Temper®

The Intelligent Solution

Heat Transfer Fluid

BIODEGRADABLE

Temper technology

System Guide

Version 6.2

English

The operational life and reliability of a refrigeration system depends to large extent on how it is installed, the system's cleanliness before first use and how the system's components are handled and mounted in relation to each other.

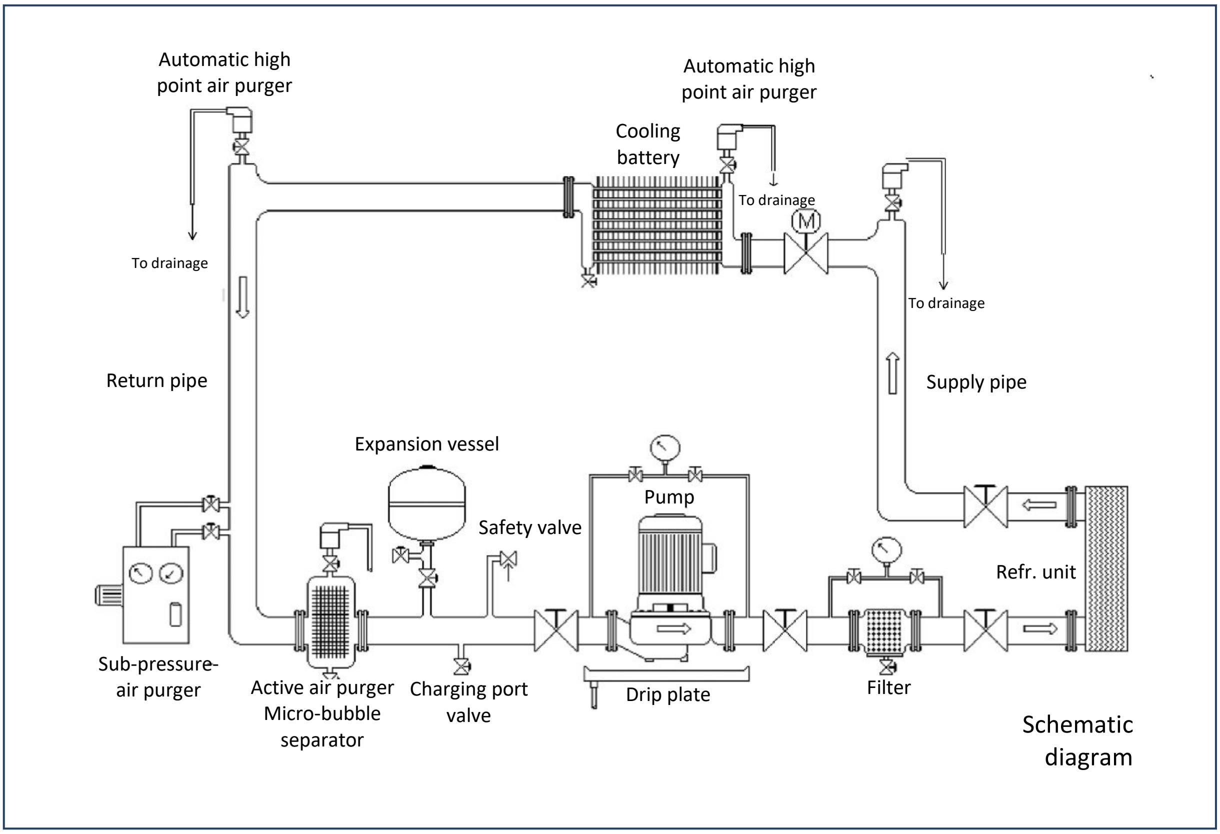

Figure 1. Schematic overview.

This guide only provides general information and recommendations and is based on our present state of knowledge and will be updated as more experience is collected from different installations.

The guide is for the benefit of the installer/design engineer and should be regarded as assistance in their work. However, the installer and designer must themselves possess the necessary skills to design and implement a fully functional indirect system.

Temper Technology disclaim all liability from any misinterpretation and therefore recommend contacting Temper Technology with any questions or concerns.

Temper – System Guide

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1 Important

In General

Before installation - Read the complete System Guide thoroughly

Only use skilled professionals to ensure a well-functioning system

Only use Temper in closed systems

Temper is always delivered ready to use and marked with the freezing point. For example, Temper -20°C = freeze protection of -20°C

Do not mix Temper with other Heat Transfer Fluids or water, only refill the system with Temper

In case of spillage, immediately clean with water

If accidental skin or eye contact occurs – rinse with water. Further information can be found on the product label or in the Safety Data Sheet

Air Purging the system

Use an effective air purging system

Since oxygen promotes corrosion processes, it is crucial to have low oxygen content in the system

A high air (gas) content in the fluid will reduce heat transfer and overall efficiency of the system

If risk of high of high air content in the system and/or elevated temperatures use stainless steel or plastic

Only use automatic air purgers at start-up, see section 7

Use a drainage pipe on all air purgers to avoid external corrosion

Air purging, preferably at +35°C, at start up is important for the systems functioning

Be aware of that air pockets in the system can damage pumps at start-up

Clean and carefully installation

Before and during installation, cover the ends of pipes to prevent dirt and damp from penetrating

Build a tight system to prevent leakage and air from entering the system

Make sure the expansion vessel is correctly dimensioned, concerning size and pressure. This is important to avoid too low static pressure, which can cause unintentionally air inlet.

Connection methods – join the system rigorously, preferably by welding, use shielding gas and clean the system afterwards

Post-tightening of flanges and connectors must be done after pressure tests and at the correct operational temperature

The in-line filter must be installed on the delivery side of the pump

Residues from welding and other dirt can damage pumps and valves severely

Do not allow the system to stand empty with no fluid or only partly filled with fluid, as this may cause surface rust on the insides of the pipes.

If contaminated with large amount of small particles during operation, use a by-pass filter to clean the fluid

Choice of material

Only use high quality components and materials

Suitable materials are stainless steel, copper, and bronze, ABS, PE and more

Unsuitable materials are; galvanized steel, zinc and soft solder

Gasket and packing material – EPDM is recommended, avoid fiber and PTFE (Teflon®), FKM (Viton®)

Use Temper only in systems with components that are suitable for Temper and always contact the supplier of components to ensure compatibility

2 Materials

When designing and installing a secondary refrigeration system it is important to know the requirements regarding material compatibility for all materials used. Additionally, materials, plastic or metal, must be suitable for the current temperature range. Select and install components whose metal compositions are as homogeneous as possible to avoid galvanic corrosion. It is advisable to choose high quality material for a long-life system.

2.1 Piping and Components

Most of the common materials such as bronze, copper, brass, mild steel, stainless steel and cast iron, as well as plastic pipes (ABS, PE) can be used together with Temper, see Table 1a. Plastic materials must be suitable for the system's minimum and maximum temperatures.

Unsuitable materials are; galvanized steel, zinc and soft solder, as stated in Table 1b.

High temperatures involve an increased risk for corrosion. This applies particularly to certain types of less noble materials, for example cast iron. When selecting materials, one must therefore take the operational temperatures in the system into account. The higher the temperature, the better quality of the materials are recommended.

Caution: Do not use zinc, zinc-plated, or galvanized metals in the heat transfer circuits running with Temper. These metals may be used as support beams, electrical conduit ladders, framing, electrical conduit or structural components. If spills or splashes of Temper may occur on any metals – rinse immediately with water to prevent surface discoloration.

Table 1a. Suitable materials:
Stainless steel
Bronze
Copper
Brass (dezincification resistant)
Mild steel
Cast iron
Aluminium
Silver brazing solder
Copper brazing solder
ABS (Plastic)
PE (Plastic)

Table 1b. Not suitable materials:
Zinc
Galvanized steel
Soft solder (tin solder)

2.2 The Galvanic Series

Table 2. The Galvanic Series
Most noble
Graphite
Stainless steel
Silver
Nickel, passivated
Silver brazing solder
Copper-Nickel
Bronze
Copper
Brass
Tin
Cast iron
Mild steel
Galvanized steel
Zinc
Least noble

When selecting materials, it is a good idea to select metals that are as close as possible to each other in the galvanic series, presented in Table 2, to minimize the risk for galvanic corrosion. It is preferable to use the same material throughout the installation.

2.3 Connection methods and sealing materials

Recommended connection methods and gasket materials:

Welding – is always preferable (always use shielding gas).

Brazing – copper or silver solder.

Flange joints (use rubber/EPDM packing) – post-tightening of flanges and connectors must be done after pressure tests and at the correct operational temperature. Insulation work in these places must be carried out after these actions have been completed.

Threaded joints – use traditional flax (hemp) with Locherpaste/Unipak/Omnifit or similar paste. Alternatively, Loctite may also be used. For the right Loctite product, contact your supplier. Avoid Teflon tape or similar.

Connecting Plastic – when connecting plastic (ABS) with metal we recommend using Loctite (to be advised by the supplier). When installing ABS, PE pipes or similar it is important to use the gluing or jointing process recommended by the supplier. The plastic must also be suitable for the operational temperatures. Avoid using plastic flanges with plastic collar sockets due to the great risk of sideways dragging and leakage. Instead, use steel-reinforced flanges.

Avoid compression fittings of various types.

The manufacturers of the various products can advise on which products to be used.

2.4 Gasket and Packing materials

Gasket and packing materials must be suitable for the system's minimum and maximum temperatures as well as Tempers' low viscosity and low surface tension. For suitable gasket and packing materials see Table 3a.

Packing material made of EPDM or nitrile rubber is recommended. Note that even small amounts of mineral oil can destroy EPDM packings.

FKM (Viton®) and PTFE (Teflon®) gaskets have poor flexibility and do not adjust well to temperature fluctuations in the system. Therefore, FKM (Viton®) and PTFE (Teflon®) increases the risk of leakages and are not recommended, see Table 3b. However, these materials are chemically compatible with Temper and can, for example, be used inside valves as sliding disk, see section 4.

- If the lining only has the purpose to protect the metal, Teflon® and Viton® may be used.
- If the lining also has the purpose to seal, neither of these materials are suitable.

Table 3a. Suitable gasket and packing materials are:
EPDM
Butyl rubber
Synthetic rubber
Nitrile rubber
Natural rubber
PE (LD and HD)
NBR (Nitrile Butadiene rubber)
Chloroprene rubber

Table 3b. Not suitable gasket and packing materials are:
Fibre packings
PTFE (Teflon®)
FKM (Viton®)
Teflon tape
Silicone

Compare with the figure 2 below. The sliding disc (3) has primary the function of a lining for sliding the ball. It has no actual sealing purpose. The O-rings (2) have the purpose to seal.

Construction
1. Spindle in chrome plated brass
2. 3 O-rings in EPDM-rubber
3. Disc in PTFE
4. Female thread BSP
5. Body in low DZR brass
6. Ball in chrome plated brass

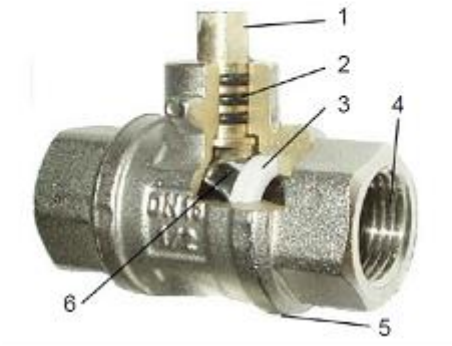


Figure 2. Ball valve with EPDM sealing and Teflon® as sliding disc

3 Pumps

Always inform the pump supplier about which Heat Transfer Fluid is to be used. Follow the pump supplier’s operational and service instructions. The pump should be surface finished externally with a non-rusting drip plate placed below, see figure 3. Stainless steel bolts must be used. The pump should also be surface treated internally. This applies particularly to the “warm side” of the system.

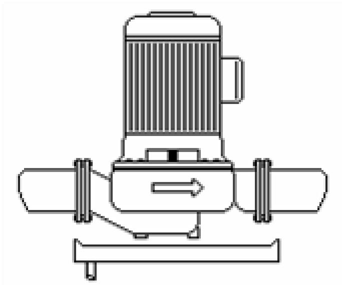


Figure 3. Drip plate placed under the pump

Experience shows that the selection of shaft sealing is important, and that “hard” shaft sealing materials should be selected (more information from the pump supplier).

Before first start of the pump, secure that no air is present to avoid damage of the shaft seal. In order to provide a good cooling effect between the stationary and rotating sealing surface, there should be a little “leakage” in this area. The excess Temper outside the seal should be rinsed away with water regularly.

4 Valves

Consult the appropriate valve supplier about the choice of valves and specify the type of Heat Transfer Fluid and operational temperatures. Valves must be constructed in materials according to the list of materials, see Table 1a, 1b, 3a and 3b. Remember that most types of valves such as balancing valves, control valves and solenoid valves may contain fibre packings; these should be changed to rubber/EPDM seals. PTFE is normally used as seat material for the sliding disk and here serves the purpose well, as Temper is chemically compatible with PTFE. See Figure 2 above.

5 Expansion Vessel

The purpose of the expansion vessel is to even-out variations in volume and pressure that can arise from varying operational temperatures. To ensure this, dimensioning of the expansion vessel must be done according to the manufacture’s recommendations. Always ensure compatibility considering temperatures and materials.

In order to monitor the vessels initial pressure, the expansion vessel must be provided with a shut-off valve and a drain valve.

It is preferred to place the expansion vessel on the pump's suction side, where normally the lowest system pressure is to be found. The purpose of this is to ensure that the pump has enough static pressure to avoid cavitation.

A common error in heat transfer systems is that the expansion vessel is under-dimensioned and with an initial pressure set too low in relation to the system's overall pressure. As a result, the system pressure fluctuates, sub-pressure in the uppermost parts of the system may occur. Further consequences are that the volume changes in the fluid cannot be counterbalanced. If automatic air purgers are installed, these may function in reverse, not as air purgers. For that reason, shut-off valves must be installed between the system and the air purgers and kept closed during operation.

6 Filter

Install the In-line filter on the delivery side of the pump to avoid cavitation. The filter should be easy to clean, and the mesh size should be approx. 0.6 – 0.8 mm.

Filters with a small mesh size, by-pass filters, may be used, especially when you have small particles in the fluid. The filter prevents the particles from damaging the shaft seal in the pumps, valves and other components. If there is high air content in the system this filter also removes precipitations. Consult with the filter supplier to get the optimal mesh size for the by-pass filter.

7 Air purging

Air pocket or presence of air in the system increases the risk for corrosion. For a properly functioning system, it is important to eliminate as much air (gas containing oxygen, carbon dioxide, nitrogen) as possible from the system.

Various problems can arise from poorly air-purged systems, such as:

- Reduced pump capacity
- Reduced heat transfer
- Corrosion, erosion
- Sealing problems
- Regulating problems

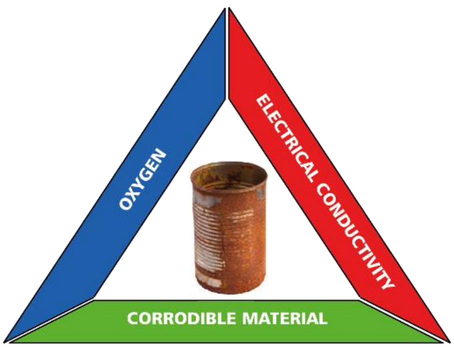


Figure 4a. The corrosion triangle

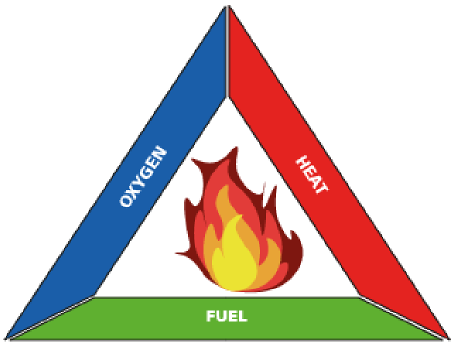


Figure 4b. The fire triangle

Just like the fire triangle, figure 4b, you can imagine the corrosion triangle, figure 4a, with the sides corresponding to oxygen, electrical conductivity and corrodible material. Take away oxygen, heat or fuel and the fire will extinguish. In the same way, you minimize corrosion by reducing oxygen and/or corrodible material.

How much air a fluid can dissolve depends entirely on pressure and temperature. High temperature and low pressure bind less gas than low temperature and high pressure. If possible, at start-up or in a by-pass flow, warm up the fluid to around +35°C – as this facilitates air purging. See also section 10. "Charging the system".

In fluids air is present in different forms:

- Free air (air pockets, air bubbles)
- Bound air (dissolved in the fluid)

The liquid can dissolve more air at low temperature and high pressure than higher temperature and low pressure as explained in figure 5.

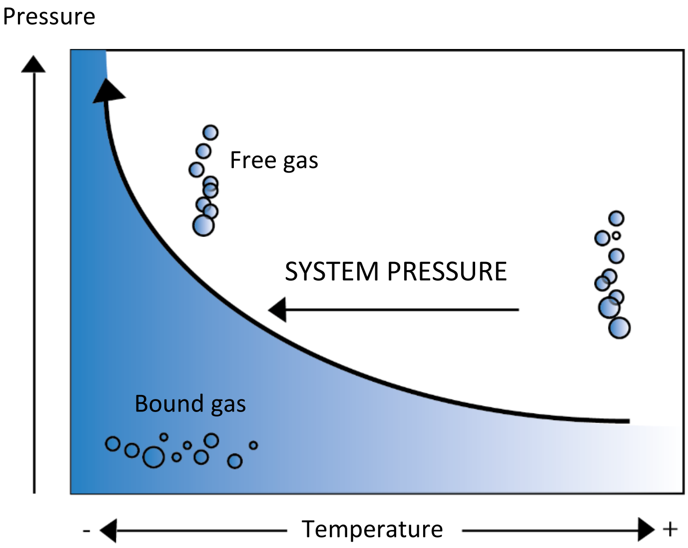


Figure 5. Solubility of air in fluids

Air purging is achieved mainly in the following ways:

1. Manual air purger
2. Automatic air purger
3. Active air purger
4. Sub-pressure air purger
5. Pump

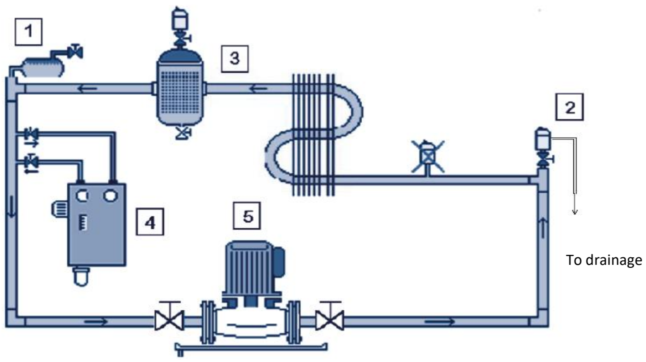
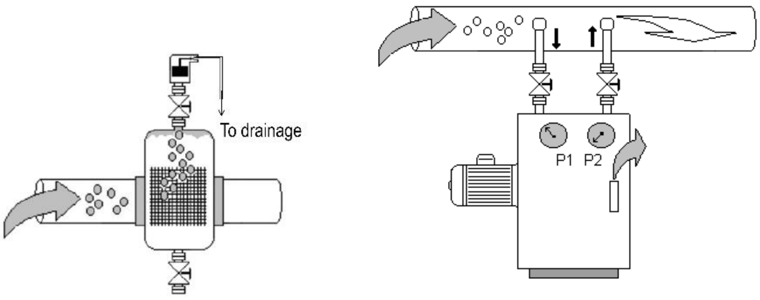


Figure 6. Location of air purgers

Manual or automatic air purgers (high point air purgers) – manual or automatic air purgers must be installed at all high points and must be placed at the end of the pipe's direction of flow, see Figure 6. If automatic air purgers are used, shut-off valves must be installed between the system and the air purgers. Automatic air purgers must only be open during fill up and service. With time, there is a risk that the floating device becomes blocked and that the air purgers will instead function in reverse. Also, see section 5 Expansion Vessel. For manual air purgers you must allow air to rise into an air collector bell. This also applies for the automatic air purgers used during filling but then shut off.

Air separator (micro-bubble separator) – an air separator (micro-bubble separator) is installed where the Heat Transfer Fluid is at its warmest and lowest pressure (return line). The micro-bubble separator only removes free air in the fluid. For micro-bubble separator, see figure 7.

Sub-pressure air purgers (vacuum degasser) – to remove bounded air from the system, sub-pressure air purgers is used, see figure 7. It does not need to be permanently connected with the system. Normally it is sufficient if the sub-pressure air purgers are connected at the start of operational running and for a time, thereafter, depending on the volume of the system. Contact the supplier of the sub-pressure air purgers for more information.



Air separator, micro-bubble separator   Sub-pressure air purger, vacuum degasser

Figure 7. Additional air purging equipment

Use a drainage pipe on all air purgers to avoid external corrosion.

8 Pressure Testing

For pressure test of the system, various methods can be used, such as air, nitrogen or water. Pressure test using air or nitrogen are preferred. With pressure tests using water, one has minimal control of how much water that can be drained when the system is emptied. Water remaining in the system will cause dilution of the heat transfer fluid, which will have a negative effect on the freezing point and the inhibitor content.

9 Cleaning

Before charging, clean the system thoroughly from dirt, welding remains, any remaining water from the pressure test and any other particles. During installation, cover the ends of pipes to prevent dirt and damp from penetrating.

NOTE! Cleaning is very important – otherwise, loose particles can cause corrosion or damage pumps and other components.

10 Charging the System

Temper is always supplied ready-mixed and must not be diluted or mixed with other fluids. The numbers on the label indicates the freeze protection temperature: Temper -20°C = Freeze protection of -20°C. Before filling the system, it is recommended to collect a reference sample.

If possible, the system can be vacuum pumped in order to minimise the risk of air pockets. However, containers and tanks must be isolated from the system to avoid damage to the materials (implosion). Check with the supplier whether installed components can be exposed to sub-pressure. Charge the system from the lowest point and fill it slowly to avoid air pockets. Charging is done with a separate pump or directly from a tank lorry. If possible, raise the temperature in the system to around +35°C to eliminate most of the "micro bubbles" in the system. Raising the temperature from +5°C to +35°C reduces the oxygen solubility in water by a factor of two, as can be seen in figure 8. This effect is similar for Temper. Alternating stop and start the circulation pump (meaning – repeatedly starting and stopping the pump) allows air bubbles to rise and leave through the air purgers devices.

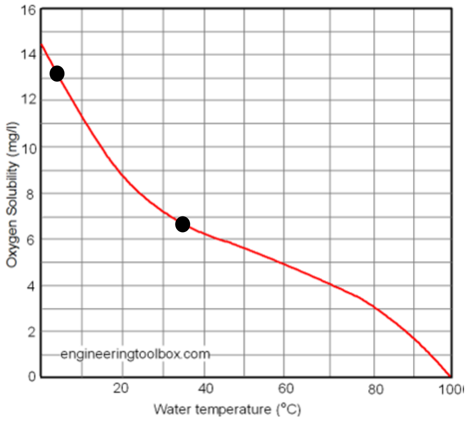


Figure 8. Dissolved or bound oxygen in Fresh Water (at atmospheric pressure) equipment

11 Storage

Store Temper in tightly closed unopened original containers not below its freezing point, in a dry place and out of direct sunlight. The product has good storage stability with a shelf life of at least two years.

When transporting Temper, there are no restriction since the product is not classified. Further information can be found in the safety data sheet.

Fluid drained from the system must be stored in closed non translucent storage containers to protect from sunlight and to prevent evaporation (freezing point may change) and collection of dirt. The fluid may never be stored in galvanised containers.

Shelf life for unopened original container is 2 years from production date if stored as recommended.

Remarks: Slight turbidity with coloured precipitations can occasionally be observed dependent on the quality of raw materials. However, this has no negative effect on the product performance.

12 Operation and maintenance

Inspections of components

Continuous monitoring and maintenance of the plant means that life expectancy increases when detection of flaws or leaks are made earlier. Regularly check the static pressure and components such as pumps; valves etc., so they are functioning properly and that there are no leakages. If leakage occurs it should always be promptly collected and then thoroughly rinsed with water, to avoid any external corrosion.

Disturbances in the operation

Air typically induces reduced capacity, excessive wear or leaks in the system, but can be addressed by continuous air-purging. If you are having problems with; corrosion, dilution, high gas content, leakages or other problems – always investigate the origin of the problems – otherwise there is a substantial risk that the problem reoccurs.

Analysis of heat transfer fluid etc.

Regularly check the fluid according to the instructions either at site (test-kit for control of pH and freezing point of Temper is available from Temper Technology) or send a sample for analysis. In order to come to the right conclusions from the analysis results, it is important to include information about the plant that may be of importance for a proper conclusion of the analysis.

The following analysis are recommended to be made no later than three months after taking the plant in operation, and after that at regular intervals of 12 months:

- The density of the liquid – will tell you the freezing point of the solution
- The pH of the liquid (nominal pH value: 8-9)
- The concentration of metal ions / corrosion products
- The concentration of the anti-corrosive additive in the liquid

Sample taken within 3 months after charging the system can be sent to Temper Technology for a free analysis.

Temper Technology may also provide blue colorant on request to differentiate from other fluids or for easy leakage detection.

Contact your distributor or Temper Technology for more information.

13 Conversion

If converting from another type of heat transfer fluid to Temper, a thorough review and overhaul of the system is essential. This is required to ensure that the components installed are compatible with Temper and that the system is cleaned in the correct way. For more information, please contact Temper Technology.

> **NOTE!** Views and recommendations above are based on our current experience and may be revised in the future.
>
> If you still have questions after reading this System Guide, do not hesitate to contact Temper Technology.