+400°C

THERMINOL®

Heat Transfer Fluids By SOLUTIA™

Applied Chemistry, Creative Solutions

+350°C

+300°C

+250°C

System Design & Maintenance

+200°C

+150°C

+100°C

+50°C

+0°C

-50°C

-100°C

™

System design and maintenance

◆ FLUID LIFE

System design and operating conditions have a critical influence on fluid life. The general design guidance in this leaflet is given to maximise fluid life and to promote safe operation.

All Therminol fluids have published recommended maximum bulk and film temperatures. These maximum use temperatures are based on long term study of thermal stability and should not be exceeded.

Fluid thermal degradation generally results in the formation of volatile products referred to as low boilers. These should periodically be removed from the system, by venting via the expansion tank. Low boilers can be highly flammable therefore relief valves and vents should be positioned at a safe distance from ignition sources and personnel. Solutia recommends the collection and disposal of low boilers.

In the event that products with high molecular weight are formed, these are referred to as high boilers and they are soluble in the fluid and do not cause coking or fouling.

It should be noted that thermal and oxidative stability are radically different issues. Whilst Therminol fluids show outstanding thermal stability at high temperatures, they will not withstand extensive exposure to oxygen at such temperatures for prolonged periods.

◆ FLUID ANALYSIS

Regular monitoring of the fluid characteristics in the system enables detection of deviations and correction. Analysis of fluid samples is provided by Solutia. Reports indicate when corrective action is considered necessary.

◆ FLUID DISPOSAL

Used fluid drained from the system should be disposed of in the way prescribed by the relevant legislation. In certain cases, reclamation may be possible.

System design

◆ MATERIALS OF CONSTRUCTION

The majority of metals and alloys normally encountered in high-temperature systems can be used. However, the use of copper, aluminium and bronze should be kept to a minimum because of their reduced metallurgical strength at higher temperatures. Otherwise see DIN 4754 or equivalent norms for selection of materials and design constraints.

◆ PUMPS

For large flow rates, centrifugal pumps should generally be used with cast or forged steel casings rated to 16 bar. The specification should be appropriate for the temperature duty. A successful and strongly recommended alternative to conventional centrifugal pumps with mechanical seals are magnetic drive pumps or canned motor pumps. Each pump should be fitted with a control device to cut off the heat source in the event of pump failure.

◆ VALVES

Cast steel globe valves with deep stuffing boxes have generally been found to give satisfactory service. Graphite packing is used to seal valve stems on high-temperature systems and generally five rings are specified to assure a reasonable seal. Install valve stems horizontally or in a downward position so that any stem leakage does not enter the insulation. An increasingly used alternative which ensures completely successful sealing is the metal bellows stem sealed valve.

◆ PIPEWORK AND FLANGES

The piping layout for Therminol systems should be sized to provide the required flow rate at an economical pressure drop. Drain valves should be provided at the low points to facilitate cleaning and vent valve connections sited at all high points.

Stresses arising from expansion during temperature changes may be avoided by use of loops and bellows. If expansion loops are used in the pump suction piping, they should be horizontal or vertically downwards otherwise they can collect air and vapour which can seriously hamper pump performance.

In high temperature systems, the entire system pipework should be of low carbon steel to DIN 2401 part 12, St 35, St 35.8 materials. These are equivalent respectively to ANSI B36.3 and ASTM A53 Tp S Gr B / A106 Gr B and ASTM A312 Gr Tp 304 SS. When using heat transfer fluids at below -20°C, the pipework material should be 304SS ASTM A312 Gr Type 304 or ASTM 106 Gr B or ASTM A 333 Gr1.

The tendency to leak through joints and fittings is a characteristic of most organic heat transfer fluids unless these fittings are extremely tight. Monitoring of piping leaks is essential, since fluid saturated insulation may create a fire hazard (see Lagging). On new systems, it is strongly recommended that a maximum number of connections are welded.

Where access is vital or a flanged connection is unavoidable, raised face flanges with weldneck joint material to DIN 2401 part 12, PN16 as per DIN 2633, PN 25 DIN 2634, DIN 2500, DIN 2512 and ANSI B16.5 Class 300. Bolting as per DIN 2507 or other equivalent standard should be used. Install flanges on horizontal pipe runs whenever possible. On vertical runs where occasional leaks can develop at flanges, install tight fitting caps to divert any fluid leakage outside the insulation.

◆ GASKETS

For flange connections in high temperature heat transfer systems where all welded construction is not possible, use stainless steel spiral wound gaskets with a flexible graphite insert. As an alternative, pure graphite gaskets may be used. Material is described in DIN 3754 part 1. A list of manufacturers is available from Solutia on request.

◆ FILTERS

Before startup of a new system, install a wire mesh strainer of approx. 120 micron mesh size in the pump suction.

When operating where solids and contaminants might enter or be generated in the system, it is advisable at the design stage to provide connection points to allow for later installation of a bypass loop between the discharge and suction sides of the pump. Filters that have generally been used are glass fibre sting-wound cartridges or sintered metal elements in the 20-30 micron range.

◆ **LAGGING**

Insulating materials which have become saturated due to leakage of heat transfer fluid are a potential fire hazard. The risk of combustion normally occurs at temperatures above 180°C.

Routine inspection and prompt elimination of leakage is therefore essential. The use of cellular glass insulation (e.g. Foamglas-Pittsburgh Corning) which resists saturation due to its closed cell structure is particularly recommended in areas of potential leakage such as near instrument connections, valve packing glands, flanges and other connections.

◆ **EXPANSION TANK**

After the heater, the expansion tank is the most critical element and its design is directly connected with the design of the entire system. We therefore recommend that a qualified engineering company or heater manufacturer should be consulted.

The expansion tank layout illustrated in the Figure performs the following functions:

1) maintains a static pump suction head
2) compensates for temperature related volume and pressure changes
3) provides a means of venting moisture and low boilers
4) prevents fluid oxidation

The expansion tank has to be positioned at the highest point of the system and connected to the inlet side of the pump. It may also be connected to the main circulating loop at the lowest pressure point.

For heating circuits, the expansion tank should be sized so that it is 1/4 full at ambient temperature and 3/4 full when the system is at operating temperature; vice versa for cooling. Fluid expansion can be 25% or more depending on the fluid choice and the operating temperature range.

The expansion tank volume has to comply with local national legislation and overflow line may be usefull to reduce its sizes in many countries.

The expansion tank should also serve as the main venting point for the system, and for optimum venting it should be provided with feed and discharge lines enabling the entire fluid flow to be directed via the expansion tank. This “double-leg” design provides higher flexibility in normal operation when compared with the more sophisticated single leg design with degassing vessel. However, with careful attention to venting systems both will give satisfactory service. The vent line should be fitted with a valve E to facilitate the purging of water and air when charging the system for the first time and all vent lines should be routed to a safe area, preferably via a cooled condenser.

Protection of the heat transfer fluid against oxidation is essential. Contact with oxygen can occur in both the expansion tank and in the collection tank, if the latter is fitted. Unless the temperature in these vessels can be limited to below 60°C the heat transfer fluid should be blanketed with an inert gas or, if this is not feasible, air contact can be minimised by the use of any cold seal trap. DIN 4754 describes these options in detail.

Inert gas blanketing (usually with nitrogen) is the most effective way of preventing fluid oxidation.

Supply and discharge of inert gas, controlled by pneumatic valves in the inert gas supply and tank venting line provide optimum protection.

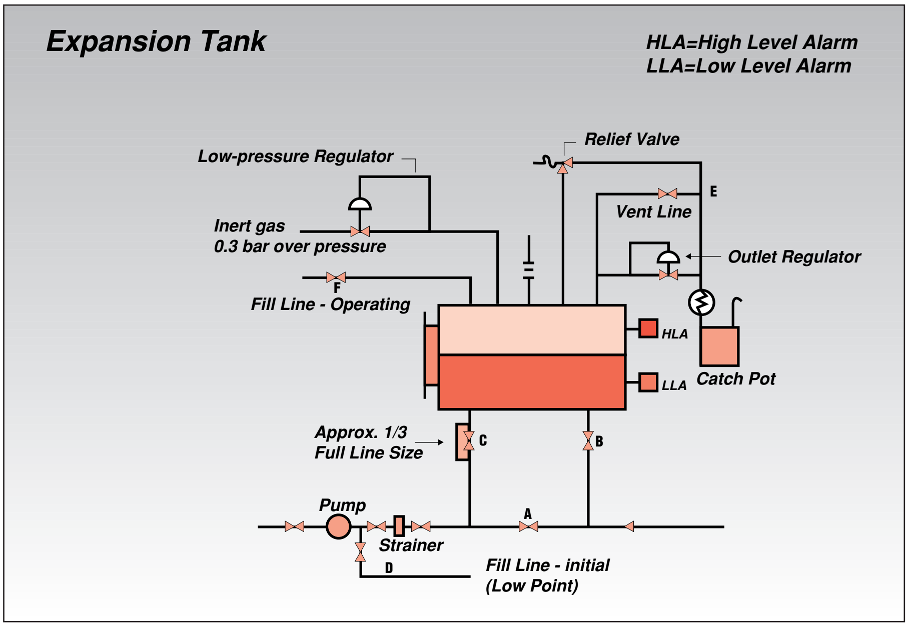
Startup, venting and normal operation of the system

The system should initially be charged via valve D with valves B, C and E open, so that optimum venting of any air in the system is ensured.

Before the first charge with heat transfer fluid there will usually be some moisture in the system, (for example due to condensation in pipes and on the walls of vessels) and during charging, the fluid mixes with this water which must be vented via the expansion tank otherwise pump cavitation may occur. This is effected by gradually heating the fluid and limiting the temperature in the expansion tank to approx. 130°C. The circulation can be regulated by partially opening and closing valves A and B. Venting is complete when no more fluid enters the catch pot. The normal fluid circuit is then established by first opening valve A and then closing valves B, C and E. The inert gas pressure can then be set.

The above process is also carried out for venting «low boilers».

For normal system operation, valve A is open and valves B, C, D, E, and F are closed. Routine fluid replenishment can be made via valve F or D.



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