M.I. 1748*

EM MAINTENANCE INSTRUCTION

SERVICE DEPARTMENT · ELECTRO-MOTIVE DIVISION · GENERAL MOTORS · LAGRANGE, ILLINOIS

ENGINE COOLANT — EMD AND CDED ENGINES

DESCRIPTION

Coolant is circulated throughout the engine to provide the means for heat transfer from the engine components. Water, corrosion inhibitor and, in some applications, antifreeze are used in coolant solutions.

Because the function of the coolant is so necessary to the operating efficiency of the engine, it is important that the selection of a coolant solution be carefully considered.

COOLANT SOLUTIONS

A coolant suitable for use in EMD and former CDED engine cooling systems must meet four basic requirements:

1. It must adequately transfer heat energy through the cooling system.
2. It must not form scale or sludge deposits in the cooling system.
3. It must not cause corrosion within the cooling system.
4. It must not deteriorate any of the cooling system seal materials.

These requirements are normally satisfied by combining a suitable water with a reliable corrosion inhibitor. Certain operating conditions may dictate the use of antifreeze-coolant. In this case the basic requirements can be satisfied with a combination of suitable water and an ethylene glycol type antifreeze which contains an adequate corrosion inhibitor. However, the use of antifreeze involves special consideration regarding Items 1 and 3 above. This will be discussed in detail in the section on antifreezes.

It should be recognized that coolants which perform satisfactorily in other applications may not be satisfactory for use in EMD and former CDED engine cooling systems. Differences in coolant volume-to-cooling system surface area ratios, coolant velocities, temperatures, and the types of materials employed make such comparisons meaningless.

The formulation of "home made" inhibitors and antifreezes is not recommended since such processes are difficult to monitor and control. The ready availability of suitable proprietary products makes these practices uneconomical and impractical.

Water quality should be evaluated whenever a new water source is to be used, or when changes in existing water sources occur. Likewise, quality of the coolant solution should be tested when a new engine is put into service, and at regular intervals thereafter. The quality of coolant should always be known and should be maintained as required.

WATER

When determining the suitability of water for use in coolant, four characteristics must be examined. These are the concentrations of chlorides, sulfates, total dissolved solids, and total hardness in the water. These materials are objectionable for a number of reasons: Chlorides and/or sulfates will promote

* This publication supersedes all information previously released regarding engine coolants.

corrosion, while hardness will cause the deposit of sludge and/or scale. Depending on its components, total dissolved solids can cause scale deposits, sludge deposits, corrosion, or combinations of these.

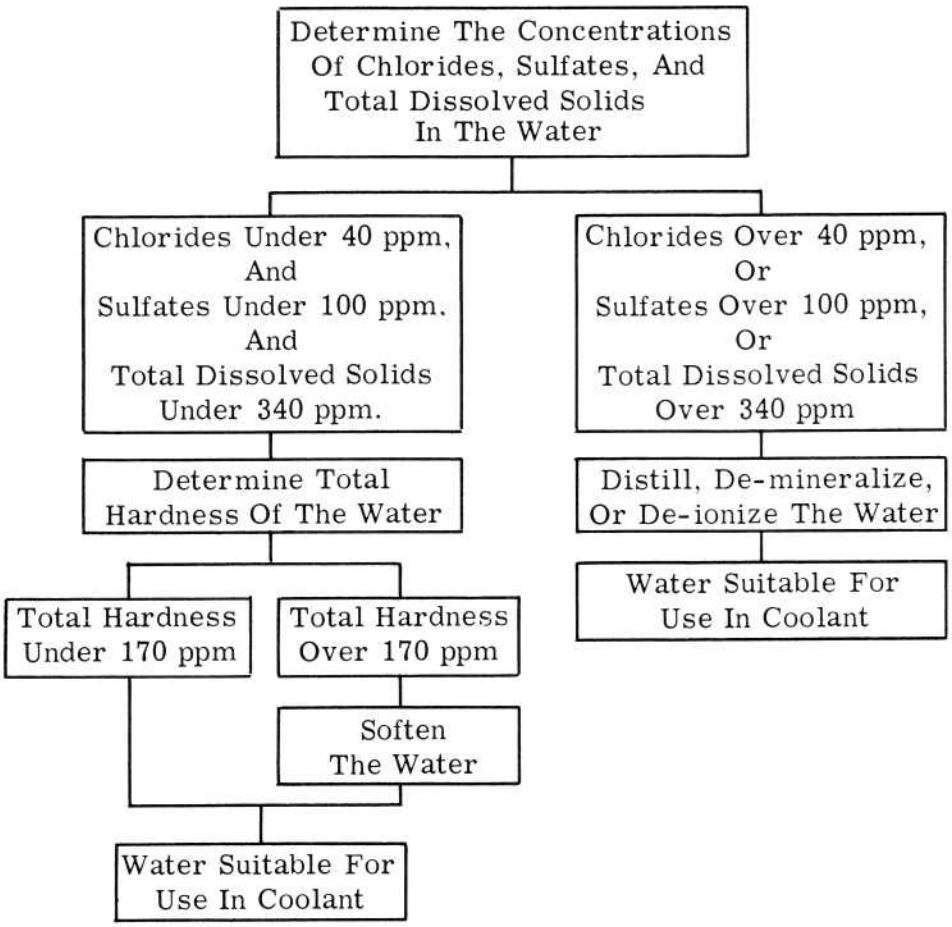
It should be recognized that chlorides, sulfates, and hardness are among, but not necessarily all, the materials which can make up dissolved solids. Each of these three categories could account for none, part, or all of the dissolved solids in a given water. Miscellaneous substances can account for substantial dissolved solids concentrations; even though chlorides, sulfates, and hardness are not present.

TABLE 1

	PARTS PER MILLION	GRAINS PER GALLON
Chlorides (Maximum)	40	2.5
Sulfates (Maximum)	100	5.8
Total Dissolved Solids (Maximum)	340	20
Total Hardness (Maximum)	170	10

Refer to Table 2 for evaluation of water intended for use in a coolant solution.

TABLE 2



Water which does not exceed the limits given in Table 1 is considered suitable for the formulation of engine coolant.

For the purpose of coolant formulation, steam condensate can usually be considered equivalent to distilled water.

In some instances, water containing up to twice the recommended maximum amount of sulfates or chlorides can be used in coolant, provided a higher than the normal inhibitor dosage is used. Electro-Motive Service personnel should be consulted if there are questions regarding a specific application.

CAUTION: Uninhibited water should never be used to fill a cooling system because of the possibility of rapid corrosion and rusting. This applies to all uninhibited water but is especially true for distilled, de-ionized, or demineralized waters, including steam condensate. Prior to application, the water should be mixed with the inhibitor or inhibited antifreeze which is to be used in the coolant.

INHIBITOR

Two basic types of inhibitors, chromate and borate, are most commonly used in EMD engine cooling systems where non-antifreeze coolants are employed. Typical products and information regarding their application are as follows:

NOTE: The units of measure throughout this publication are those commonly used in the United States.

Dry Measure:
16 Ounces = 1 Pound

Liquid Measure:
32 Ounces = 1 Quart
4 Quarts = 1 Gallon

CHROMATE TYPE

NOTE: Chromate type inhibitors should not be used in cooling systems containing ethylene glycol antifreeze solutions.

1. Nalco 38 - Nalco Chemical Company

2. Dearborn 517 - Dearborn Chemical Company

These products are marketed in the dry pellet and/or pulverized form. When the cooling system is first filled, use either one of these products at a concentration of 0.6 ounces per gallon of water. Thereafter, the inhibitor concentration should be maintained at a minimum of 0.4 ounces per gallon. Make-up coolant should contain at least 0.4 ounces per gallon.

To avoid possible skin irritation, the usual safety and hygienic precautions should be exercised when handling chromate type inhibitors.

BORATE TYPE

1. Nalco 39 Pellet or Pulverized - Nalco Chemical Company

2. Nalco 40 Pulverized - Nalco Chemical Company

3. Dearborn 527 - Dearborn Chemical Company

When the cooling system is first filled, use any one of the above products at a concentration of 1 ounce per gallon of water. Thereafter, the concentration should be maintained at a minimum of 0.75 ounces per gallon. Makeup coolant should contain the 0.75 ounce per gallon dosage. Pellet and pulverized borate inhibitors are difficult to

dissolve. Therefore, it is suggested that these products be pre-mixed into a water slurry prior to preparation of the coolant solution.

4. Nalco 39 Liquid - Nalco Chemical Company

   When the cooling system is first filled, use at a concentration of 3 fluid ounces per gallon of water. Thereafter, the concentration should be maintained at a minimum of 2 fluid ounces per gallon. Make-up coolant should contain at least 2 fluid ounces per gallon.

For your convenience, EMD can supply some of the inhibitors mentioned above. Quantities and part numbers are as follows:

Nalco 39 Liquid	5 Gallons	8241520
Nalco 39 Pulverized	75 Ounces	8224785
	50 Pounds	8256673
Nalco 38 Pellets	40 Ounces	8253607
	50 Pounds	8253581

Test kits for evaluating Nalco and Dearborn inhibitor concentrations may be purchased from Nalco Chemical Company and Dearborn Chemical Company respectively. Inhibitor concentrations should not be determined by the color of the coolant. Experience has shown that this practice can give very inaccurate indications.

The use of soluble oil type inhibitors or vapor phase type cooling system preservative is not recommended.

ANTIFREEZE

With certain qualifications, ethylene glycol type antifreezes can be employed successfully in EMD and former CDED engine cooling systems. Alcohol type antifreezes are not recommended.

As mentioned previously, the ready availability of suitable proprietary brands of ethylene glycol products makes the formulation of "home made" antifreezes both uneconomical and impractical. Antifreeze brands which have been frequently and successfully used in EMD and former CDED engine cooling systems include:

1. Ambitrol CN - The Dow Chemical Company
2. Ambitrol FL - The Dow Chemical Company

   Ambitrol CN is an inhibited ethylene glycol antifreeze concentrate while Ambitrol FL is a completely formulated coolant containing inhibited ethylene glycol concentrate and de-ionized water. The FL product is designed for use in areas where water suitable for coolant formulation is not available.

   Both Ambitrol products can be re-inhibited with Ambitrol inhibitor when the original inhibitor charge becomes depleted.

3. Prestone - Union Carbide Corporation

   The Prestone inhibitor system includes a polar oil that is not soluble in either water or ethylene glycol. Coolants containing Prestone must be well agitated immediately preceding application to a cooling system in order to ensure thorough dispersion of the polar oil. Immediately after adding Prestone coolant to a cooling system, it would be desirable to operate the engine to ensure that the polar oil is distributed throughout the system. This will minimize any tendency of the polar oil to agglomerate.

4. Zerex - E. I. du Pont de Nemours & Co.

Fig. 1 depicts the freezing points of typical ethylene glycol antifreeze and water solutions. The freezing points of specific brands may vary slightly from prints

shown on the graph. However, the graph is sufficiently accurate for use in estimating antifreeze requirements, regardless of brands.

Proprietary brands of antifreeze should be used at no less than 30% and no more than 60% in the coolant solution. Solutions of less than 30% do not provide sufficient corrosion inhibitor protection for EMD and former CDED engine cooling systems. On the other hand, there is nothing to be gained by using antifreeze concentrations of over approximately 60%. As can be seen in Fig. 1, the freezing point actually occurs at higher temperatures as antifreeze concentration is increased over the 60% level.

Although the use of antifreeze is acceptable within the 30 to 60% range, it is not desirable to use more than necessary within that range. For example: if a 40% solution will provide the required freezing protection, then nothing more than a 40% solution should be used. Aside from the fact that this is good economics, we recommend against the use of excessive

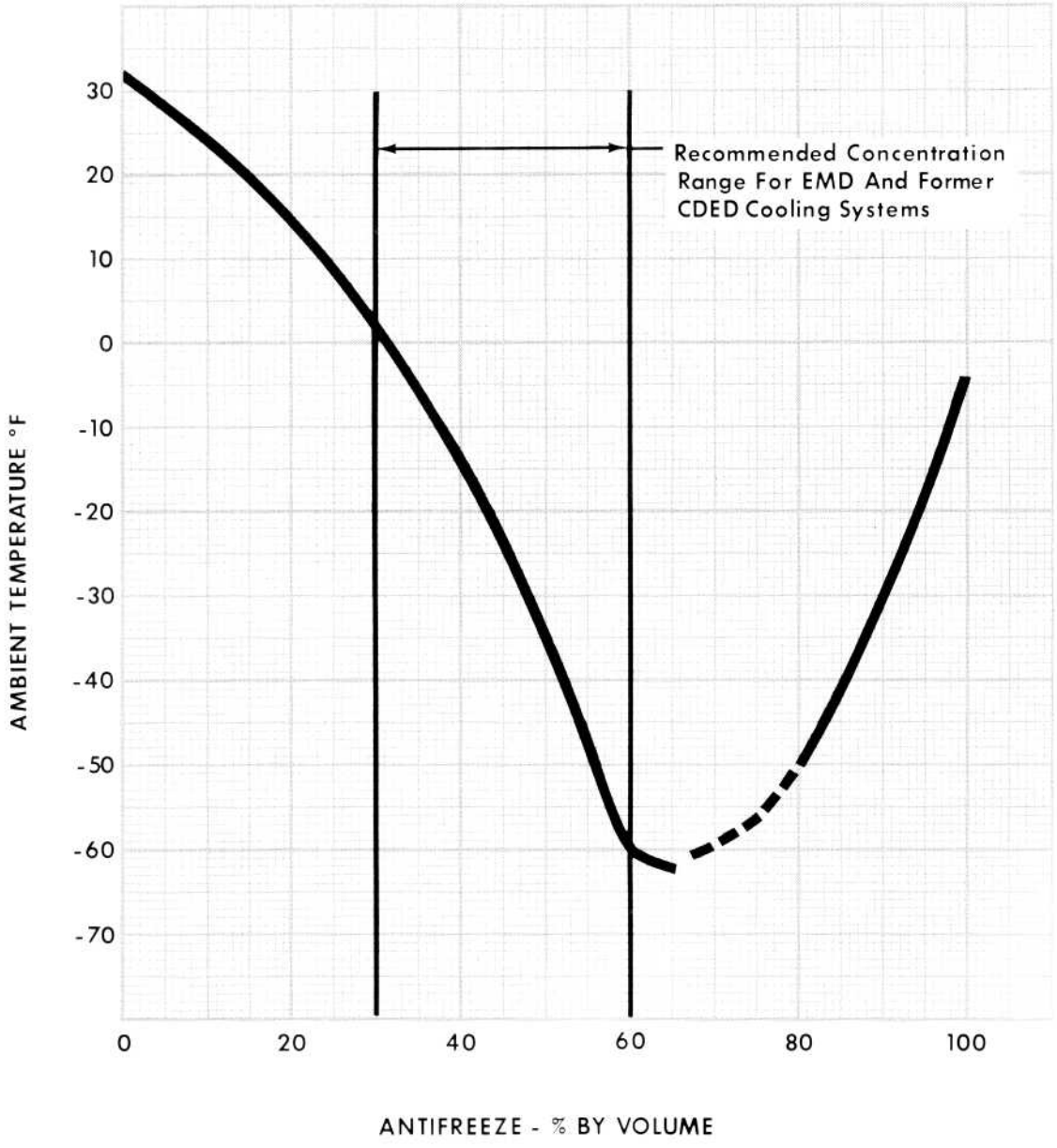


Fig. 1 — Freezing Points Of Aqueous Solutions Of Ethylene Glycol Antifreezes

concentrations of antifreeze because of the adverse effects on heat transfer within the cooling system. As the antifreeze concentration in the coolant is increased, the thermal conductivity of the coolant decreases.

In some instances a supplemental corrosion inhibitor may be required; even in new coolants containing over 30% antifreeze. The decision to use a supplemental inhibitor would be influenced by factors such as water quality and antifreeze brands. It is suggested, that where the use of antifreeze is contemplated, an Electro-Motive representative be supplied with the following information. He will then be able to comment as to the suitability of the proposed application.

1. The proposed antifreeze brand name, if the antifreeze is of United States manufacture.
2. A two quart sample of the proposed antifreeze, if it is not manufactured in the United States.
3. An analysis of the water which is proposed for use in the coolant. This should include the characteristics noted in Table 1.
4. The expected high and low ambient temperatures which the equipment will encounter.

Litho in U.S.A.