

RESTRICTED
DIRECTORATE GENERAL BORDER ROADS
GENERAL MAINTENANCE INSTRUCTION
NO 37

Front precautions for water-cooled engines of vehicles plant and Equipment

1. In order to prevent damage by frost to water-cooled IC/CI engines, which are used, in locations affected by severe winter conditions (working temperatures below 4⁰C). [Precautions as detailed in subsequent paras will be strictly observed.
2. The areas in which these precautions are to be observed and dates when these should be applicable will be decided and necessary orders to that effect issued by CEs Projects in consultation with SOs EME.

ACTION

- 3 By Chief Engineers;
Workshops;
User units.

REQUIREMENT OF STORES

4. <u>Designation</u>	<u>Quantity</u>	<u>Remarks</u>
a) Anti-freeze coolant Ethylene Glycol or Ethylene Glycol or any commercial Equivalent)	As required basis	-
b) Soda ash commercial (COS Part No IHA-0311) or equivalent)	As required basis	-
c) Hydrometer .. Qty one (COS part No H6/HF 10964 & 65 -1,000 to 1,200 gm/ml or equivalent)	-	For wksp only
d) Potassium dichromate Solution	As required basis	For wksp only
e) Sulphuric Acid	As required basis	-do-

- 5 The quantity of antifreeze coolant to be demanded will not exceed 45 % to 60 % of the total capacity of the cooling systems of the engines concerned depending upon the degrees of protection required, as per sub-sub-para '6 (a) (iv)', plus an allowance of 10 % topping up.

FILLING ANTIFREEZE COOLANT IN COLLING SYSTEMS
OTHER THAN TRAILERS FIRE PUMP

6 (a) When the cooling system of an engine is to be filled with antifreeze coolant, following procedure will be followed:-

(i) Drain off the cooling system completely.

Prepare a solution of Soda Ash commercial, (Ordinance part No IHA-033) in the ratio of one pound of soda to one gallon of water and refill cooling system. Use the vehicle normally for about 6 hrs or 100 miles and drain off the soda solution. Thoroughly flush the cooling system with clean water and close drain cocks.

Notes:- Flushing with soda ash will not be carried out in respect of engines having aluminum blocks or aluminum cylinder heads. The flushing out in such cases will be done with water only after draining out the cooling system.

(ii) Ensure that all hose joints are in good condition and thoroughly tightened up.

(iii) Ensure that cylinder head gaskets are sound and cylinder head nuts have been properly tightened. Linkage of antifreeze coolant into engine lubrication system will result in contamination and subsequent formation of a tarry and gummy material in oil, which may lead to seizure of the engine.

(iv) Prepare the solution of antifreeze coolant by mixing the coolant and water in following proportion (by volume)

(aa) 25% antifreeze coolant for temperatures upto -10°C ($+ 14^{\circ}\text{F}$)

(bb) 55% antifreeze coolant for temperatures upto -25°C ($- 13^{\circ}\text{F}$)

(cc) 65% antifreeze coolant for temperature upto -40°C (-40°F)

(dd) 70% antifreeze coolant for temperatures upto $- 60^{\circ}\text{C}$ (-76°F)

Thoroughly mix the solution in a clean container. Close drain cocks properly and fill the cooling system with the prepared solution until the top of cylinder block or bottom of header tank is covered up. Start and warm up the engine. When thoroughly warm completely fill the radiator with this solution. (This will avoid waste due to expansion).

b) The antifreeze coolant is reusable after ascertaining its serviceability and should be preserved when no longer required. (para 8 refers)

(c) Loss of liquid due to leakage will be made up with the same solution of antifreeze coolant and water with which the system was originally filled.

(d) A blue circle will be painted on the header tank or equivalent position when the cooling system has been filled with a solution of antifreeze coolant. The circle will be superimposed on a white square background if required to render it conspicuous.

25%, 55%, 65% or 70% will be painted in yellow inside the blue circle to indicate the percentage of antifreeze coolant in the solution. This mark will be rubbed off when antifreeze coolant solution has been drained out and replaced with plain water.

Note: The cooling systems filled with ethylene Glycol or equivalent is, however, painted with a red circle and the percentage of Ethylene Glycol or equivalent is painted in white.

**DRAINING OF ANTIFREEZE COOLANT AT THE END
OF THE FROST PRECAUTION PERIOD**

7. Frost precaution will be discontinued from dates as notified in orders issued by CE (P) except for such 'B' and 'C' vehicles as have been specially prepared for low temperature operation. Procedure for draining of antifreeze coolant on other vehs & plants is as follows:-
- (a) Drain the entire contents of the cooling system.
 - (b) Thoroughly flush out cooling system with water and subsequently fill with clean (Preferably soft) water.
 - (c) Rub off the blue circle on the radiator header tank or equivalent position.

SERVICEABILITY OF USED ANTIFREEZE COOLANT

- 8 Antifreeze coolant drained out from cooling system of vehicles/plants will be examined, before re-using as follows:-
- (a) Immediately after draining, the material shall be examined for the presence of extraneous matter in the form of sediments, suspended matter or presence of any insoluble impurities or immiscible oil. If present, the extraneous matter shall be removed by filtration through an appropriate number of layers of muslin cloth or decantation. Oil if present will be siphoned out.
 - (b) After filtration /siphoning as above, the specific gravity of the material should be checked using Hydrometer part No H6/HF 10964 & 65 (1,000^o C to 1,200 gm/ml). In case the Hydrometer is not available with the units, necessary assistance on checking the specific gravity (SG) may be obtained from the dependant workshops. The standard specific gravity of various concentrations of antifreeze coolant in water at 25^oC /25^oC are as under :-

SG at 25^oC/25^oC

95%	-	1.241
85%	-	1.221
75%	-	1.200
65%	-	1.173
55%	-	1.148
45%	-	1.128
35%	-	1.098
25%	-	1.064
15%	-	1.039

(i) If the specific gravity of the mixture is less than 1.039, i.e., corresponding to 15% antifreeze coolant and 85% water by volume, the mixture should be disposed off as waste.

(ii) If the specific Gravity of the mixture is above 1.039, the mixture can be reused by adding Antifreeze coolant or water as the case may be to bring its specific gravity to the required figure depending on the ambient temperature at which the vehicle is intended to operate (see para 6(iv) above).

(iii) After bringing the solution to the specified specific gravity, it should be transferred to clean, dry and rust-free jerricans which should be securely closed after filling. The filled jerricans should be marked for easy identification and kept under covered accommodation under normal storage conditions.

Note :- In case of doubt regarding the suitability of a particular stock of antifreeze coolant solution, facilities exist at the Defence Research laboratory (Materials) Kanpur for testing of specimen solutions.

9. Field Workshop should carried out these tests during periodical inspection of vehicles using antifreeze coolant.

CONTAMINATION TESTS FOR ANTIFREEZE COOLANT

- 10 To ascertain the contamination of lubricating oil with traces of antifreeze solution, following procedure will be followed:-

(a) Drain out ot 10 CC of the oil from the sump in a test tube, add 1cc of 1% potassium dichromate solution and 10cc of 10% sulphuric acid solution. An intense bluish green coloration in the lower layer will indicate the presence of antifreeze in the oil.

(b) Contamination of antifreeze with oil is liable to impair heat transfer efficiency of the coolant.

11. To ascertain the contamination of antifreeze coolant with traces of lubricating oil, the following procedure will be followed:-

(a) Stir the sample thoroughly and transfer 25cc into a clean and clear glass vessel. Add 25cc of water to the sample in the glass vessel, stir and allow to stand. If oil separates itself as a distinct layer at the top, it will indicate that the antifreeze coolant solution is contaminated with oil.

USE OF ANTIFREEZE COOLANT IN ENGINE COOLING SYSTEM OF TRAILERS FIRE PUMP

- 12 (a) antifreeze coolant will not be used in the water pump portion of trailers fire pump. When not in use, the water pumps will therefore be drained off to

avoid damage due to frost. The prime movers of the trailers fire pump have cooling systems of two types:-

(i) Pumps fitted with open circuit system of water cooling, i.e., where a water bleed from the main pump circulates through engine for cooling it and then runs to waste:

(ii) Pumps fitted with a closed circuit system of water cooling, i.e., where the water in the cooling system of the engine does not mix with the water being pumped.

(b) Frost precautions for trailers fire pump, therefore, fall into two distinct classes.

(i) For trailers fire pump which fall into type (a) (i) category above, eg, "DENNIS type TA 350/500 GPM", Antifreeze Coolant will not be used,

(ii) For trailers fire pump which fall into type (a) (ii) category above, eg, "COVENTRY CLIMAX type Dodiva FF 500 GPM", the header tank and cylinder block of these types of engines will be filled with antifreeze coolant. General instructions contained in paras (6), (7) and (8) above will apply.

PRECAUTION TO BE TAKEN AGAINST DAMAGE BY FROST WHEN ANTIFREEZE COOLANT IS NOT USED IN WATER COOLED ENGINES

13. (a) When a vehicle or equipment having a water cooled engine is to remain parked overnight or for any length of time and it may not be required for immediate use or when antifreeze solution is not available, the following precautions will be observed.

(i) The radiator caps will be removed and if detachable kept in a safe place in the vehicle, eg, glove box;

(ii) Water will be drained off from the cooling system. To do this, place the vehicles on a level ground and open out all the drain cocks. These drain cocks may be fitted to any part of cooling system, eg, radiator, pumps or water jacket. Take care that none of the drain cocks are clogged and ensure that the entire cooling system is completely drained off;

(iii) When all the water has been drained off, run the engine at idling speed for ONE minute and then switch off. Close all the drain cocks. Ensure that the engine is not run any further with empty cooling system. Otherwise get damaged, it may.

(iv) Fit a radiator muff and bonnet cover if available. Otherwise use improvised material of adequate size for covering up radiator grills and the bonnet. This is intended to prevent over-cooling of the engine.

14. For starting up the engine on which above precautions have been carried out, adopt the following procedure:

Fill the cooling system with cold water., Initially free the engine by hand cranking then switch on and starts up the engine. Warm the engine by running at fast idle speed for five minutes. Keep radiator muff and bonnet cover in position during the warming up period.

PRECAUTIONS TO BE TAKEN IN SITUATIONS NECESSITATING THE VEHICLE TO STAND BY FOR INSTANT USE OR WHEN THE VEHICLE IS HALTED TEMPORARILY AND ANTIFREEZE COOLANT IS NOT AVAILABLE

15 The following procedure will be followed:

- (a) Fit radiator mumm/bonnet cover, or cover these parts with improvised material
- (b) Run the engine intermittently for durations upto 5 minutes at fast idle speed without racing, The frequency will depend on the severity of frost. These intervals will be such that water in the cooling system does not reach the freezing point.

GENERAL

16. Precautions to be observed in cold weather to maintain the working temperature of the engine

- (a) Fan belts will not be removed in an attempt to prevent over-cooling as this would stop circulation and thus cause damage to the engine.
- (b) Under very severe conditions, when a vehicle is on the move, the radiator muff can be kept on partly or wholly. The temperature gauge reading will, however, be occasionally observed and if overheating is indicated, muff cover will be removed;
- (c) Damage to engine is usually caused in cold weather by resorting to following practices which must be avoided:-
 - i) Starting the engine before filling up the cooling system with water or with the cooling system with water or with the cooling system partly deplete of water;
 - (ii) Adding hot water in cooling system when veh engine is exposed to severe cold;
 - (iii) Running the engine for more then one minute or in excess of idling speed after the water has been drained off;
 - (iv) Endeavoring to starts the engine which was laid off for a few hours without first freeing the bearings by turning the engine by hand cranking.
- (d) Vehicles parked in the open & exposed to severe cold, will have their parking brakes released to prevent seizure of the brakes. If standing on a slope, scotches or stones will be kept against the wheels to prevent the vehicles from rolling away.

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