RESERVE ENGINE COOLING SYSTEMS
ANTIFREEZE SOLUTIONS
AND TREATMENT FOR RUST AND LEAKS

CONTENTS PAGE

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 to list AQUA-TANE as an alternate inhibitor. Revision arrows are used to emphasize the more significant changes. The Equipment Test List is not affected. However, the Equipment Test List of other practices that reference this section is affected.

1.03 In this section, the term cooling system refers to radiators, water jackets of engines, cooling tanks, 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 municipal water flows.

1.04 Cooling systems should be free from leaks to avoid losing rust inhibitor and antifreeze. Additions of ethylene glycol may aid in detection of leaks not previously observed. If an unusual amount of coolant must be added to maintain the required level, the entire cooling system should be checked for leaks. When any work is done in accordance with this section, check for leaks and correct as covered in Part 7.

1.05 When any work is done involving the removal of a rubber hose, check the condition of the inside of the hose and, if it shows any signs of wear or deterioration, replace with new sections. Scraps of rubber from worn out hose may restrict the flow of coolant and cause overheating of the engine.

1.06 Cooling water which is red from rust or amber to orange from the presence of the dichromate-type rust inhibitor (which is no longer approved for reserve engines) should be drained, the cooling system cleaned (Part 6), and fresh water and rust inhibitor (Part 3) or antifreeze (Part 4) added.

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. Previous reports or analyses on the water may be used to determine whether or not the water has 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 the 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, in accordance with 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. However, before adding cool liquids, let the engine cool 10 to 15 minutes after draining.

2. APPARATUS

2.01 ***List of Gauges and Materials:*** The following gauges and materials are used in this section.

Danger: When handling the chemicals listed, take care to avoid bodily contact with spillage. Rubber gloves, rubber apron, and eye protection should be worn when applying rust inhibitors and antifreeze to cooling systems.

GAUGES	DESCRIPTION
—	Syringe, Hydrometer (with Thermometer) E. Edelmann Co, Chicago, "Zero-Tester" Model 180 (Mfr Disc.), Model 400B, or Model 808 (formerly Model 116)
MATERIALS	
—	Alkacid Tester, Fisher Scientific Co
—	Antifreeze, Ethylene Glycol Type (without "stop-leak" additive)
—	⧫AQUA-TANE Cooling System Treatment, General Industrial Research, Box 44, Linden, N.J. 07036 (8-oz or 16-oz cans)⧫
KS-14666	Cleaning Cloth
—	Nalcool 2000 Cooling System Treatment
—	Sal Soda
—	Trisodium Phosphate

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

3. RUST INHIBITOR

Danger: Rust inhibitors are poisonous and should not be taken internally.

3.01 Cooling systems not containing antifreeze should have rust inhibitor added whenever the system is filled, or drained and refilled (see paragraph 3.03). When Nalcool 2000 cooling system treatment is used, add on the basis of 16 ounces per 16 quarts of coolant. ⧫When AQUA-TANE cooling system treatment is used, add on the basis of 16 ounces per 25 quarts of coolant. With either product, for making up loss of coolant, add on the basis of 16 ounces per 80 quarts of coolant added.⧫

3.02 Liquid inhibitors may be poured directly into the cooling system after the engine has been run long enough to bring the water up to 120°F or higher. After adding inhibitor, run the engine for at least 15 to 20 minutes to ensure adequate mixing. Be sure that no foreign materials, such as parts of the inhibitor container, are introduced into the system.

Note: On engines which presently have the Du Pont No. 7 liquid antirust and water pump lubricant in the cooling system, replace the Du Pont inhibitor with the Nalcool 2000 ⧫or AQUA-TANE⧫ during the next scheduled draining of the system.

3.03 In cooling systems containing Nalcool 2000 ⧫or AQUA-TANE⧫ cooling system treatment, but not antifreeze, the inhibitor may be used for 250 hours of engine operation but not more than 3 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 the engine for 10 to 15 minutes, and draining. If a more complete cleaning is required, proceed as covered in Part 6.

3.04 ⧫The manufacturer of AQUA-TANE advises that their product cleans as well as inhibits. For this reason, when AQUA-TANE is first installed,

drain and hose-flush at end of first year. Thereafter, drain and hose-flush at 3-year intervals as covered in paragraph 3.03.

4. ANTIFREEZE

Danger: Antifreeze preparations are poisonous.

4.01 In some cases, draining of the cooling system between runs, instead of using antifreeze, may be approved by the supervisor. Such draining must be complete, leaving no pockets of coolant to freeze. When refilling the system, rust inhibitor is required except in the case of a real emergency. 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 32°F.

4.02 ***Methanol or ethanol (alcohol type) antifreezes should not be used for reserve power equipment—use ethylene glycol type.*** The amount of ethylene glycol required to protect 1 gallon of coolant at different temperatures is given in the list that follows. If decimals are dropped from the list, the values are percentage by volume. Excess antifreeze is quite acceptable except that ethylene glycol types in concentrations above 60 percent give less protection than at lower concentrations.

GALLONS OF ETHYLENE GLYCOL PER GALLON OF COOLANT	PROTECTS TO DEGREES FAHRENHEIT
.17	+20
.25	+10
.33	0
.39	−10
.45	−20
.50	−30
.53	−40

Caution: Never use a straight solution of antifreeze. Undiluted ethylene glycol protects to only 0°F.

4.03 Approved brands of commercial antifreezes of the inhibited ethylene glycol types are listed in Section 065-370-101. Only the ethylene glycol type of antifreeze 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 Section 065-370-101 are used, follow local instructions on their use since this section would not necessarily apply in all particulars.

Warning: Antifreeze of the ethylene glycol type containing "stop-leak" additive or any sealer SHOULD NOT be used in reserve engines.

4.04 Before adding antifreeze to a cooling system already containing antifreeze or an inhibitor, proceed as follows:

(a) Where the water contains a dichromate-type inhibitor or the Du Pont No. 7 acid and rust inhibitor (which are no longer approved for engines) as evidenced by records or by an amber to orange color of the coolant, run the engine until the coolant is up to the approximate operating temperature, drain completely, and flush as covered in paragraph 3.03. Then proceed as covered in paragraph 4.05.

(b) Where the water contains the Du Pont No. 7 Antirust and water pump lubricant as indicated by records, drain the system. Then proceed as covered in paragraph 4.05.

(c) Where the water already contains antifreeze, drain out enough of the coolant to make room for the antifreeze which is to be added. 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 points). 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.

Danger: If the engine temperature appears excessive after running and it is

certain that the excessive temperature reading or indication is not due to heat absorption while the engine is shut down, do not check the coolant level without letting the engine cool down for at least 10 minutes. (Waiting only a matter of seconds may result in a boiling bath due to a faulty radiator cap.) When removing the cap, cover it with a thick towel or other heavy cloth. Then turn the cap very slowly to the first notch position, pause to let any residual steam escape, and then remove it. Ensure that the entire cap is covered with the towel.

4.06 After thorough mixing (5 to 10 minutes running of the engine), test the solution as covered in paragraph 4.11. If hydrometer indicates that solution will not give protection down 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 and may be added later in place of water which has evaporated.

4.07 After an engine has been run for some time on emergency service and is ready to go back to reserve duty, test the solution with a hydrometer as covered in paragraph 4.11 and add antifreeze if necessary.

4.08 The strength of ethylene glycol solutions in reserve engines should be tested once in the late autumn and once in the middle of winter. Whenever substantial additions are made to replace evaporation, run the engine 5 to 10 minutes to mix well and test with hydrometer. Additional tests are justified if strong fumes are noticed while the engine is running.

4.09 The same ethylene glycol solution should be left in the engine on a year-round basis, and the coolant checked as covered in Part 5. If the coolant shows an acid condition, it should be replaced. If the coolant is found to be satisfactory, it may remain in the engine cooling system as long as it continues to show no acidity.

Note: An additional check for the presence of rust in the coolant follows. Open the water drain cock and collect a sample of the coolant in a clear glass container. A solution without any indication of rust may remain in the engine cooling system. If rust is present, the system must be drained, flushed, and refilled using new antifreeze.

4.10 Ethylene glycol antifreeze may tend to cause the engine to operate at a slightly higher temperature. However, if the engine has been running too warm or 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 in accordance with Part 6.

4.11 To use a ***hydrometer,*** draw enough liquid into a jar to raise the float and then release pressure on the bulb. Be sure that the float is floating but not touching the plug at the top of the 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 Edelmann type, which includes the older model 116, determination of the freezing point should be in accordance with local instructions.

5. TEST FOR ACIDITY

5.01 Test coolant containing antifreeze for acidity every 6 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 cases, clean the cooling system as covered in Part 6.

6. CLEANING COOLING SYSTEM

6.01 To clean the cooling system, proceed as follows:

(1) Drain the radiator.

(2) Prepare a well dissolved solution consisting of 1/2 ounce of trisodium phosphate to a gallon of water or 1/2 ounce of sal soda to a gallon of water.

Danger: Sal soda and trisodium phosphate are poisonous and should not be

taken internally and strong solutions are injurious to the skin.

(3) Fill the cooling system with the solution. Operate the engine for 5 minutes, and then drain.

(4) Repeat the treatment covered in (3).

(5) Fill the cooling system with clean water. Operate the engine for 5 minutes, and then drain. Reverse flush, if feasible; otherwise, again refill with clean water, operate, and drain.

(6) 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 the hose into the upper hose connection of the engine block until clear water flows from all drains.

6.02 In severe cases, it may be necessary to repeat several times the trisodium phosphate or sal soda treatment.

7. LEAKS

7.01 If leaks are present, add or replace the water pump packing, gaskets, or rubber hose as required and tighten the cylinder head nuts. Do not use a sealer to stop leaks.