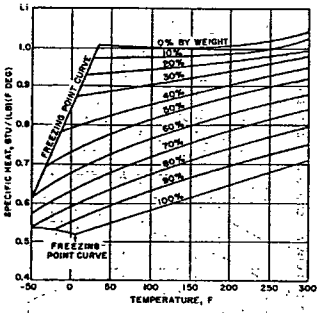


Fig. 17 .... Specific Heat of Aqueous Solutions of Ethylene Glycol

The use of certain oxidants such as sodium chromate in conjunction with glycol solutions should be avoided, as premature oxidation of the glycol can occur. Generally, combinations of the two types of additives, inhibitors and stabilizers, offer the best corrosion resistance in a given system. Commercial inhibited glycols for various applications are available from several suppliers.

## Service Considerations

*Storage and Handling.* Inhibited glycol concentrates are stable, relatively noncorrosive materials with high flash points. Under some conditions they can be stored in mild steel, though stainless steel or aluminum vessels or even containers lined with a baked phenolic or vinyl resin coating may be required. Regarding container selection, it should be pointed out that the chemical properties of an inhibited glycol concentrate can be substantially different from that of its dilution, and therefore the effect of the concentrate on the particular container components in contact with the glycol should be known.

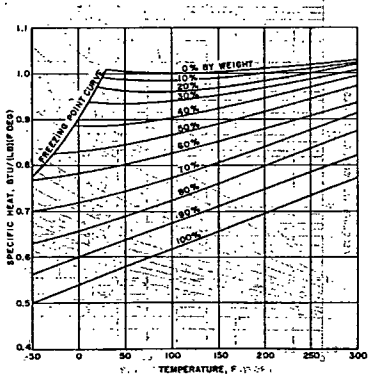


Fig. 18 .... Specific Heat of Aqueous Solutions of Propylene Glycol

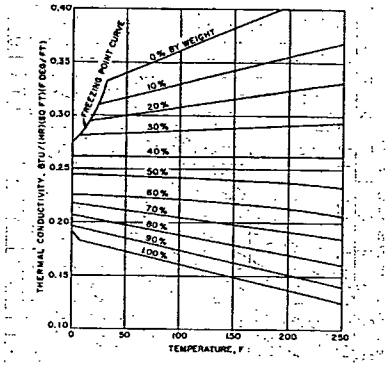


Fig. 19 .... Thermal Conductivity of Aqueous Solutions of Ethylene Glycol

Transfer pumps should be chosen only after consideration of the temperature-viscosity data. Centrifugal pumps with electric motor drives are often recommended. Rubber-impregnated asbestos or its equivalent is considered a suitable pump packing material; a mechanical seal may also be satisfactorily employed. Transfer piping of mild steel with a minimum diameter of two inches is generally suggested. Welded construction is normally used in conjunction with the piping, although flanged and gasketed joints are also satisfactory.

*Preparation Prior to Application.* Before an inhibited glycol

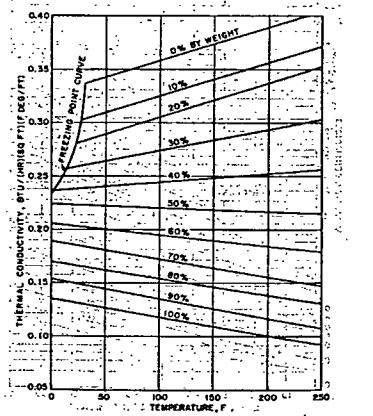


Fig. 20 .... Thermal Conductivity of Aqueous Solutions of Propylene Glycol



is charged into a new or old system, residual contaminants such as sludge, rust, brine deposits, oil, etc., should be removed as completely as possible, in order that the contained inhibitor may function properly. It is generally better to avoid the use of strong acid cleaners; however, if they are required, inhibited acids should be considered. In any event, care should be taken to insure that the cleaning agent is completely removed before charging with inhibited glycol.

The quality of the water of dilution must be considered, because water from some sources may contain corrosive elements which reduce the effectiveness of the inhibited formulation. Preferably, surface waters that are classified as *soft* and are low in chloride and sulfate ion content (less than 100 ppm each) should be employed. The use of distilled, deionized, or condensate water should help to avoid the undesirable effects of poor quality water.

The decision to employ an inhibited glycol should be consistent with potential temperature factors. In systems where a high degree of aeration is encountered, a maximum bulk fluid temperature of 180 F is proposed, but up to 250 F may be permissible in a pressurized system if air intake is kept to a minimum. Maximum skin temperatures should not exceed 300–325 F, and should be even lower if the hot wall surface area is large in proportion to the quantity of fluid circulated. Nitrogen blanketing is often helpful in minimizing oxidation when the system is operating at elevated temperatures for extended periods.

From the low temperature standpoint, operation below − 60 F is not recommended, although slightly lower temperatures may be tolerable in certain operations where the solution temperature is cycled periodically to a higher level.

It is usually advantageous to install suitable filters, as the removal of active sludge and other contaminants may be critical. It has been noted that, in some instances, inhibitors have been rapidly and completely adsorbed by such contamination, thereby leaving the fluid ineffective for corrosion inhibition.[9] Such adsorption should be considered when selecting a filter.

*Inhibitor Maintenance.* One of the most important aspects in maintaining a glycol solution in a relatively noncorrosive condition over a long period of time is the inhibitor monitoring and maintenance schedule. The desirability of establishing and maintaining a satisfactory inhibitor level cannot be overemphasized. However, a specific schedule is not always easy to establish, since the rate of inhibitor depletion depends upon the particular conditions of use. Analyses of samples immediately after installation, after 2 to 3 months service, and after 6 months, should establish the pattern for such a schedule. Visual inspection of the solution and filter residue is often helpful in judging whether or not active corrosion is occurring.

In general, properly inhibited and properly maintained glycol solutions should provide advantages in corrosion protection as compared to brine solutions in most systems. An indefinite service life, however, should not be expected. The preservation of costly equipment is, perhaps, the chief advantage of these materials. Indiscriminate mixing of inhibited formulations should be avoided unless known to be compatible. In this connection, the replacement of brine systems with inhibited glycol should be approached with caution because of the potential incompatibility of the brine components with these glycol formulations.

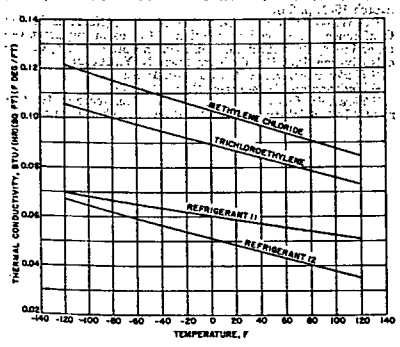


Fig. 21 .... Thermal Conductivity of Liquid Halocarbon Coolants

Table 4 .... Freezing and Boiling Points of Halocarbon Coolants

| Refrigerant No. | Refrigerant Name | Freezing Point, F | Boiling Point, F |
|---|---|---|---|
| 12 | Dichlorodifluoromethane | −252 | −21.6 |
| 11 | Trichloromonofluoromethane | −168 | 74.8 |
| 30 | Methylene Chloride | −142 | 103.6 |
| 1120 | Trichloroethylene | −123 | 188.4 |

## HALOCARBONS

Many of the common refrigerants can be employed as secondary coolants as well as primary refrigerating media. Favorable properties for applications as heat transfer fluids include low freezing points, low viscosities, nonflammability, and good stability. Physical and thermodynamic properties for all the common refrigerants are presented in Chapters 19

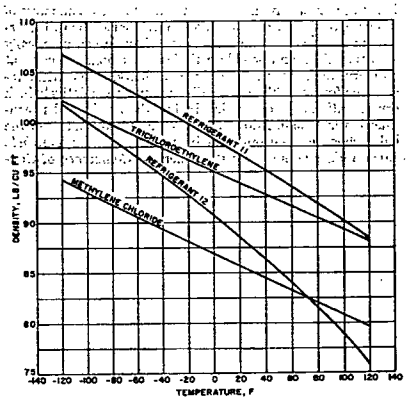


Fig. 22 .... Density of Liquid Halocarbon Coolants