

ANTIFREEZE SOLUTIONS FOR
RESERVE ENGINE COOLING SYSTEMS
AND TREATMENT FOR RUST

1. GENERAL

1.01 This section covers application of rust inhibitors and antifreeze in power plant reserve engine cooling systems and the testing and cleaning of such systems.

1.02 This section is reissued for the following reasons:

- (a) to cover use of new rust inhibitor.
- (b) to omit practice of adding rust inhibitor in cooling systems containing antifreeze.
- (c) to specify life of antifreeze and rust inhibitor.
- (d) to emphasize need for soft water.
- (e) to add acidity test of coolants.
- (f) to refer to ethanol instead of alcohol.

Changes are marked by arrows

1.03 The term cooling system as used herein refers to radiators, water jackets of engines, cooling tanks, and associated piping and rubber hose. It also includes the engine side of heat exchangers. It does not include portions of the cooling system through which city running water flows.

1.04 Cooling systems should be free from leaks to avoid losing rust inhibitor and antifreeze, if for no other reason. Additions of ethylene glycol often bring to light leaks not previously observed. When any work is done in accordance with this section, check for leaks. Add new water pump packing, gaskets, or rubber hose as required and tighten cylinder head nuts.

1.05 When any work is done involving the removal of rubber hose, check the condition of the inside of the hose and replace by new sections if they show any signs of wear or disintegration. Scraps of rubber from worn out hose may readily cause stoppage of the cooling system and overheating of the engine.

1.06 Cooling water red from rust should be drained, the cooling system cleaned (Part 6) and fresh water and rust inhibitor (Part 3) or antifreeze (Part 4) added. Water treated with dichromate-type rust inhibitor may be a color between amber and

orange but this color need not be confused with the red caused by rust.

1.07 Some cooling system failures thought to be due to antifreeze or rust inhibitor, may be due to the use of hard water, particularly where high temperatures are reached in restricted passages as around immersion-type water heaters. Only soft water should be used in engine cooling systems. It should be noted that even surface water may be hard in some areas, for example, limestone areas. If in doubt as to the suitability of local water, discuss with supervisor. He may have access to previous reports or analyses on the water or be able to determine whether or not the water had been approved for use without treatment in boilers. Water which has been found by the telephone company or other companies such as power companies to be too hard for boilers, hot water heaters, etc. is also too hard for this application. Where local water is unsatisfactory, local conditions will determine most economical source of supply.

1.08 In some cases, an unauthorized package of inhibitor of unknown analysis has been shipped with engines. This should be discarded unused. If it has been applied, the cooling system should be drained and flushed before inhibitors or antifreezes are added per this section.

1.09 Hot engine blocks are sometimes cracked due to pouring cold water or other liquid into the system too soon after running. This is not likely to occur where engine temperatures were not excessive before draining and the added liquid is not colder than tap water. It is safer, however, to let the engine cool 10 to 15 minutes after draining before adding cool liquids.

1.10 As specified herein, neither dichromate-type inhibitor nor oxalic acid should be used in cooling systems where they would come in contact with aluminum or zinc (including galvanizing). Approved engines do not have such parts except in immersion oil coolers. Galvanized piping and tanks may be furnished with some of the larger engines. An occasional galvanized pipe fitting can be ignored but long runs of galvanized piping and galvanized tanks would make the use of the above materials objectionable.

2. GAUGES AND MATERIALS (See A710.011)

Acid, oxalic

Antifreeze

Ethanol type (previously called alcohol)

Ethylene glycol type

Methanol type

Cloth, cleaning, twill jean, D-98063

Hydrometer, syringe, with thermometer,

E. Edelman Co., Chicago, "Zero-Tester"

Model 20 for ethanol

Model 150 for methanol

Model 180 for ethylene glycol

Model 808 for all three (Previously

Model 116)

Inhibitor, rust

→ Inhibitor, acid and rust, No. 7 (powder)

Inhibitor, rust, automotive (dichromate)

Kerosene

Soda, washing, commercial

→ Tester, Alkacid, Fisher

↖ Note: Most of the above chemicals will attack painted or varnished surfaces, particularly in strong concentrations and if the exposure is for extended intervals. Avoid spillage and flush spilled material from painted or varnished surfaces with water promptly.

3. RUST INHIBITOR

↖ Caution: Rust inhibitors are poisonous when taken internally and the dichromate type in concentrated solutions is injurious to the skin.

3.01 Cooling systems not containing antifreeze should have rust inhibitor added whenever the system is filled or drained and refilled. See 3.04. When duPont No. 7 acid and rust inhibitor is used, apply on the basis of one ounce of powder per gallon of coolant. When dichromate-type inhibitor is used, apply on the basis of 3/4 oz. per gallon of coolant. More than specified amount is acceptable but less than specified amount, in the case of the dichromate type, is likely to be harmful.

Note: The duPont company use the No. 7 designation for a variety of other products including polishes and another rust inhibitor in liquid form which is not approved herein. The approved variety is a powder in a 5 oz. package. It is known as "No. 7 acid and rust inhibitor."

3.02 In the absence of local preference to the contrary, it is suggested that the cheaper and more generally available dichromate-type inhibitor be used except:

(a) dichromate-type inhibitor shall not be used where there is aluminum or zinc (including galvanizing) in the cooling system. See 1.10.

↖ (b) dichromate-type inhibitor should not be used in engines having immersion water heaters.

(c) only duPont No. 7 acid and rust inhibitor should be used at time of filling if antifreeze is to be added in a few months and draining plus flushing of the cooling system before adding the antifreeze is impracticable.

3.03 Where the inhibitor is in lumps or large crystals, it must be dissolved in a small amount of hot water before pouring it into the cooling system. Inhibitor in form of powder, granules, or small crystals may be poured directly into the cooling system after running the engine long enough to bring the water up to 120F or higher. After adding inhibitor, run for 15 to 20 minutes to insure mixing. Be sure that no foreign material such as parts of the inhibitor container are introduced into the system.

3.04 In cooling systems containing inhibitor but no antifreeze, the same inhibitor may be used for 300 hours of engine operation but not more than three years. At the end of this period, the system should be flushed and refilled using new inhibitor. Flushing in this case means filling with water, operating engine for 10 to 15 minutes, and draining. If more complete cleaning is required, see Part 6.

4. ANTIFREEZE

Caution: Antifreeze preparations are poisonous, some extremely so. Ethanol and methanol are volatile and their fumes are both flammable and toxic. Keep flames away from containers that hold or have held ethanol or methanol. Observe all local ordinances on use, handling, or storage of alcohol (ethanol or methanol).

↖ 4.01 In some cases, draining of the cooling system between runs, in lieu of the use of antifreeze, may be approved by the supervisor. Such draining must be complete, leaving no pockets of coolant to freeze and, except in cases of real emergency, rust inhibitor is required. For these reasons, draining is not generally acceptable and antifreeze will be required if the temperature of the coolant in any part of the system is likely to fall below 32F. The gallons of each type of antifreeze required to protect one gallon of coolant to different temperatures is given below. If decimals are dropped from the table, the values are percentage by volume. Excess antifreeze is quite acceptable except that:

(a) very high concentrations of ethanol- or methanol-type antifreezes tend to boil off causing objectionable fumes.

(b) ethylene glycol types in concentrations above 60 per cent give less protection than at lower concentrations. Undiluted ethylene glycol, for instance, protects to only 0°F.

Antifreeze Type	Gallons of Antifreeze per Gallon of Coolant						
	+20F	+10F	Zero	-10F	-20F	-30F	-40F
Ethanol	.19	.29	.37	.44	.49	-	-
Methanol	.13	.20	.28	.35	-	-	-
Ethylene glycol	.17	.25	.33	.39	.45	.50	.53

4.02 Approved proprietary brands of commercial antifreezes of the ethanol (inhibited denatured alcohol), methanol (inhibited wood alcohol), and inhibited ethylene glycol types are listed in Section A710.011. It is anticipated that the type of antifreeze used in the company automobiles may be the most economical and convenient for use in reserve engines, except that, due to temperatures involved, only the ethylene glycol type is approved for reserve engines of the diesel type. Do not mix antifreezes of different types or even of the same type but made by different manufacturers. Where antifreezes other than those approved in A710.011 are used, follow local instructions on their use since this section would not necessarily apply in all particulars.

4.03 If engine has been running too warm or if it is thought for other reasons that there is dirt in the cooling system, clean out in accordance with Part 6 before adding antifreeze.

4.04 To add antifreeze to a filled system, drain out enough of the coolant to make room for the antifreeze. If water contains dichromate-type inhibitor as evidenced by records or an amber to orange color of the coolant, run engine until coolant is up to approximately operating temperature, drain completely and flush (see 3.04) before adding antifreeze. If system is not drained, pour in the antifreeze and then add soft water until the solution can just be seen in the top of the radiator (or just below other high level check point). Run the engine for 5 to 10 minutes and add soft water to bring level to operating point but avoid overfilling.

4.05 If system has been drained, pour approximately a gallon of soft water into the radiator, pour in the antifreeze, and add soft water until the solution can just be seen in the top of the radiator (or just below other high level check point). Run the engine for 5 to 10 minutes and add soft water to bring level to operating point but avoid overfilling.

4.06 After thorough mixing (5 to 10 minutes running of the engine) test the solution. See 4.11. If hydrometer

indicates that solution will not give protection to the desired temperature, draw off solution and add more antifreeze until satisfactory. If convenient, the solution drawn off may be saved in a porcelain or glass container to be added later in place of water to replace evaporation.

4.07 After an engine has been run for some time on emergency service and is ready to go back to reserve duty, test solution with hydrometer (see 4.11) and add antifreeze if necessary.

4.08 Routining of engine on reserve duty is by no means as severe on antifreeze as is motor vehicle service. The strength of ethylene glycol solutions in reserve engines should be tested once in the late autumn and once in the middle of winter. Ethanol or methanol solutions should be tested every 6 to 10 weeks during the cold season. Ethanol or methanol solutions in engines run continuously or on a one-half or one-third time basis, should be checked every two weeks or at as near that frequency as routine visits to the office permit. Whenever substantial additions are made to replace evaporation, run engine 5 to 10 minutes to mix well and test with hydrometer. Additional tests are justified if strong fumes are noticed while engine is running.

4.09 Ethanol or methanol solutions may be drained in the spring and replaced by soft water and rust inhibitor or they may be left in the cooling system. However, in warm weather, fumes from them are likely to be objectionable, making draining desirable. The same amounts of these antifreezes probably will be required in the fall, whether or not the cooling system was drained the previous spring but leaving it in saves one application of inhibitor.

4.10 The same ethylene glycol solution should be used for 300 hours of engine operation but not more than three years. This type antifreeze should be left in the cooling system the year around. It tends to cause the engine to operate at a slightly higher temperature but where actual overheating is observed, it is more likely to be due to dirt or clogging of the system than to the antifreeze. In case of overheating, clean per Part 6.

4.11 To use hydrometer, draw enough liquid into jar to raise float and then release pressure on bulb. Be sure float is floating but not touching plug at top of hydrometer jar. Read temperature and liquid level on the float. From correction table on or furnished with the hydrometer, determine freezing temperature of the coolant. Where hydrometers are of other than the Edelman type, which includes the older model 116, determination of the freezing point should be per local instructions.

5. TEST FOR ACIDITY

- 5.01 Test coolant containing antifreeze for acidity every six months.
- 5.02 To test, drain a small cup of coolant from lowest convenient point in the cooling system and immerse a piece of alkacid test paper from the Fisher Tester.
 - (a) If the paper turns green or blue, the coolant is satisfactory and no further action is required.
 - (b) If the paper is yellow, orange, or red, acidity is indicated. In such case, clean cooling system with kerosene and soda per Part 6.

6. CLEANING COOLING SYSTEM

Kerosene - Soda

6.01 To clean the cooling system, drain and pour into the system a quart of kerosene for each gallon of system capacity. Dissolve in a small amount of hot water, 1/2 pound of washing soda or one pound of bicarbonate of soda, preferably the former, for each gallon of system capacity and pour into the system.

Caution: Washing soda is poisonous if taken internally and strong solutions are injurious to the skin.

6.02 Fill the cooling system with water. Operate for an hour or more with load, covering the radiator if necessary, to raise the water temperature to at least 160F. Drain system promptly and after allowing a few minutes for engine block to cool, refill with clean water, operate for 10 to 15 minutes and again drain. Reverse flush, if feasible, otherwise again refill, operate and drain.

6.03 To reverse flush (a very desirable process when obstruction is in the radiator tubing) remove radiator hose connections and with a water hose force water into the lower radiator connection until clear water flows from the upper radiator connection. Then force water from hose into upper hose connection of engine block until clear water flows from all drains.

Oxalic Acid

Note: Oxalic acid should not be used in engines having aluminum cylinder heads or other zinc (including galvanizing) or aluminum parts exposed to the liquid. See 1.10.

6.04 When cooling systems still overheat after the kerosene-soda treatment described above they may be treated with oxalic acid.

Caution: Oxalic acid is poisonous when taken internally.

6.05 Drain radiator. Dissolve in a small amount of hot water 1/2 pound of oxalic acid powder or crystals for each gallon of cooling system capacity and pour into cooling system. Fill system with water.

6.06 Operate engine and flush in accordance with 6.02.

6.07 In severe cases it may be necessary to repeat several times alternating between the kerosene-soda treatment and the oxalic acid treatment. Do not mix the oxalic acid with the kerosene-soda mixture.