present in Air Coolers:

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

If the Air Cooler has any external leaks, the process in which the Air Cooler is used should be stopped immediately and have the leak repaired by qualified personnel. When extreme conditions occur, and the possibility of a failure is imminent, plant-/end-user safety regulations shall be followed.

2.2. General Safety

When installing, operating and maintaining this Air Cooler, pay attention to safety:

- Obey all applicable safety laws and regulations.
- Obey all plant regulations.
- Make sure that only trained and qualified personnel work on it. 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.
- 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 (PPE)

The Air Cooler is often used for applications containing high pressure, high temperature and/or toxic chemicals. When performing operating or maintenance tasks, make sure you wear the appropriate Personal Protective Equipment (PPE): protective clothing, gloves, safety glasses, etc.

Always follow local regulations regarding PPE.

2.5. Actions in extreme conditions

In the unlikely event of emergency operating conditions always follow emergency plant regulations. Immediate evacuation of service personnel to be according plant regulations.

3. Environmental Considerations

CAUTION	
	You are required by law to dispose waste products and end of life equipment, according to local regulations.

3.1. Disposing of Waste Products

Make sure waste products are diverted to a safe and suitable location. Always follow local and plant regulations.

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

3.2. End of Life Equipment

WARNING	
	HAZARDOUS CHEMICALS: Dangerous chemical might be released during removal of the cooler. Wear Personal Protective Equipment (PPE). Follow all safety regulations and Plant regulations.

WARNING



HIGH PRESSURE: High pressure might be stored in the cooler. Before removing or re-installing the assembly, make sure the entire assembly has been de-pressurized (and drained if required).

WARNING



HOT SURFACES: The cooler and surrounding surfaces might be hot. Take care when touching components. Wear the appropriate Personal Protection Equipment (PPE), according to plant regulations.

The equipment must then be deinstalled and transported to a safe location. Always pay extra attention to safety!

Note: End of life equipment must be disposed of according to local environment laws and regulations.

4. Description

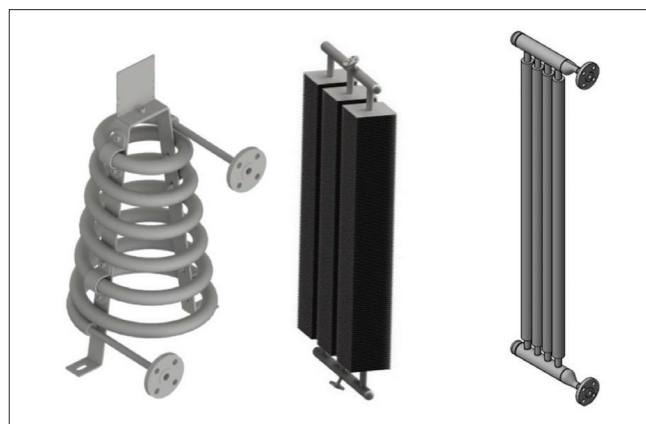


Figure 4: ANC Cooler Series, ANQ Cooler Series, and Finned Pipe Series

4.1. Product purpose

The Air Cooler is designed as natural convection seal cooler. These products are intended to cool fluids without the use of cooling water, where cooling water is not readily available. The Air Coolers are designed to comply with API 682.

The purpose of the Air Cooler is:

- To provide cooling for barrier fluid in a pressurized dual seal arrangement in an API Piping Plan 53A, 53B, 53C and 54
- To provide cooling for buffer fluid in an un-pressurized dual seal arrangement in an API Piping Plan 52
- To provide cooling for process or pumping fluid in a single or dual seal arrangement in an API piping Plan 21, 23, and 41
- To provide cooling for external flush fluid in an API piping Plan 32 seal arrangement.

4.2. Design Features

Operating conditions may vary, for example in a mechanical seal the seal chamber pressure and temperature limit the system. However, the operating conditions can never exceed design conditions. Refer to the general assembly drawing of the Air Cooler Series for design conditions and operating constraints.

4.2.1. Finned Pipe Series

- Meets API 682 4th edition design requirements
- For design specifics, refer to General Assembly drawing
- Tubing, piping, headers or flanges are made out of 316 Series Stainless Steel
- Fins are made out of Aluminum or 316 Series Stainless Steel
- Standard arrangement of 1 to 6 sections of finned pipes depending on heat removal requirements
- Standard lengths between the 1 and 2,5 meter of finned pipes sections depending on heat removal requirements and space restrictions

4.2.2. ANQ Series

- For design specifics, refer to General Assembly drawing
- Piping, headers and flanges are made out of 316 Series Stainless Steel
- Large sized aluminum rectangular shaped fin to maximize the efficiency of the cooling surface
- Standard arrangement of 1 to 3 sections of fins depending on heat removal requirements
- Mounting the ANQ fin cooler at a 27.5 degree tilt will maximized efficiency of radiant heat
- Constructed of 316L stainless steel piping
- When mounted vertically and tilted with high point vents and low point drains, will allow complete, drainage and Venting of fin piping fluids to prevent vapor lock conditions and ensure the highest efficiency

4.2.3. ANC Cooler Series

- Meets or exceeds API Standard 682 4th design requirements
- For design specifics, refer to General Assembly drawing

- Consists entirely of 316 Stainless Steel to provide superior corrosion resistance and suitability for marine environments
- Can be power cleaned without damaging the fins
- Allows complete draining and venting to prevent vapor lock conditions and allow user friendly change of fluid
- Different configurations available to provide the cooling characteristics needed
- Increased cooling capacity at wind still conditions due to its conical design
- Compact height, results in easily accessible drain and vent connections.
- Refer to the general assembly drawing of the ANC cooler series for design conditions and operating constraints.

4.3. Product Components

4.3.1. Finned Pipe Series

Finned Pipe Series are engineered cooler developed by Flowserve. For design specifics refer to the GA drawing. The parts and materials can deviate per design:

Number	Part	Function
1	Flange	Connection point to fluid line
2	Reducer	To enlarge the area from fluid line to the header
3	Header	Enlarge the fluid volume for better distribution over multiple finned pipes or finned tubes
4	Pipe or tube for fins	The part where the fluid is cooled
5	Elliptical head	End cap for header
6	Fins	Extended area for the pipe or tube to distribute heat too, for more contact area with the air for more efficient cooling

Table 1 – Finned Pipe Cooler Series Components

4.3.2. ANQ Series

ANQ Series is a standardized cooler with in which the following parts are included:

Number	Part	Function
1	Flange	Connection point to fluid line
2	Reducer	To enlarge the area from fluid line to the header
3	Header	Enlarge the fluid volume for better distribution over multiple finned pipes or finned tubes
4	Pipe for fins	The part where the fluid is cooled
5	Elliptical head	End cap for header
6	Fins	Extended area for the pipe to distribute heat too, for more efficient cooling

Table 2 – ANQ Cooler Series Components

4.3.3. ANC Series

The Product components of the ANC Series are:

Number	Part	Function
1	Flange	Connect to the closed loop.
2	Finned pipe ANC 6S Finned pipe ANC 12S Finned pipe ANC 12P	Exchange heat with environment.
3	Adapter manifold (for ANC 12P only)	Connection between Cooling and connecting parts of the Heat Exchanger.

Table 3 – ANC Cooler Series Components

4.4. The Operating Principle

4.4.1. Finned Pipe Series

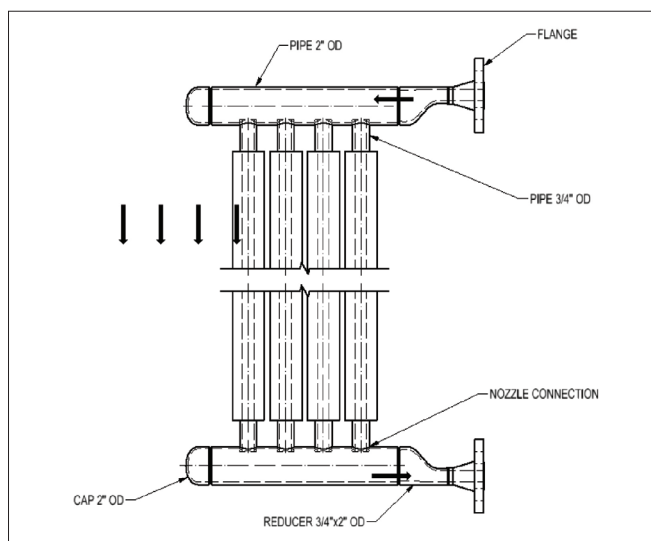


Figure 5: Mounting and connecting the Finned Pipe Series.

The fluid that requires cooling is flowing in the top of the Finned Pipe Series. From there it will be divided between the finned pipes and flows down. At the lowest point the fluid is cooled down.

4.4.2. ANQ Series

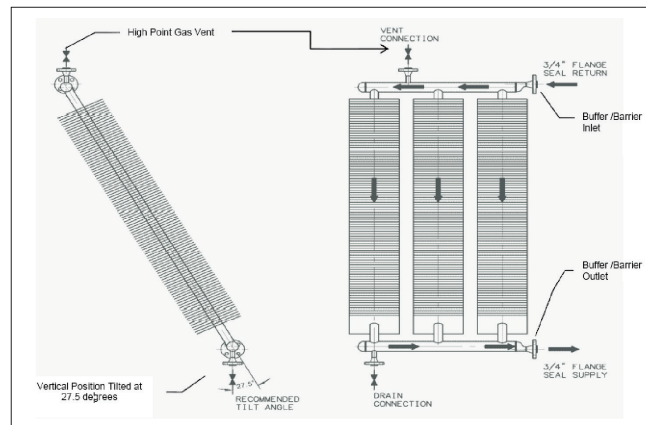
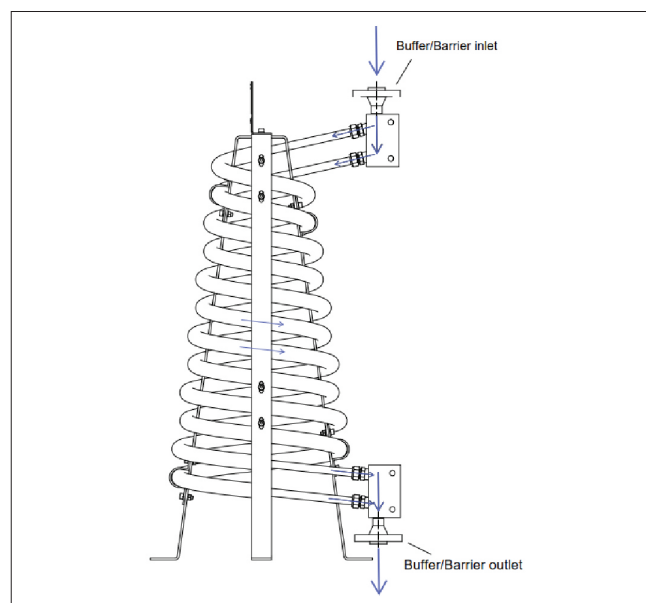


Figure 6: Mounting and connecting the ANQ Series.

The fluid that requires cooling is flowing in the top of the ANQ Series. From there it will be divided between the finned pipes and flows down. At the lowest point the fluid is cooled down.

4.4.3. ANC Series



The fluid that requires cooling flows in through the top of the ANC Cooler Series. From there the fluid flows down in a conical coil.

The process connection may be flanges, tube end or National Pipe Taper Female (NPTF).

4.5. Identifying the Product (Type Plate)

The nameplate is, as per Flowserve standard, shown on the general assembly drawing.

5. Preservation, Packing, Transport and Storage Requirements

5.1. Mechanical Preservation Instructions

5.1.1. Preservation

Equipment should not be sealed in a way that it will obstruct inspection. Access for normal inspection and preservation maintenance shall be provided. Internal surfaces of pressure vessels, piping systems and similar equipment shall be dried and cleaned of surface corrosion and foreign material.

All threaded openings shall be provided with steel caps or solid-shank steel plugs of metallurgy equal to the metallurgy of the component being capped or plugged. All open tube connections shall be capped.

Heat exchangers, piping and valves shall be thoroughly cleaned and dried after manufacturing and testing, prior to application of preservatives.

For equipment where water is used for cleaning or pressure testing, the water shall have antifreeze medium added unless the water is completely drained off. This also applies if the ambient temperature is below 4°C during any of these operations.

Internal surfaces wholly consisting of corrosion resistant materials shall not be preserved unless stated otherwise. All valves to be in closed position, except for ball valves which shall be in open position.

5.1.2. De-Preservation

For de-preservation the threaded opening caps and flange cover need to be removed prior to commissioning. During hook up it is mandatory to keep these covers/plugs in place for as long as possible to prevent contamination.

5.2. Packing

WARNING	
	CRUSH HAZARD: Possible injury and/or trapped limbs. Take care to avoid being trapped or crushed between heavy, moving objects when (un)boxing the cooler.

The Air Cooler is to be carefully lifted inside a timber box.

Always make sure that proper lifting devices are used.

To prevent damage during transport all equipment needs to be properly secured inside their timber

package with suitable bolting, straps, or wooden supports.

For unboxing, the equipment must be lifted carefully out of its shipping box.

5.3. Transportation and Storage Requirements

Note: The following requirements apply to the Air 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	Inspect coolers that have been dropped or have been subjected to impacts during transport to confirm that they are operational before installation.
Warehouse requirements	The warehouse must be dry and dust free.
Long-term storage	After a storage period of 2 years, inspect the Air Cooler before installation.
Preserving installed system	The preserving medium prevents damage to the installed system or mechanical seal (i.e. preventing fouling or chemical attack). Contact Flowserve if you are unsure which preserving medium to use.

Table 4 - Transport and Storage Criteria

6. Installation

6.1. Introduction

WARNING	
	CRUSH HAZARD: Possible injury and/or trapped limbs. Take care to avoid being trapped or crushed between heavy, moving objects when installing the coolers

Before installing the Air Cooler, make sure you have read and understood the installation requirements in this section. If you have any questions regarding the installation of the Air Cooler, contact your local Flowserve representative.

6.2. Safety Considerations

WARNING	
	CHECK BEFORE OPENING: Under no circumstances should the coolers be opened while it still contains any hazardous materials or when it is pressurized.

DANGER	
	SUFFOCATION HAZARD: Breathing hazardous chemicals in a confined space can result in sudden unconsciousness or death. Take extra care when working in confined areas.

Position the Air Cooler as close to your main equipment 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 If the Air Cooler is being installed in a confined area, make sure there is adequate ventilation. Adequate ventilation is required for:
- Safe venting of the Air Cooler
- Correct cooling of the fluid

6.3. Installation Requirements

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

6.4. Product Set-up

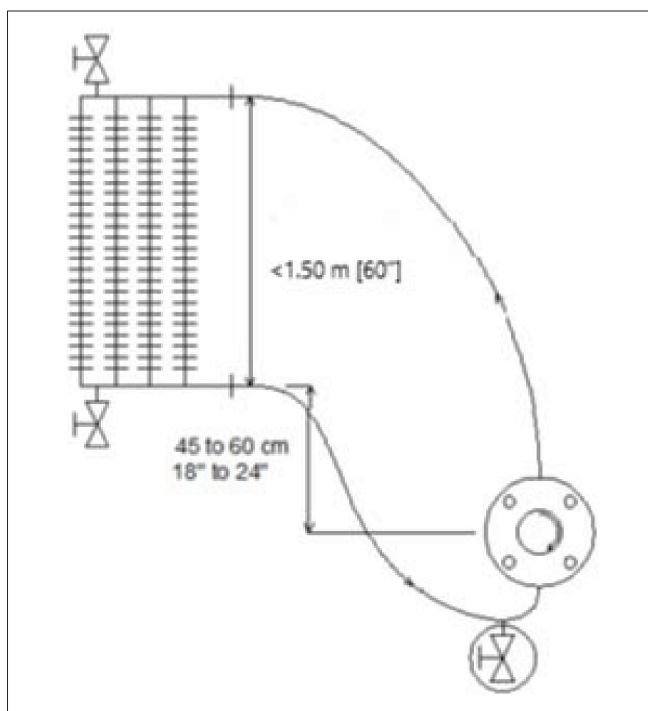


Figure 7: Set-up for Air Cooler with height < 1.5 meters

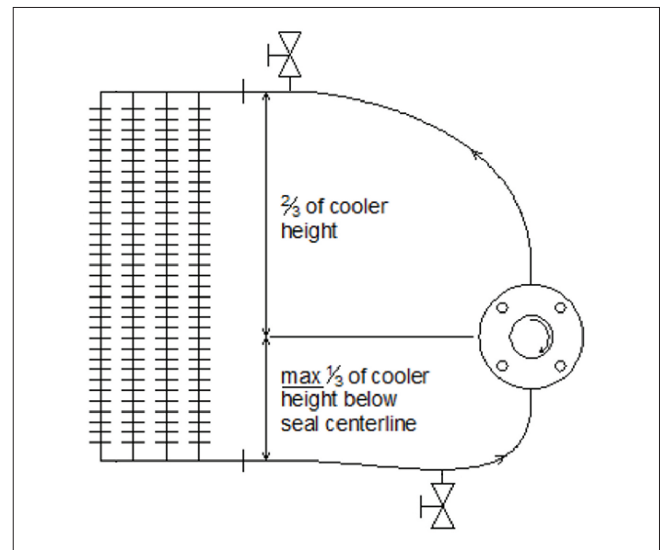


Figure 8: Set-up for Air Cooler with height ≥ 1.5 meters

6.4.1. Installation of air cooler

6.4.1.1. Finned Pipe Series

Installation Considerations:

- Ensure that the Air Cooler and loop can be completely vented. This is achieved by placing a vent location at the highest point in the loop.
- Ensure that all the gas/air is vented from the Air Cooler and the loop, so the fluid flow will be optimal as possible. This results in the most effective performance of the Air Cooler.
- Ensure that the Air Cooler and the loop can be completely drained.
- When the Air Cooler will be installed in a closed loop for cooling purposes, Flowserve recommends positioning the Air Cooler according section 6.4. This will promote thermosyphoning when main equipment is in hot stand-by.

6.4.1.2. ANQ Series

Follow Set-up procedure set in 6.4.1.1. Finned Pipe Series.

6.4.1.3. ANQ Series

Set-up procedure:

- Ensure that the Air Cooler and loop can be completely vented. This is achieved by placing a vent location at the highest point in the loop.
- Ensure that all the gas/air is vented from the Air Cooler and the loop, so the fluid flow will be optimal as possible. This results in the most effective performance of the Air Coolers.

- Ensure that the Air Cooler and the loop can be completely drained.
- When the Air Cooler will be installed in a closed loop for cooling purposes, Flowserve recommends positioning the Air Cooler according section 6.4 figure 8. This will promote thermosyphoning when main equipment is in hot stand-by.

6.4.2. Interconnected Piping

The flow of fluid through the Air Cooler is either generated by:

- a pumping device included in the seal design
- an externally circulating pump
- Thermosyphoning

The interconnecting piping between the Air Cooler and the main equipment must be correctly fitted; otherwise the flow of the fluid through the Air Cooler will be restricted and have a negative impact on the performance.

Pay attention to the following points:

- Minimize the number of restrictions (for example, limit the number of elbow/tee fittings).
- Unless otherwise specified, the pipe size should be $\frac{3}{4}$ " and schedule shall be the same as the system piping.
- The pipes must be clean and free of burrs.
- The total pipe length and number of bends shall be kept to a minimum.
- Use smooth, large radius bends; do not use elbows, tees, etc.
- Pipe runs should be sloped continuously up or down to allow for adequate circulation, proper venting and draining.
- Make sure that the loop, including seal flange, does not include vapor traps. When vapor traps cannot be avoided, a proper venting solution shall be added.
- For threaded connections, do not use Teflon tape, use an anaerobic thread sealant.
- Leak testing is recommended after assembly, refer to end user specifications or procedures.

6.5. Installation Procedure

Use this procedure to install or reinstall the system.

Procedure

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

2. Determine the installed position of the system. Refer to the Installation requirements, section 6.3.

WARNING	
	CRUSH HAZARD: Possible injury and/or trapped limbs. Take care to avoid being trapped or crushed between heavy, moving objects when installing the cooler

3. Use an appropriate lifting device to position the Air Cooler Series as close as possible to the main equipment. Make sure you leave sufficient room for operation and maintenance purposes.
4. Make sure that the Air Cooler is installed in a rigid support to counteract any vibrations and instability.

WARNING	
	HIGH PRESSURE: High pressure might be stored in the cooler. Before removing or re-installing the assembly, make sure the entire assembly has been de-pressurized (and drained if required).

5. Install the Air Cooler, according to the Installation requirements. Refer to sections 6.
6. Manufacture the interconnecting piping according to the Installation requirement. Refer to section 6.4.2.

Note: Not all connections in the following step may apply to your system (some are optional). Also, the names used in this procedure may vary slightly to the names in the assembly drawings. Refer to the Assembly Drawing in the Appendix for full details. In case of doubt, contact your local Flowserve representative.

7. Make the following connections:

- Barrier fluid supply line to main equipment: Connect the "to seal connection" to tap LBI (barrier fluid inlet) on the main equipment flange.
- Barrier fluid return line from main equipment: Connect the "from seal connection" to tap LBO (barrier fluid outlet) on the main equipment flange.
- Drain: Connect the "drain connection" to a drain or a disposal point.

8. Make sure the installation is correctly earthed to prevent the risk of explosion, caused by static electricity. Refer to the in the Appendix for full details.

Note: Leak testing is recommended after assembly. Refer to end user specifications or procedures.

7. Operation

Use this procedure if:

- The Air Cooler is being set-up for the first time, or
- The flushing fluid has been completely drained from the system.

7.1. Product Start-up

Procedure of preparing the product for use:

- Ensure that the Air Cooler and loop can be completely vented. This is achieved by placing a vent location at the highest point in the loop.
- Before start-up, ensure that all the gas/air is vented from the Air Cooler.
- Ensure that the Air Cooler and the loop can be completely drained.
- When Air Cooler will be installed in a closed loop for cooling purposes, Flowserve recommends positioning the Air Cooler with a minimum of 2/3th of the total length above the centerline of the main equipment when the total height becomes otherwise impractical. This will promote thermosyphoning when main equipment is in hot stand-by
- At start-up, ensure that the flush fluid flow is set and stabilized at the prescribed flow rate determined for the application.

7.2. Product Monitoring

WARNING	
	HIGH PRESSURE: Take caution when de-pressurizing the systems. Systems might have energy stored inside the Air Cooler. Make sure that de-pressurizing happens slowly.

WARNING	
	HOT SURFACES: The cooler and surrounding surfaces might be hot. Take care when touching components. Wear the appropriate Personal Protection Equipment (PPE), according to plant regulations.

WARNING	
	HAZARDOUS CHEMICALS: Hazardous chemicals might be released during removal of the Air Cooler. Wear Personal Protective Equipment (PPE). Follow all safety regulations and Plant regulations.

Use this procedure to monitor the system:

1. Monitor the Air Cooler for correct operation. Also refer to the Periodic maintenance tables in section 8.2.

2. Make sure:

- there are no leaks
- the seals and/or bearings are not running hot
- there is no cavitation in the system
- there is no heavy vibration in the system

3. If you notice any problems with the Air Cooler, follow plant regulation for reporting and correcting faulty equipment.

Air Cooler performance should be monitored periodically. Baseline temperatures should be collected soon after equipment commissioning.

Periodically the Air Cooler temperature, pressure and flow should be monitored to prevent damage or failure to the equipment.

7.3. Shut-Down Product

WARNING	
	HIGH PRESSURE: Take caution when de-pressurizing the systems. Systems might have energy stored inside the Air Cooler. Make sure that de-pressurizing happens slowly.

WARNING	
	HOT SURFACES: The cooler and surrounding surfaces might be hot. Take care when touching components. Wear the appropriate Personal Protection Equipment (PPE), according to plant regulations

WARNING	
	HAZARDOUS CHEMICALS: Hazardous chemicals might be released during removal of the Air Cooler. Wear Personal Protective Equipment (PPE). Follow all safety regulations and Plant regulations.

The Air Cooler may be disconnected only by qualified personnel, in accordance with national, plant- and end-user safety regulations and Chapter 2 in this manual.

Check if the Air Cooler can be shut down. Check if the Air Cooler can be de-pressurized without negatively affecting the mechanical seal installed in main equipment. System cannot be shut down if the following main equipment conditions occur:

- Main equipment/ Pump is on hot stand-by
- Main equipment/ Pump is pressurized
- Main equipment/ Pump is in operation

Note: Always shut down the system according to plant regulations/ end user safety procedures.

If the above points are checked, the Air Cooler can be shut down:

- Isolate the Air Cooler
- De-pressurize the Air Cooler

Note: For (re)-installation, removal and maintenance work, the Air Cooler must be de-pressurized (and drained if required).

8. Maintenance

8.1. General Guidelines

Periodic maintenance must be done at regular intervals (weekly, monthly, yearly). Refer to the following tables.

All liabilities and warranties to Flowserve for damage incurred using non-original replacement parts and accessories will be rendered null and void.

8.2. Periodic Maintenance Tables

Use the following tables to plan the periodic maintenance for your system (refer to the table of contents and the Appendix for the relevant information)

Weekly maintenance
Check the seals, Air Cooler, and interconnecting pipe work for leaks. Rectify if necessary.
Check the fluid pressure, flow and temperature.
The fins should be clean. Clean of dust and other substances that will reduce heat exchange to the environment.
Monthly maintenance
Do all weekly periodic maintenance procedures.
Check all earthing connections. Rectify if necessary.
Check the fluid for impurities.
Vent the Air Cooler.
Yearly maintenance
Do all weekly and monthly periodic maintenance procedures.
Replace the fluid if required.

Table 5 - Periodic Maintenance Tables

8.3. Inspection Procedure

WARNING	
	HIGH PRESSURE: Take caution when de-pressurizing the systems. Systems might have energy stored inside the Air Cooler. Make sure that de-pressurizing happens slowly.
WARNING	
	HOT SURFACES: The cooler and surrounding surfaces might be hot. Take care when touching components. Wear the appropriate Personal Protection Equipment (PPE), according to plant regulations.
WARNING	
	HAZARDOUS CHEMICALS: Hazardous chemicals might be released during removal of the Air Cooler. Wear Personal Protective Equipment (PPE). Follow all safety regulations and Plant regulations.

The product maintenance procedure is as follows:

- Properly tie cooler to lifting devices.
- Remove the Air Cooler from service. Refer to section 7.4 Shut-Down Product.
- Properly tie connect to lifting devices and place on the desired position.
- Internally and externally clean the Air Cooler without damaging the equipment.
- Inspect all components for damage or corrosion and replace as needed.
- Secondary sealing components such as gaskets should always be replaced.
- Leak testing is recommended after assembly. Refer to end user specifications or procedures.

9. Troubleshooting

Use the following table to troubleshoot the application.

Once the problem has been identified, use the procedures in this manual to maintain the system.
Contact your local Flowserve representative for more information.

Note: the recommended response actions always include notify the supervisory authority and respond according plant regulation.

Parameter	Indication (1)	Possible Cause	Solution
Pressure	Reducing fast (1)	- Leakage in connections, gaskets, piping - Mechanical seal failure	- Check connections for leakage - Check gaskets for leakage - Check piping for leakage - Check mechanical seal
Temperature	High	- Insufficient circulation - Cooler not working	- Check for blockages - Outside of cooler not clean

Table 6 - Localization and Elimination of faults, Damages and their Consequences

(1) The pressure drop should be monitored over time. A too fast drop in pressure compared to previous measurements could be an indication for one of the mentioned possible causes.

ANNEX I

System logbook

Copy and use this logbook to record periodic or corrective maintenance done on your system. Use the following codes and enter remarks, the date, and your name:

Weekly maint.= W	Monthly maint. = M	Yearly maint.= Y	Adjust = A	Replace = R
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ANNEX II

Air Cooler Assembly Drawing



Headquarters

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