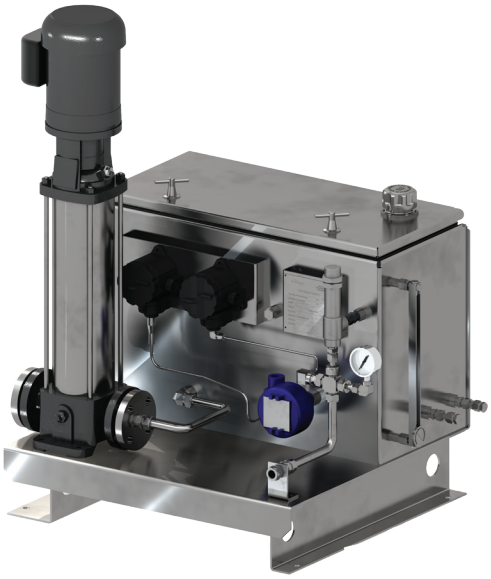
FLOWSERVE

USER INSTRUCTIONS

Installation
Operation
Maintenance

Installation, Operation, & Maintenance Manual N54 circulator for General Industry Service Models N54O, N54W



Experience In Motion

List of Figures

List of Tables

1. Introduction

1.1 About this manual

This manual provides information for the installation, operation, and recommended maintenance of the seal auxiliary system describe herein. It is intended for use by qualified personnel, trained and experienced with the seal auxiliary system and all associated equipment.

Operating features and some optional equipment covered here may not be included on every system. Refer to the detailed system drawing in the appendix to determine the exact system configuration.

1.2. How to use this manual

Before unpacking the equipment, fully read and understand the content of this manual and any referenced material. If any questions arise, contact your local Flowserve representative for assistance.

Use this manual to inspect the system upon delivery and ensure proper installation, operation, and maintenance. Refer to this manual and any application specific information from the system drawings attached when contacting Flowserve.

1.3. Other supplied documentation

The appendix of this manual includes system drawings such as Piping & Instrumentation Diagram (P&ID), General Arrangement (GA), Bill of Materials (BOM), Wiring Diagrams, and sub-component manuals. These documents are considered an integral part of this document and the information within must be followed.

1.4. Conformity with norms and directives

The seal auxiliary system conforms to the following norms and directives (as applicable):

- ASME B31.3

1.5. Use of Signal Words and Safety Alerts

The use of Signal Words and Safety Alerts are presented in this manual to alert personnel to potentially dangerous situations. Additionally, Notices are placed throughout the documents to communicate important information required for the successful operation of the system. These alerts (from the least severe to the most severe) are:

NOTICE: Indicates information considered important, but not hazard-related.

CAUTION
Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

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

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

The above signal words and safety alerts are shown in their generic form. Specific alert symbols may be used to communicate the nature of the alert and the text will convey a concise message that includes the type of hazard, the consequence of not avoiding it, and direction for how to avoid the hazard.

2. Safety

The Plan 54 system has been manufactured to generally accepted engineering standards. There is still, however, a risk of personal injury or property damage if this chapter and the safety instructions in thisdocumentation are not observed.

NOTICE: Read this documentation completely and thoroughly before working with the Plan 54.

All operating and maintenance tasks need to be carried out in compliance with Health, Safety and Environmental (HSE) requirements as specified by company, local, government and regulatory agencies. Applicable HSE requirements may include the following:

- Equipment hazard reviews
- Hot work permits
- Personal Protective Equipment (PPE) requirements
- Lockout/Tagout procedures
- Handling and disposal of liquids and contaminants
- Incident reporting and investigation procedures
- Management of Change

2.1. Plan 54 Hazards

An Plan 54 seal auxiliary system is a complex assembly designed to provide conditioned and pressurized fluid to a mechanical seal. The following hazards may be present:

- High pressure
- Electrical Shock
- Explosion
- Dangerous chemicals/process contamination
- High Temperature (hot surfaces)
- Pressurized Nitrogen (N2) in the accumulator
- Dangerous moving parts

2.2. Personal Protective Equipment (PPE)

At all times, when working at or in the vicinity of the system, observe the following minimum requirements for personnel.

The specific installation may require additional PPE.

- Hearing protection
- Respirator

2.3. General safety

When installing, operating, and maintaining the 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 2.4.
- Read and understand each part of this manual.
- Follow the installation, maintenance, and operating procedures exactly.
- Wear the relevant Personal Protective Equipment (PPE).
- Never work alone.
- 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, shut off 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
- Check MSDS for relevant information

2.4. 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

3. Environmental considerations

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

3.1. Disposing of waste products

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

3.2. End of life equipment

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

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).

WARNING
HOT SURFACES Conditions within the system may result in high surface temperatures. Wear Personal Protective Equipment (PPE).

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

4. Design Overview

4.1. Purpose of the Plan 54

The Plan 54 is an independent hydraulic system designed to provide cool, clean, pressurized fluid to dual mechanical seals. The fluid circulating through the system provides a controlled environment for the reliable operation of the mechanical seal. This fluid lubricates the seal faces, cools and acts as a barrier between the process fluid and the environment (Barrier Fluid).

For successful operation of the Plan 54, the barrier fluid pressure is required to always be greater than the pump seal chamber pressure or vessel pressure in mixer applications. This positive differential pressure results in a small leakage of barrier fluid across the in-board seal face into the process and across the outboard seal face (typically to atmosphere).

4.2. Functional Description of the Plan 54

The Plan 54 is a packaged system consisting of various subsystems, as shown below, to support one mechanical seals. Some variations of each subsystem are available.

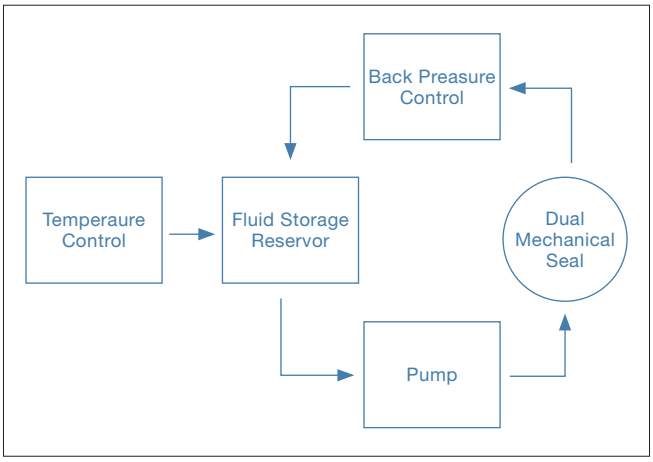


Figure A - Plan 54 Sub Systems

4.2.1. Barrier Fluid

The Barrier fluid is an integral component of a Plan 54 seal support system and must be compatible with the process. The circulating fluid serves to lubricate and cool the mechanical seal.

4.2.1.1. Barrier Fluid for Oil Based Systems

The N54O model Plan 54 must only operate with oil-based barrier fluids. The fluid not only lubricates and cools the seal it provides lubrication to the Plan 54 pump. It is important to maintain the fluid viscosity to provide adequate lubrication. The following Flowserve products or equivalents are recommended.

Barrier Fluid	ISO Viscosity Grade	Viscosity ASTM D-445
DuraClear 5, DC-5-F	ISO VG 5	5.1 cSt @ 40°C 1.7 cSt @ 100°C
DuraClear 32, DC-32-F	ISO VG 32	31.4 cSt @ 40°C 6.0 cSt @ 100°C
A viscosity as high as 95 cSt is acceptable for a short period (i.e., Startup)		

Table 1 – Recommended Barrier Fluids for Oil Systems

4.2.1.2. Barrier Fluid for Water Based Systems

The N54W model Plan 54 is designed for water-based barrier fluids. The fluid also must lubricate and cool the seal.

Generally speaking, and depending on the application, municipal drinking water that is pollution free, bacteriologically safe, and has a neutral pH is acceptable for use.

If the source of cooling water is a cooling tower, the presence of contaminants may vary over time and contaminants will need to be controlled to the levels listed in the table below. The pH level should be in the range of 6.5 – 8.0 for most applications. The use of chlorine is encouraged to limit the growth of microbiological organisms. Chlorine concentration should be less than 5ppm.

Compounds	Allowable quantity (parts per million)
Ammonia	None
Bacteria	Must be bacteriologically safe
Calcium	<800 ppm
Chlorides	<5 ppm
Dissolved Solids	>50 but <500 ppm; limit to 150 ppm if abrasive solids present
Iron	3 ppm
Nitrates	<10 ppm
Nitrogen compounds	None
Oxidizing salts or acids	None
pH level	6-8.5 recommended
Silica as SiO_2	<150 ppm to limit silica scale
Sulfides	<1 ppm
Sulphur dioxide	<50 ppm

Table 2 – Recommended Barrier Fluids for Water Systems

Consult with Flowserve for assistance with barrier fluid selection. The final selection of the barrier fluid depends upon many different factors and ultimately the system owner has the responsibility to approve the final selection.

4.2.2. Barrier Fluid Storage Reservoir

The Plan 54 reservoirs purpose is to hold a volume of fluid, transfer heat from the system, allow solid contaminants to settle and facilitate the release of air and moisture from the fluid. The volume provides ample barrier fluid to circulate through the seal and make up for many months of run time at normal seal consumption.

Reservoir Level	Volume	Unit
Minimum Operating	8.5 (32)	Gallon (liter)
Maximum Operating	25 (95)	Gallon (liter)
Usable	16.5 (62.5)	Gallon (liter)
Total Fill Volume	25 (95)	Gallon (liter)

Table 3 – Reservoir Volumes

Reservoir includes features to provide additional function to enhance the operations of the system. The standard reservoir supports the following features:

Feature	Function
Level Gauge	Provides visual indication of the fluid level.
Fill Cap	Easily removable, non-vented cap, for adding fluid to the reservoir.
Temperature Indicator	Indicated the bulk fluid temperature within the reservoir.
Low Level Switch (optional)	Provides a remote alarm to signal when the reservoir level has fallen below the minimum operating level requiring fluid be added.

Table 4 – Reservoir Features

4.2.3. Pump

The N54O and N54W both have circulating pumps to generate flow but are different styles with different capabilities. The N54O uses a fixed positive displacement gear pump for oil-based fluids where the N54W uses a multi-stage centrifugal pump for water-based fluids.

Refer to Appendix A - for pump performance curves.

4.2.3.1. Pump Capability for Oil Based Systems

The gear pump in the N54O model has the following pressure-flow characteristics.

Pump Capacity (nominal)	Flow Rate	Unit
Low Flow Option	4 (15)	GPM (l/min)

Table 5 – N54O Pump Capacity

The pump is equipped with an internal pressure limiting valve.

Optional Equipment: External Pressure Limiting Valve

The actual pump capacity will depend on the application conditions. The chosen barrier fluid, operating temperature, and operating pressure will influence the volumetric efficiency of the pump and therefore the actual flow produced.

4.2.3.2. Pump Capability for Water Based Systems

Optional Equipment: None

4.2.4. Back Pressure Monitor and Control

The barrier fluid pressure on the seal is controlled by an adjustable self-actuated back pressure regulator located in the return line.

The pressure set point of the regulator is read on the pressure indicator installed near the regulator.

The optional pressure switch provides a dry contact for a remote alarm to signal if the barrier fluid pressure is below the minimum operating pressure. When the switch is in the alarm state the differential pressure across the primary faces of the mechanical seal is below an acceptable level or possibly reversed. This poses a risk of damaging the seal and/or contaminating the R54.

Pressure Control	Pressure	Unit
Back Pressure Regulator	50-450 (345-3100)	psig (kPag)
Pressure Indicator	0 – 600 (0 – 4000)	psig (kPag)
Pressure Switch (optional) (Single SPDT)	0-400 (0-2800) Deadband 5-24	Psig (kPag)

Table 6 – Pressure Monitor and Control Ranges

The pressure regulator and switch will be adjusted during the initial startup procedure. Guidelines for their setting are as follows:

- Back Pressure Regulator Set Point = Seal Chamber Pressure + 50 psig
- Pressure Switch Set Point = Seal Chamber Pressure + 20 psig

The values listed in Table 6 represent the adjustable spring range of the regulator. The pressure at the seal will be different and vary by application. Many variables, including piping length, flow rate, temperature, and fluid type effect this difference. Do not plan to operate at the extremes. If in doubt, contact your Flowserve representative for assistance.

Blocked components such as the PCV failing closed could result in a buildup of pressure. Ensure internal relief valve of the pump is properly set. If the optional relief valve is included in the system, make sure the setpoint corresponds to the system design conditions

NOTICE: It is the Owners responsibility to determine and take the appropriate action whenever a lowpressure alarm is indicated.

4.2.5. Temperature Monitor and Control

Heat is added to the barrier fluid as it cools the seal. This heat, and any heat generated by the Plan 54 itself, must be removed from the system. Cooling the barrier fluid is accomplished by passing water through a coil of tubing submerged in the reservoir.

The optional temperature switch provides a dry contact for a remote alarm to signal if the barrier fluid temperature is above the recommended operating temperature. When the switch is in the alarm state there is a risk of reducing component life and could indicate:

- insufficient cooling water flow
- low water pressure
- fouling of the heat exchanger
- High cooling water temperature

NOTICE: It is the Owners responsibility to determine and take the appropriate action whenever a hightemperature alarm is indicated.

Temperature Control	Temperature	Unit
Normal Fluid Temperature Maximum Fluid Temperature	120-140 (49-60) 180 (82)	°F (°C)
Temperature Indicator	0-250 (-20 – 120)	°F (°C)
Temperature Switch (optional) (Single SPDT)	75-205 (20 - 95) Deadband 8 -16 (4.4 – 8.9)	°F (°C)

Table 7 – Temperature Control Range

4.3. Identifying the product (nameplate)

Figure 4 - Nameplate

4.4. Plan 54 Product Offerings

N540	4	N1	R	1	S	L	S

Mode	
General industry oil single seal	N540

Nominal Flow	
4 GPM	4

Region	
Europe (ATEX/MACHINERY DIRECTIVE)	E1
North America (NEC/UL/CSA/CRN)	N1

Pressure Relief	
None	0
Relief Valve	R

Barier Pressure	
30-100 PSI	1
60-175 PSI	2
150-350 PSI	3

Pressure Instrument	
0	None
S	Switch (LOW)

Level Instrument	
0	None
L	Switch (LOW)

Temperature Instrument	
0	None
S	Switch (HIGH)

Table 8 – N54O Part Numbers

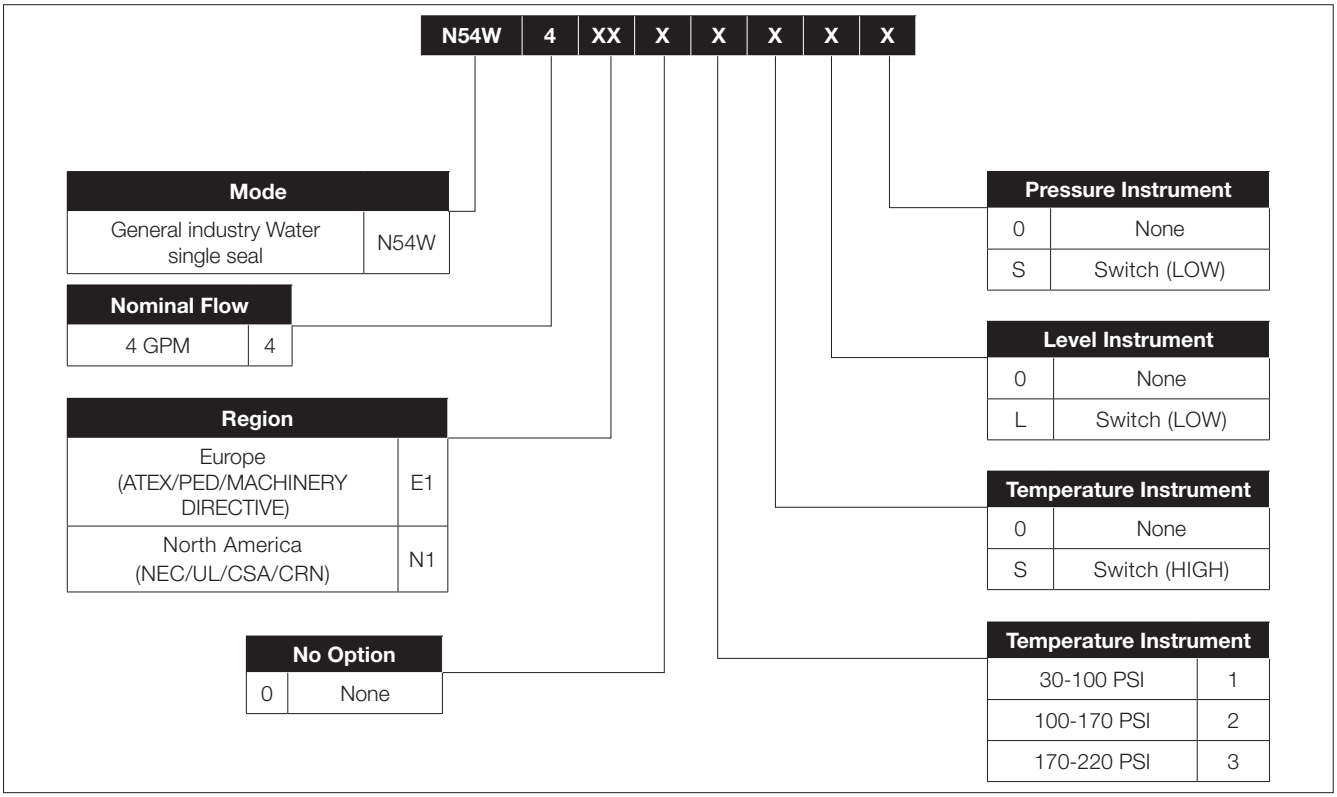


Table 9 – N54W Part Numbers

5. Transport and storage requirements

5.1. Receiving and Unpacking

The N54 has been carefully prepared for shipment to protect and preserve it during transportation. The system requires careful handling and storage to ensure reliable operation.

The N54 and related equipment must be transported and stored in the original, unopened shipping container. Upon receiving the system, the user is responsible for inspecting the container for any signs of damage and for determining the status of any shipping damage indicator. If the container or any tattletale indicators show damage, the container should be opened for further inspected. An inspection by Flowserve or its appointed representative is strongly advised.

If the container is opened for inspection or other purpose and the system will not be immediately installed, the system must be repackaged and resealed in a manor equivalent to the original packing.

In addition to the original factory protective packaging, several preservation steps have been taken.

- Residual barrier fluid from the factory performance test remains in the system.
- All opening into the system have been blinded or plugged.
- All conduit connections to instruments are plugged.

While the original shipping container is suitable to protect the system from damage due to normal handling, it is not designed to protect from handling abuse or poor storage conditions. The system must be stored in a clean, dry, stable environment. In the original shipping container, the system may be stored for up to 3 months under the following environmental guidelines:

- Indoor storage only
- Temperature range 4°C to 37°C (40°F to 100°F). Avoid large fluctuations.
- Low humidity, less than 65% RH.
- Atmosphere free from rain, dust, steam, chemicals, oils, radiation, and ozone.
- Storage surface free from impact and vibrations.
- No threat of water reaching above container bottom support (typically 3 ½ inches).
- No storage in the vicinity of where steel is processed or other dust/grit raising activities such as sandblasting are performed.

Reference FIS222eng - Flowserve Mechanical Seal and Seal Support System Storage.

If system needs to be stored for an extended period before installation or commissioning, a specific inspection and maintenance schedule must be implemented. Refer to Flowserve Long Term Storage Procedure (FIS222eng). Contact your Flowserve representative for assistance.

Once the maximum storage time has elapsed, it is recommended that you have the system inspected by a Flowserve representative.

6. Installation

6.1. Introduction

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

6.2. Introduction

The following sections outline the scope of the N54 installation and the items to be prepared for installation.

NOTICE: Any design, construction, or materials required by Section 6.2 are the Owners responsibility.

6.2.1. Safety considerations

The preferred location on the N54 installation is as close as practical to the seal(s) being served and at a similar elevation. In all cases, ensure there is sufficient allowances for:

- Evacuation of the Plant in case of an emergency. Do not block walkways or impede emergency egress.
- Reliable operation of the system. Do not install the system near sources of excessive heat, vibration, or particulates.
- Safe operation and maintenance of the system. Ensure there is adequate clearances are maintained to allow safe access to and around the equipment.
- Hazardous Areas. Ensure that all equipment and installation methods meet or exceed the hazardous area requirements.

DANGER	
	RISK OF EXPLOSION If the system is being installed in a hazardous area, there could be an explosion risk. Make sure all instrumentation has the adequate explosion protection.

6.2.2. Foundation

The N54 requires a firm stable foundation. Either steel base or concrete pad. The foundation should be flat and level, with anchor bolts set firmly in place. If a steel baseplate is used, it shall have sufficient rigidity to prevent distorting or movement of the system after it is bolted down.

NOTICE: The design and construction of the foundations is the Owners responsibility.

6.2.3. Interconnecting Piping - Barrier Fluid

The N54 requires piping to be installed to and from the mechanical seal.

1) From the Seal Supply connection on the N54 to the Barrier In (BI) connection on the seal gland.

2) From the Barrier Out (BO) connection on the seal gland to the Seal Return connection on the N54.

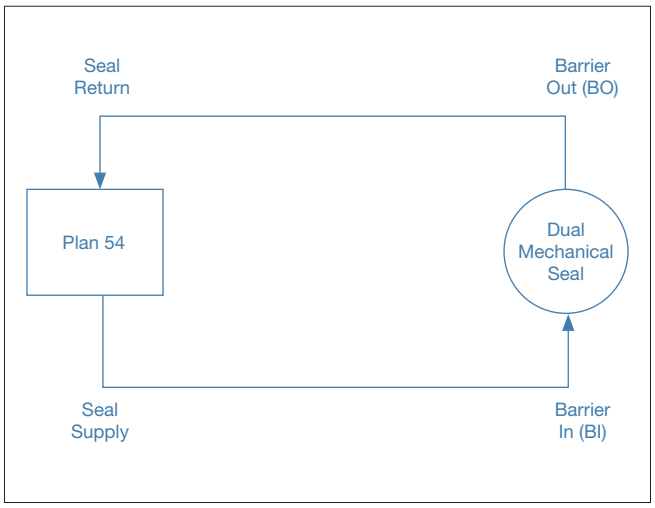


Figure B - Minimum Barrier Fluid Piping

General guidelines for the design and installation of this barrier fluid piping should be followed to minimize pressure losses.

- Pipe or tubbing is acceptable.
- Stainless steel is preferred.
- Choose a size and wall thickness to meet the application requirements.
- Design goal should be to limit the fluid velocity to 7-10 ft/sec and limit the total equivalent length so the frictional loses do not exceed 10% of the normal operating pressure.
- The preferred size is either:
  - ¾”x 0.095” tubing
  - ¾” schedule 80 pipe (NPS).

- Minimize the number flow restrictive components such as fittings, valves.
- Keep the total pipe length and number of bends to a minimum.
- Smooth, large radius bends are preferred over elbows, tees, and other restrictive fittings.
- Pipe runs should be sloped continuously up or down to allow for good draining.
- The pipes must be clean and free of burrs.
- Do not use Teflon tape on threaded connections. Loctite 577 thread sealant or a similar product is preferred.

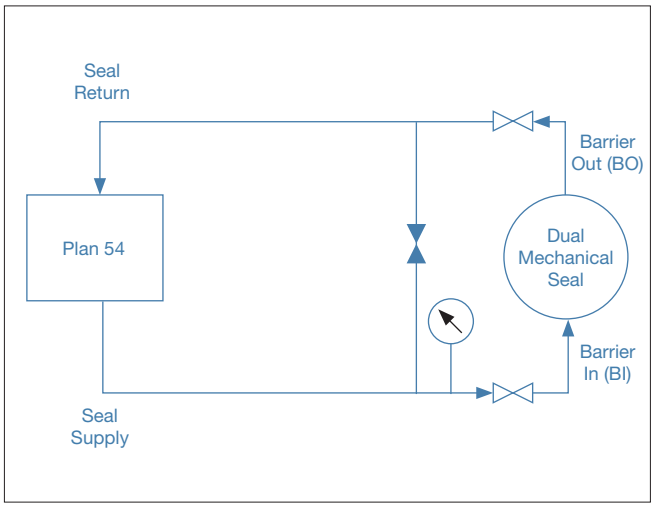


Figure C: Recommended Barrier Fluid Piping

NOTICE: If isolation valves are part of the interconnecting piping, these valves shall be full bore and “locked open” during operation.

6.2.4. Interconnecting Piping - Cooling Water

The N54 requires piping to be installed in and out the heat exchanger.

1) From the plant cooling water source to the N54 heat exchanger inlet connection (CWI).

2) From the heat exchanger outlet connection (CWO) to the plant cooling water return.

General guidelines for the design and installation of the cooling water piping should be the same as for the barrier fluid piping. Cooling lines should be kept free and clear of any obstructions such as orifices or blocked valves that could interfere with its operation and effectiveness. Blocked cooling lines could result in higher-than-expected barrier fluid temperatures as well as a safety concern due to the increased pressure. If any blocked valves are to be installed on the cooling water lines, Flowserve recommends the installation of a relief valve.

The minimum recommended cooling water piping is shown in Figure 3.

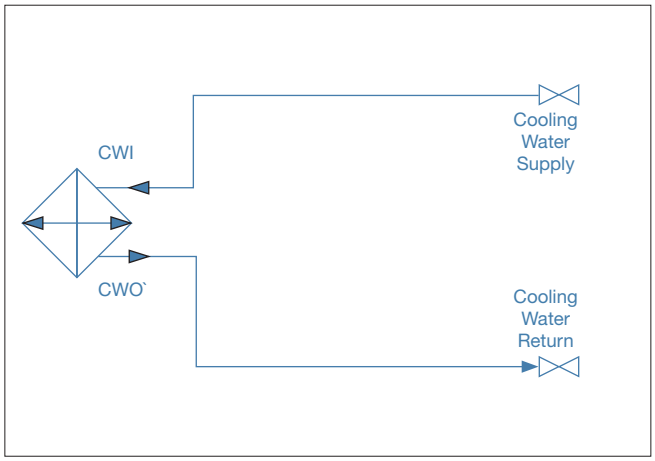


Figure D: Minimum Cooling Water Piping

The recommended piping should include a valve for back flushing and a relief valve to protect the cooling system from over pressurization as shown in Figure 4.

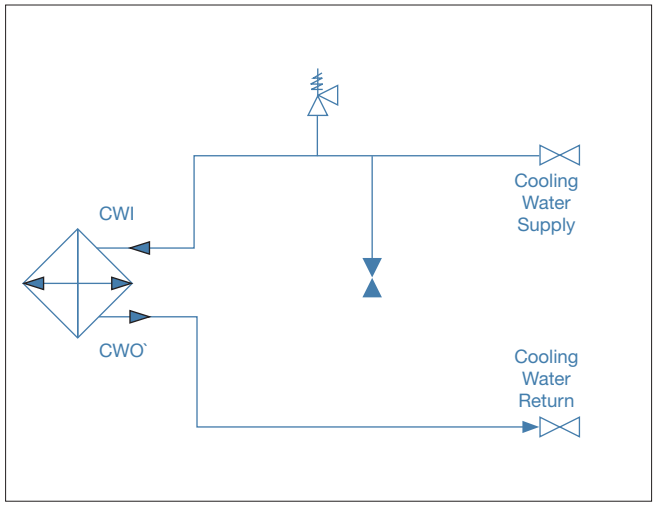


Figure E: Recommended Cooling Water Piping

NOTICE: It is the Owners responsibility to protect the N54 and cooling water system over pressurization and freezing.

6.2.5. Power Wiring

The N54 is equipped with an

- Electric motor driver for the main pump

6.2.6. Instrument Wiring

The N54 is equipped with the following electrical instruments that must be wired to the owners DCS

- Level Switch – Low (Optional)
- Pressure Switch – Low (Optional)
- Temperature Switch - High (Optional)

6.3. Installation procedure

Use the following step-by-step procedure to install or reinstall the system.

1) Before installing the system, inspect all components for damage. If any of the components are damaged, it shall be reported to the Flowserve representative.

2) Use an appropriate lifting device and set the system on the foundation. Secure in place with anchored bolts.

NOTICE: It is the Owners responsibility to mount the system securely to its prepared foundation.

3) Manufacture the interconnection piping as describe in Section 6.2.

4) Flush the interconnection piping prior to installation.

5) Wire the electric motors.

6) Wire the provided instrumentation.

7) Make sure the installation is correctly grounded and grounding surface is free of paint to ensure a solid grounding path.

8) Make a final check to ensure that the unit has been properly connected according to the system schematic.

7. Operation

7.1. Initial Start-up

Use the following procedure to prepare the N54 for operation under these conditions:

- Initial start-up
- Return to service after maintenance
- Return to service after being idle for more than 30 days

NOTICE: It is important to circulate the barrier fluid and purge all air from the system components and piping before applying significant pressure.

1) Fill the system with Barrier fluid to a level greater than the minimum operating level. Filling to the maximum operating level is preferred.

2) The pressure limiting valve(s) have been factory set to the design pressure of the N54 and should not require any adjustment. It must not be set to a higher value. However, if the factory setting is determined to inappropriate for the application an adjustment is necessary. The preferred method is to remove the valve from the system and send back to the manufacturer to be reset and re-calibrated.

3) If possible, install a temporary strainer in the return line to filter the fluid as it returns to the tank. This will protect the system from any construction debris in the interconnecting piping.

4) Ensure that all block valves are open. All gauge block valves should be open, and vent valves should be closed.

5) If the interconnecting piping was installed as show in Figure 2, bypass each seal serviced by this system. This will reduce any construction debris from entering the seal.

6) Confirm proper pump rotation by jogging the main motor. Refer to markings on the motor for correct direction.

7) Start the pump and allow the system to run for about 30 minutes to allow the system to stabilize and purge any air. Open the instrument bleed valves to purge air any trapped air.

8) It is likely that a significant volume of barrier fluid will be required to fill the components and piping. If at any time the fluid level reached the minimum operating level, add additional fluid.

9) Fill the auxiliary filter with fluid by slowly switch the filter change over valve.

10) If equipped, repeat steps 6) through 8) of this procedure for the auxiliary pump. It is acceptable to start the auxiliary pump prior to shutting off the main pump.

11) With normal flow establish from either the main or auxiliary pump, set the back pressure to the required value. A single back pressure regulator controls the pressure on each seal and was factory set to its minimum setting. It must now be set to the value required by the seal, 25-50 psi (2-4 barg) above the seal chamber pressure. Slowly increase the pressure by turning the adjusting screw clockwise until the pressure on the seal reaches the designed value.

12) If the seal(s) were bypassed in Step 5) switch the valve to flow through the seal(s). If the system includes two seal supply lines, each is equipped with a globe valve. These globe valves should normally be fully open. Their function is to balance the available flow between each seal and not to restrict the flow to any specific value. Restricting the flow from the positive displacement pump will cause an unnecessary rise in pressure and potentially bypass through the pressure limiting valve.

13) Once the barrier pressure has been set, lock the adjustment screw using a wrench.

14) At this point the system is operational. Follow the Normal Start-up steps in section 7.2 to place the system into service.

7.2. Normal Start-up

Use this procedure to start the system.

NOTICE: Startup and pressurization of the seal must precede pressurization of the pumps.

1) For the N54O oil system using an ISO Vg 32 fluid, verify that the temperature of the oil in the tank is at 65 °F.

2) Start the pump. After a few minutes the flow and pressure at the seal should stabilize.

3) Verify the barrier fluid pressure and flow match the expected values.

4) Verify cooling water flow through the heat exchanger. The barrier fluid temperature will be less than normal until the pump seal is in operation.

5) After the pump seal is in operation, verify that the barrier fluid temperature in the reservoir is normal and stable as per the P&ID.

7.3. Operating

During Normal operation the N54 will provide barrier fluid to the seal at a steady pressure, flow rate, and temperature. Monitoring and recording specific information can provide valuable data on the operation and assist in troubleshooting in the event a malfunction. To ensure long term operation, manually log the operating conditions listed below and note any variation from previous days. On a daily basis, log the following information:

- Fluid level (LG-100)
- Bulk Fluid Temperature (TI-100)
- Barrier fluid pressure (PI-200)

If the fluid level is above or below recommended levels, barrier fluid will need to be added or removed as necessary to ensure optimal operation. The fluid level should not be above 90% or below 30% capacity or above/below the upper/lower limits of the liquid level gauge readable range respectively. If the fluid temperature is above 180 (82) °F (°C), check cooling water temperature or seal failure

When selected, the following instruments should be monitored continuously through the owners DCS or similar system where each instrument can provide immediate notification of an abnormal condition.

- Barrier Fluid Level (LS-101)
- Barrier Fluid Pressure (PS-200)
- Barrier Fluid Temperature (TS-101)

Initiation of the level switch indicates lower or higher than recommended liquid level in the tank. Check for

- seal failure or leakage within the N54 system.
- If the inboard seal fails, the system will see pump product which can be at an elevated temperature. If the outboard seal fails, the pressure in the mechanical seal drops and the inboard seal will not be cooled down sufficiently which results in overheating of the mechanical seal. If equipped, a trip alarm can be set at the temperature switch to shut down the pump on high temperature alarm.

  Otherwise, the integral temperature gauge on the level gauge should be monitored regularly to ensure the temperature is not beyond recommended levels.
- This N54 system may only be operated within the permissible limiting values for the intended use. The operating and design parameters shall never be exceeded. Operators should never exceed the permissible nozzle loads of the tie in points.

7.4. Shut down

Use the following procedure to remove the N54 from operation.

NOTICE: It is the owner's responsibility to ensure that the process pump(s) being supported by the N54 are safely shutdown, isolated, and depressurized to atmospheric pressure prior to shutting down the N54.

NOTICE: It is the owner's responsibility to ensure that any alarms that might be trigger when shutting down the N54 are safely managed.

1) Shutdown, isolate, and depressurize to atmospheric pressure the process pump(s) being supported by the N54. Ensure that the seal chamber pressure does not exceed the barrier fluid pressure at any time during the shut-down

2) Stop the active circulating pump, main or auxiliary.

3) Ensure that the N54 is isolated from other equipment that may create a hazard.

4) Ensure that the lock-out/tag-out of the N54 is complete.

5) Prior to servicing any component, ensure that there is no stored energy and temperatures are at ambient conditions.

WARNING
 HIGH PRESSURE The cooling water circuit of the N54 system is not protected against overpressure. If the return line is closed, a water line could burst. Make sure a pressure relief valve is installed in the cooling water circuit.

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

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

WARNING
 HIGH VIBRATION External vibration can cause rupture in piping/components which will cause leakage. Regular maintenance of tube fittings and components will prevent leakage.

WARNING
 STATIC ELECTRICITY Observe precautions for handling electrostatic sensitive devices. Avoid electrostatic. charge: do not rub non-metallic surfaces with a dry cloth; ensure cloth is damp.

8. Maintenance

8.1. Introduction

Proper maintenance is critical to ensuring that the N54 system fulfils its required function. Maintenance must be done at regular intervals and should be part of the facility's overall maintenance plan. The following paragraphs provide important maintenance requirements for the N54 system. Addition information on the major components can be found within the supplied vendor documentation.

To avoid potential explosion hazards during maintenance, the tools, cleaning, and painting materials used must not give rise to sparking or adversely affect the ambient conditions. Where there is a risk from such tools or materials.

8.2. Barrier Fluid

The quality of the barrier fluid can greatly affect the performance and life of the mechanical seal system. The fluid not only provides lubrication and cooling for the seal but for all components on the N54 system.

The service life of the barrier fluid can vary dramatically in different applications. In general, fluids operating at high temperatures will have a shorter life than fluid operating at lower temperatures. When operating the N54 within the conditions outline in Section 4.2 it is recommended that periodic fluid sampling and analysis should be performed.

Check the fluid each month for changes in the following:

- pH
- Color
- Viscosity
- Particulate Contamination
- Water Contamination
- Process Contamination

Any significant changes require a fluid change and further analysis.

8.2.1. Check barrier-fluid Level

The barrier fluid level in the reservoir must be maintained between the minimum and maximum parting levels as indicated on the level gauge. Operating the system below the minimum level risk damage to the system and seal.

During normal operation, the mechanical seal will consume barrier fluid an a very low rate. However, over time this will result in a falling liquid level in the reservoir. A low-level alarm will be indicated by the level switch when it falls to the minimum acceptable level. Immediate action is required to replenish the reservoir level. It is not necessary to wait for an alarm before refilling. It is recommended that the level be checked and replenished as required monthly.

8.2.1.1. Adding barrier-fluid

Safety is the primary concern when performing this function. In some instances, the system will need to be refilled while in operation.

- Use only new fluid from a clean container.
- Ensure that the area around the fill port is clear of debris.
- Remove the fill cap.

- Add barrier fluid by simply pouring the fluid through the open fill port.
- Fill to the Maximum level as indicated on the level gauge. (typically, approximately 1" below the top of the gauge).
- Close the fill cap.

8.2.1.2. Changing barrier-fluid

If the barrier fluid becomes contaminated or show evidence of derogation, some or all the fluid may need to be replaced.

Fluid can be drained through the reservoir drain port and then refilled through the fill port.

- If the system is NOT in operation, the reservoir can be completely emptied.
- If the system is in operation, DO NOT drain the reservoir below the minimum operating level and then refill as soon as possible.

8.3. Heat Exchanger

The capacity of the heat exchanger is as follows:

N54W: 8400 BTU/hr

N54O: 4500 BTU/hr

These values are estimated based on the data below. The actual heat removal changes if any of the barrier fluid viscosity, temperature, flow rate and cooling water inlet temperature changes during operation.

Barrier Fluid	Temperature	Unit
Barrier Fluid Supply Temperature	120 (49)	°F (°C)
Barrier Fluid Return Temperature	140 (60)	°F (°C)
Cooling Water Flow	4 (15)	GPM (LPM)
Cooling Water Temperature In	90 (32)	°F (°C)
Cooling Water Temperature Out	106 (41)	°F (°C)

Required maintenance of the heat exchanger is highly dependent on the quality of cooling water. One indication of fouling will be a reduction of cooling capacity. Performance of the cooler can be judged by monitoring the bulk fluid temperature in the reservoir or by a high temperature alarm.

reduction in effectiveness can be detected. Any loss in efficiency, indicated by higher temperatures, can normally be traced water scale.

If the cooling water had been pipe as shown in Figure 4, the heat exchanger can be back flushed by closing the water supply and opening the vent valve. Cooling water will flow backwards through the heat exchanger and out the vent.

NOTICE: It is the owner's responsibility to properly dispose of any cooling water and debris flushed from the heat exchanger.

8.4. Level Switch

The N54 reservoir can be equipped with an optional level switch to detect low liquid level. Optionally, a second ultrasonic level switch can be installed to

detect high liquid level. For detail instructions on safety, wire, operating, and servicing refer to the manufacturers document located

8.5. Pressure Switch

The seal return piping on the N54 can be equipped with an optional pressure switch to detect low liquid pressure and provide an alarm to indicate the minimum operating level has been reached.

For detail instructions on safety, wire, operating, and servicing refer to the manufacturers document located in the Appendix.

8.6. Temperature Switch

The N54 can be equipped with a temperature switch located in the barrier fluid stream at the heat exchanger outlet. The switch will detect high liquid temperature and provide an alarm to indicate the maximum operating temperature has been reached.

For detail instructions on safety, wire, operating, and servicing refer to the manufacturers document located in the Appendix section.

8.7. Pump

The N54 can be equipped with one of two different pumps types.

For detail instructions on safety, operating, and servicing refer to the manufacturers document located in the Appendix.

8.7.1. Pump for Model N54O

The N54O is fitted with a positive displacement gear pump. With an efficiency rate of 95%, this gear pump was specifically selected due to its ability to handle a wide range of viscosities from 5 cSt to 32 cSt. It has a simple yet efficient design consisting of only a few moving parts, making it easy to maintain and repair. This pump is able to maintain a consistent flow rate regardless of changes in pressure or viscosity, making it highly reliable and accurate.

8.7.2. Pump for model N54W

The N54W is equipped with a versatile and reliable 2 HP (1.5 kW) vertical multistage centrifugal pump that offers high efficiency, easy maintenance, and compact size. The pump's advanced hydraulic design and highquality materials enable it to achieve high efficiency, resulting in lower energy consumption and reduced operating costs. Additionally, the pump's modular design makes it easy to maintain and repair, which reduces downtime and extends the life of the pump. Its vertical multistage design allows it to be compact, making it ideal for

installations where space is limited.

8.8. Driver

The Plan 54 driver is a 1.5 HP electric motor depending on the system capacity.

For detail instructions on safety, wire, operating, and servicing refer to the manufacturers document located in the Appendix.

8.8.1. Driver for Model N54O

The N54O is driven by a 1.5 HP electric motor. Based on region selection, the motor operates on either 460 VAC, 3 PHASE, 60HZ (NEC) or 380 VAC, 50 HZ (IEC). It is fully rated for NEC and IEC hazardous areas.

For detail instructions on safety, wire, operating, and servicing refer to the manufacturers document located in the Appendix.

8.8.2. Driver for model N54W

The N54W is directly coupled to a 2 HP motor. The motor is a totally enclosed, fan-cooled motor. It is motor is fitted with a built-in thermal overload switch (TP 211 according to IEC 34-11). It must be connected to a motor-protective circuit breaker according to local regulations.

The motor operates on either 460 VAC, 3 PHASE, 60HZ (NEC) or 380 VAC, 50 HZ (IEC). It is motor is fully rated for NEC and IEC hazardous areas.

For detail instructions on safety, wire, operating, and servicing refer to the manufacturers document located in the Appendix.

9. Troubleshooting

Use the following table to troubleshoot the system. Once you have identified the problem, use the procedures in this manual to maintain the system. If you are not sure how to troubleshoot or maintain your system, please contact your local Flowserve representative.

Issue	Common Causes
Unable to maintain Pressure (Low Pressure)	Pressure Control Valve setting Low: The PCV may be set lower than desired. • Adjust the PCV according to the directions in the manufacturers IOM. Pressure Relief Valve setting Low: The PRV may be set lower that required and allowing fluid to bypass back to the reservoir. • Adjust the Relief valve according to the directions in the manufacturers IOM.
Unable to maintain Pressure (High Pressure)	Pressure Control Valve setting High: The PCV may be set lower than desired. • Adjust the PCV according to the directions in the manufacturers IOM. Poor supply and return line piping: The supply and return line piping should be sized and constructed to eliminate as much pressure loss as practical. Fluid Temperature Low / Viscosity High: Low temperature can cause the barrier fluid to have a too high of viscosity, creating high pressure loss on theseal supply and return lines. • Insulate and heat trace the lines to maintain temperature. • Reduce cooling water flow rate.
Unable to maintain Flow	Low pressure relief valve setting. A low setting may allow partial flow to leak back to the reservoir. • Fulflo relief valves may be adjusted as necessary. Leser relief valves have to be sent to the manufacturer for recalibration and testing Worn Pump: If the circulator pump wears the discharge flow rate will decrease. This will be more apparent at higher pressures. • Measure the flow rate at normal operating pressure and again at ½ normal operating pressure. If the flow increases more than 20% then the pump may need to be replaced. Note: pump wear can be accelerated by poor quality barrier fluid and/or failure to maintain system filtration and contaminant prevent ingression.

Issue	Common Causes
Unable to maintain Level	Low Reservoir Level. Normal seal leakage consumes barrier fluid and will cause the level to drop. • Refill the reservoir to the normal level or greater. Do not excess the High Level.
High Level Alarm	The reservoir has been overfilled. • Lower the reservoir level by draining fluid using the drain port. The seal is or has been reverse pressurized and process has entered the reservoir. • Take an oil sample and check for process contamination.
Filter Differential Pressure Alarm	High differential pressure occurs when the oil filter is clogged. Replace filter to reduce DP and clear alarm.
High Temperature Alarm	Lack of circulation of the barrier fluid could cause temperature increase in the system. The integral temperature gauge on the level gauge should be monitored regularly to ensure the temperature is not beyond recommended levels. Lack of calibration

10. Spare parts

- The system is designed to provide reliable operation under a wide range of operating conditions. However, repairs will be necessary when system components reach the end of their normal life expectancy or when the system has been operated outside of its design capabilities.
- All liabilities and warranties to Flowserve FSD for damage incurred through the use of non-original replacement parts and accessories will be rendered null and void.
- Please note that special manufacturing and delivery specifications exist for all parts of our products manufactured or produced by ourselves and the replacement parts are always offered in accordance with the latest technology and with the most current regulations and laws.
- Flowserve uses SPIR lists with parts to be procured at Flowserve, that can be used for exchange when defect. Contact a Flowserve representative for a SPIR list of the system.

11. Appendix

11.1. 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:

Code	Remarks	Date	Name

Maintenance	W = weekly M = monthly Y = yearly A = adjust R = replace

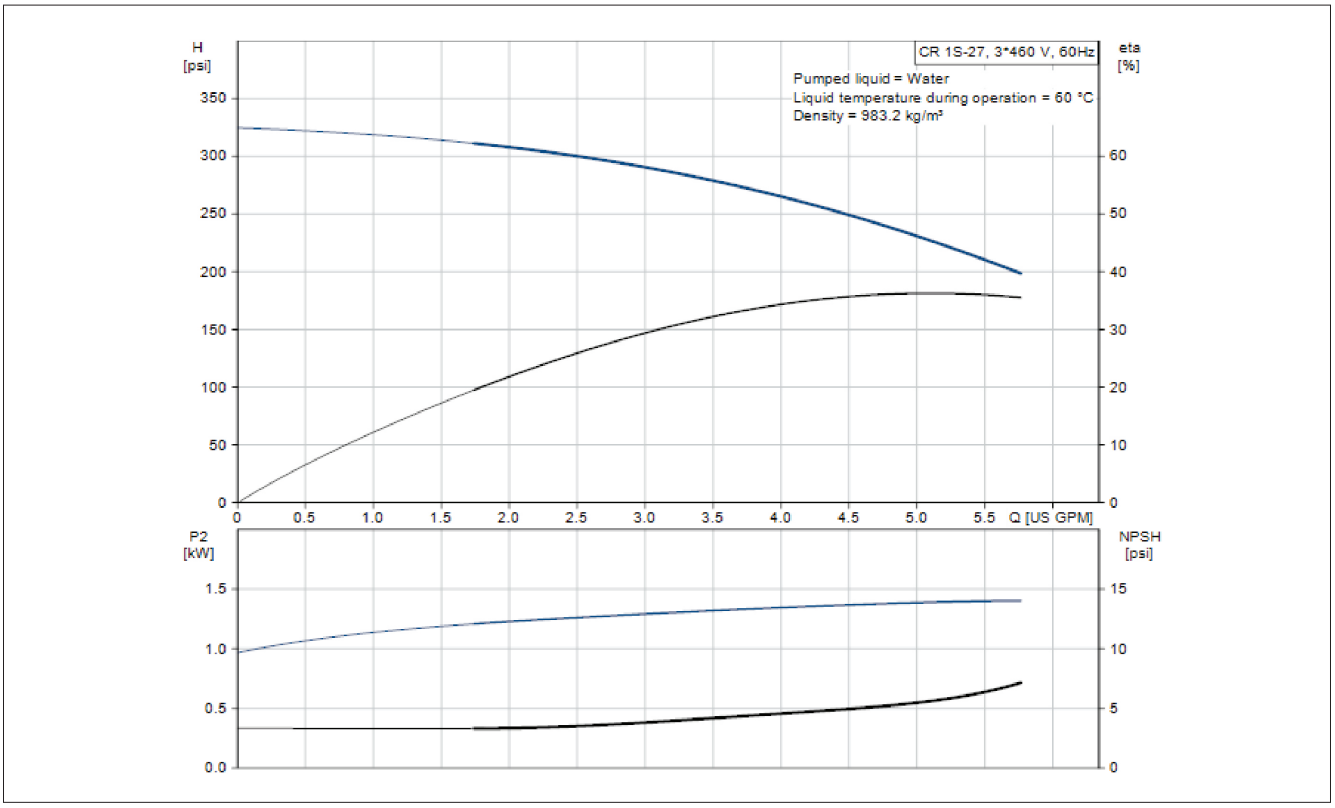
11.2. GA drawings

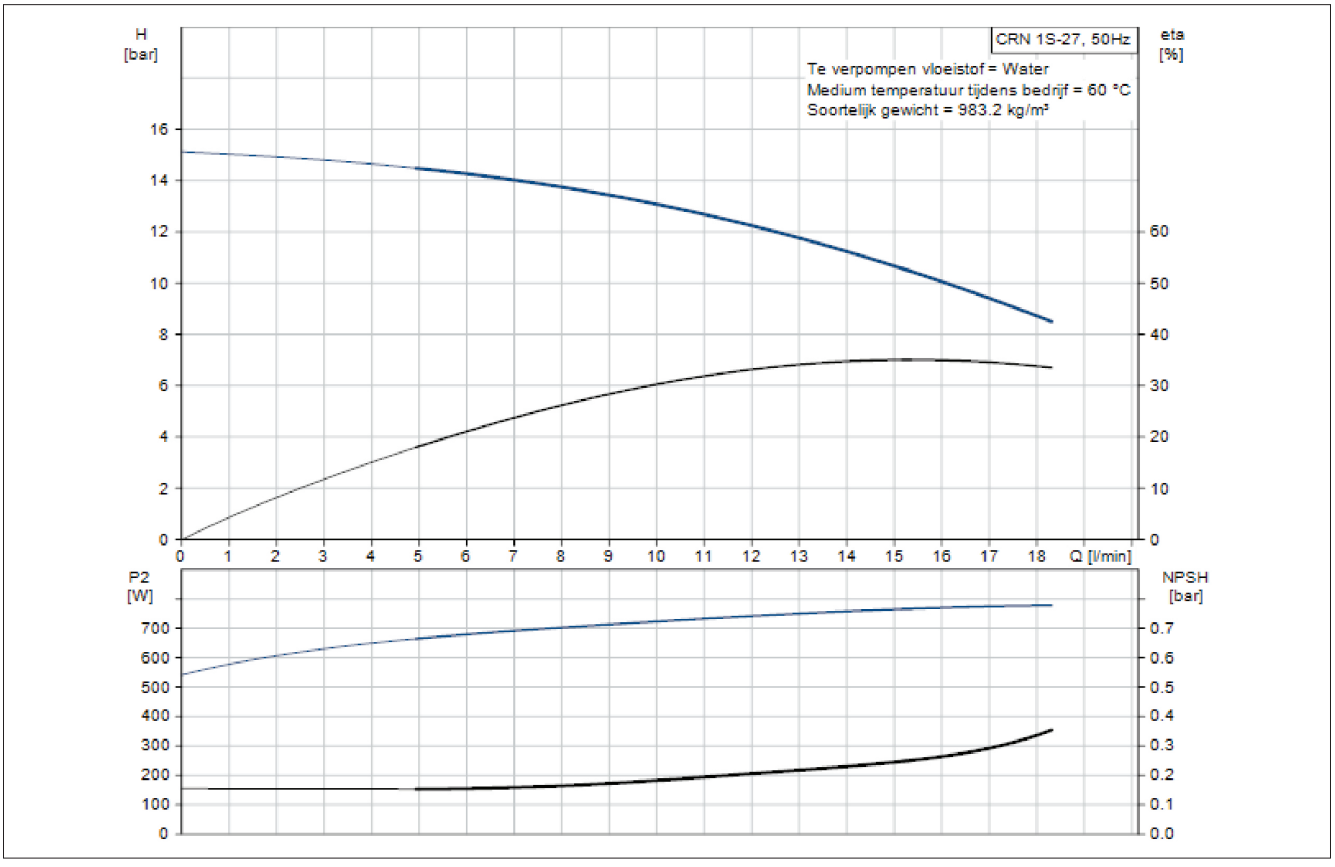
Note: Please see following inserted page(s):

11.3. Vendor documentation

Note: Please see following inserted page(s):

Appendix A - Pump Curves – GI Water





Headquarters
Flowserve Corporation
5215 North O'Connor Blvd.
Suite 700
Irving, Texas 75039-5421 USA

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