

GENERAL MAINTENANCE INSTRUCTION NO. 18

GENERAL MAINTENANCE INSTRUCTIONS FOR VEHICLES AND EQUIPMENTS

INTRODUCTION

Vehicles and equipments are indispensable tools for construction of roads in border areas, at high altitudes and rugged terrains. Some equipments are so deployed that failure of the single equipment may prove very costly and slow down road construction and delay restoration of communication. In some regions, the roads are such that to replace defective equipment such as tractor, road roller by a serviceable one is laborious and time consuming and even at times may be impossible. It is therefore, of utmost importance that the equipment is operated and maintained at a high standard of fitness to derive maximum benefit and life out of the equipment.

2. RESPONSIBILITY FOR MAINTENANCE

(a) NECESSARY FOR A HIGH STANDARD OF MAINTENANCE :-

It is only by the adherence to the principles of maintenance as embodied in a comprehensive programme and carried out by operators to the smallest detail that the utmost efficiency in the operation of vehicles and equipment can be attained, costly repairs and replacements can be avoided and the maximum number of vehicles and equipment can be kept on the road in first class running order. Efficient maintenance necessitates concentration on the simpler tasks by the users and handing over the more advanced repairs and adjustment to the skilled workshop and technical personnel /facilities.

(b) REQUIREMENTS

Mechanical efficiency of vehicles and equipment can be said to be achieved only when a maximum percentage of the total vehicles and equipment on charge of a unit are kept fit for longest duration and ready for immediate use. A unit in Border roads which has kept its equipments in good working order 80% of its total equipment day (ie 25 days out of 30 days in a month) in a year will be considered efficient. The Chief Engineers may initiate suitable monthly/quarterly return to watch this aspect of equipment performance. To ensure this, a unit commander has to maintain strict supervision on equipment maintenance.

RESPONSIBILITIES OF SO 1/SO 2 (EME) AT PROJECT HEADQUARTERS WITH REGARD TO MAINTENANCE

- (a) SO 1/SO 2 EME at Project Headquarters is the Technical Adviser to the Chief Engineer on all matters affecting the repair /maintenance and inspection of all vehicles/ equipment in the Project.
- (b) He is directly responsible to the Chief Engineer for the general efficiency, repair and recovery of technical equipment of the Project.
- (c) His Chief duty is to ensure that the maximum possible proportion of the equipment is in a serviceable condition.

(d) He will ensure that the inspection of equipment for which he is technically responsible is systematically carried out.

(a) He will ensure that :-

(i) Action is taken promptly in all authorized modifications.

(ii) Units are given every possible assistance in the care of their equipment and that they are advised as to action required to obtain necessary technical information;

(iii) That the procedure laid down for reporting defects in the equipment is properly carried out by all concerned;

(iv) All instances of neglect or misuse of equipment that come to his notice are brought to the attention of the Chief Engineers /Headquarters Directorate General Border Roads.

(v) He keeps himself and the Chief Engineer thoroughly acquainted of the condition and percentage availability, which is his concern;

(vi) He visits units/inspects equipments as necessary for the above purpose.

(vii) Ensure quality and promptness in field repairs.

PRINCIPLES OF MAINTENANCE

(a) **Cleanliness** of the equipment particularly the working areas is very essential.

(b) **Inspections** Regular and routine inspections must be rigidly carried out.

(c) **Lubrications** Periodicity and correct grade of lubricant must always be adhered to.

(d) **Preventive repairs** When a part such as fan belt, brake shoe, clutch plate, oil filters, fuel filters, tyres, bearing, oil seal, hose, joints, gaskets, spark plugs are in an advanced stage of deterioration, it should be replaced.

(e) **Timely repairs** Faults which cannot be rectified must be reported immediately. Work beyond the capability of the operator or unit tradesmen must not be attempted as, apart from the possibility of damage this leads to neglect of the simpler tasks which are essential to avoid more extensive costly repairs and replacement.

(f) **Special maintenance instructions** require to meet the operating conditions and specialty of equipments must be strictly followed.

IMPORTANT ASPECTS OF MAINTENANCE

Inspections

5. To assess the mechanical condition and to provide timely repairs of all vehicles, equipment and plants held by various units, periodical inspection as below will be carried out :-

- | | | |
|-----|-----------------|------------------------------------|
| (a) | 'B' Vehicles | - By Field Workshops –Once a year |
| | | - By SO 1/ SO 2 (EME) –Once a year |
| (b) | Engineering and | - By Field Workshops –Twice a Year |

Other miscellaneous - By SO 1/SO 2 (EME) –Once a year
Equipments

6. The programme for the inspection by Field Workshop /SO1/SO 2 (EME) will be so coordinated so as to ensure that the inspection is carried out at regular intervals.

Timely Repairs

7. The old saying “STITCH IN TIME SAVES NINE” must be rigidly followed as for as the repairs to the equipments are concerned. Minor defects should not be neglected as these will become major defects if not attended to in time. Defects must be attended to as soon as noticed. The Unit/Task Force Commander/Chief Engineers should examine this aspect during their visits/inspection to the units.

Running in Period

8. The life of any vehicle/equipment will invariably depend on how the equipment has been run during the running in period. Needless to say that the speeds and the loads should never be exceeded during this period. Most of the projects have their units period should be completed in plains before taking new/overhauled equipment to the unit location in hills.

Supervision for Maintenance

9. Lack of effective supervision in carrying out the various maintenance tasks will have an adverse effect on the maintenance and consequently on the availability of the equipment. SO 1/SO 2 (EMEs) at Project Headquarters must devise their own ways and means to ensure that the various maintenance tasks are carried out regularly under proper supervision of trained personnel. Each Project will evolve an organisation system and drill for it.

Mobile Maintenance Teams

10. When a Task Force has many detachments out and dispersed, many maintenance facilities cannot be provided and supervision tends to be poor. Also, after using and equipment for the full day, particularly when working hours extend too late in the evenings to achieve the targets, in view of the limited holding of the equipment, the operators may not be able to undertake all aspects of maintenance.

11. Task Force may, therefore, organize Mobile Maintenance Teams from within their resources (Jeeps/trucks and technical and not technical personal) who should be made responsible for certain maintenance aspects only such as preventive repairs. Special lubricants, adjustments and running maintenance will still be the responsibility of the drivers /operators. These teams should work to a schedule under direct control of Officer Commanding Field Workshop and should be able to carry out through maintenance (Specially hourly /mileage tasks) of vehicles/equipments and plants held by the Task Force at regular intervals. The Officer Commanding Field Workshop would need a jeep and unit tradesmen/personnel to be allocated by the Task Force Commander. The working of the Mobile Maintenance Team will be reviewed after six months.

Utilisation of Equipments

12. Task Force Commander in their enthusiasm to achieve their target, at times have been utilizing their equipments continuously and also in double shifts without giving any time to the operator to carry out its regular maintenance. This naturally has an adverse effect on the performance of the equipment and in the long run, effects its working and

life. Short-term gain results in long-term loss. As far as possible, it should be ensured that such situation is avoided. Operators must be given time for their maintenance.

Premature Failures

13. The life of each equipment has been laid down by Headquarters Directorate General Border Roads vide letter No. 16155/EME/TM/BRD dated 08/10 Dec 64. Majority of the equipment should be able to achieve this target if regular the users carry out maintenance. If however, due to any reason the equipment fails to achieve even 75% of the specified life, the matter should be properly investigated through a Board of Officers vide Headquarters Directorate General Border Roads letter Number 16187/DGGBR/E4/T dated 08 Oct 69. Remedial actions will be taken as per the recommendation of the Board.

Training of Operators

14. Training of personal both in operation as well as maintenance is extremely essential and should be organized in a realistic manner in each Task Force. When over a new operator is given charge of a vehicle/plant or machinery, he must be first trained by the supervisory staff of the unit of the operation and maintenance to be carried out.. For this, refresher course for the supervisory staff may be conducted under officer commanding Field workshops. This will go a long way in helping the Task Force Commanders to achieve their targets. As with better-trained operators and more effective maintenance, there will be less changes of the breakdown of the equipment.

15. Prior to receipt of a new type of equipment a training cadre should be conducted. In case Chief Engineers need assistance of the manufactures, Headquarters Directorate General Border Roads will be approached. Base Workshops and Field Workshop will get their trade man also trained on new equipment through local courses and manufactures.

Procedure

16. In order to avoid haphazard work and to ensure that no points are over locked, operators will carry out maintenance in a systematic manner. Experience shows that the tasks, which have to be carried out on equipment, can be divided as follows: -

- (a) Running Maintenance.
- (b) Tasks, which are to be, carried out on time –basis and periodicity basis.
- (c) Tasks, which have to be carried out on mileage/hrs basis.

Running Maintenance

17. First Parads (To be done Before the vehicles/equipment in employee)

- (a) Check fuel, oil and water.
- (b) Clean windscreen, windows and driving mirror.
- (c) Check tyre pressures and inflate if necessary.
- (d) Start engine and check lights, wind –screen wiper, trafficators and horn.
- (e) Check whether ammeter is registering and oil pressure gauge is indicating.
- (f) Check operation of brake pedal. Drain water from vacuum brake system if fitted.
- (g) Examine for oil, fuel and water leaks.
- (h) Listen for unusual knocks, rattles and uneven running of engine.

18. Halt Parade (To be done during halts between long runs)

- (a) Check oil, water and fuel and replenish if necessary.
- (b) Check for oil leaks from all assemblies and under chassis.
- (c) Visually check tyres for correct pressure. Check for presence of pieces of flint/stone/glass lodged in the tread, and remove same if present.

19. Last Parade (To be done at the end of day's work)

- (a) Carry out checks shown in Halt Parade.
- (b) Examine Road springs for loose 'U' bolts and broken leaves.
- (c) If ordered, carry out frost precautions.
- (d) Enter mileage/hours, fuel and oil drawn in the log book.
- (e) Leave the equipment ready to move off.
- (f) Record in the logbook, weekly, Monthly and mileage/hourly tasks carried out.
- (g) Reports if engine overheats, oil pressure too high/low, charging rate too high/low and MPG low.

Tasks to be carried on a Time - Basis

20. A few hours should be allowed in a week for each vehicle/equipment for carrying out the various weekly and monthly maintenance tasks as specified in the General Maintenance Instruction No.06 & 07.

21. The first three letters of the maintenance day should be painted prominently in the front portion of the vehicle/equipment to indicate the day of maintenance. The vehicles /equipment should be put in to use on this day only after the maintenance tasks are complete. These tasks must be performed under the supervision of at least an NCO/Grade I and a proper record for the same maintained in the logbook, which must be checked monthly by unit Mechanical Transport Officer and Field Workshop.

Task to be carried out on mileage/Hours –Basis

22. Task bases on mileage/hours run should be carried out as specified in the General Maintenance Instruction No. 06 and 07.

23. In addition to the above is some tasks are specified by the makers in the operator's/Maintenance Manual issued along with each equipment, these should also be completed and a record to the effect made in the logbook. Field Workshop through Equipment Officers' Conference may bring these tasks to the notice of units.

24. Where there are more than one makes of and equipment such as road rollers. Compressors, Stone crushers, vehicles SO I/SO 2 (EME) may combine the specified maintenance tasks into a common maintenance tasks for all the makes/models of a same category of equipment. When necessary, advice of specialist will be asked for.

Lubrication

25 **General**

The most vital aspect of maintenance in any equipment is lubrication. Lubrication may be divided generally into three classes.

- (a) Lubrication of the engine.
- (b) Lubrication of the gearbox, transfer case, axles and steering box, reduction gear, drives.
- (c) Lubrication of the chassis working parts including wheels.

26. Lubrication charts are provided for all makes and type of vehicles and equipment in the service. These charts show the type of the lubricant to be used for the various parts of the vehicles/equipment and in certain cases the frequency with which it should be applied (Refer General Maintenance Instruction No.5)

27. A reserve of engine oil should always be carried in the tin provided for this purpose. Care should be taken that the top of the tin is wiped clean and dry before the screwed cap is removed and oil poured out.

28. Lubrication of the Engine.

(a) It is essential that the correct grade of oil as laid down for the particular engine is used. Only in an extreme emergency will another grade of engine oil be used in which case the nearest specification to that laid down for the engine will be used. On no account will two grades of oil be mixed. If an alternative grade has to be used the original oil will be completely drained.

(b) A "Dip Stick" indicator is incorporated on all vehicles except motorcycles. This dipstick is graduated and shows the depth of oil in the engine sump. This dipstick will be inspected frequently and the oil kept up to the full mark. The procedure for checking the oil level in the sump is as follows: -

- (i) Place the equipment on level ground.
- (ii) Stop engine.
- (ii) Await a few moments to let the oil settle in the sump.
- (iii) Remove dipstick and wipe it clean with a clean cloth. Cotton waste must not be used.
- (iv) Replace dip stick –remove-check level.
- (v) Pour into engine sump estimated amount of oil required and re-check.

(c) When filling or "topping up" the sump the oil funnel with the coarse gauge filter will be used. The cap and oil filter neck will be wiped clean prior to removing the cap for filling to ensure that no grit or dirt enters the sump.

(d) The majority of engine lubricating systems are fitted with an oil pressure indicator or gauge. The correct registration of the gauge shows that the oil in the engine is being circulated correctly. The gauges or indicators vary in type, the majority however, are of the dial type fitted to the dash board of the vehicle. If in doubt as to the correct oil pressure refers to maintaining workshop.

(e) The operator's first duty after starting the engine is to ascertain from the pressure gauge that the oiling system is working correctly. He should also during the course of his duty glance occasionally at the oil gauge for the same purpose.

(f) If oil pressure gauge is not provided/working. Removing the filter cap from the oil tank and observing the nature of the oil in the tank can ascertain the circulation of oil. Froth on the oil indicates that oil is circulating properly.

(g) It is important that the external area of the oil sump is kept free from mud and oil. This facilitates the dissipation of heat from hot oil in the engine sump.

Lubrication of gear boxes and driving axles

29 Oil filler plugs are provided for gear boxes and rear axles on nearly all equipments. These filler plugs also serve to indicate when an axle or gear box contains the correct amount of lubricant. When filling or topping an axle or gear box these plugs should be removed and the lubricating oil poured in until it begins to run out of the filter plug hole. It is important when filling the rear axle to ensure that the equipment is on the level. Overfilling is likely to occur if the front of the equipment is lower than the rear. Overfilling of driving axles will result in oil getting into the brake drums.

30. **Chassis Lubrication**

(a) A regular routine of chassis lubrication must be incorporated in all maintenance programmes. A diagram indicating the various lubricating points should be available in the Mechanical Transport section /Logbook of the equipment. Colour code should be given for each type of lubricant to be used in the above diagram.

All lubricating point should be painted with the code colour to facilitate the operator to identify the correct lubricant to be used. Kilometer/hours run may also be indicated near the lubricating point for ready reference Operators should be trained on this diagram and as far as possible the lubrication tasks must be done supervision.

(b) Chassis lubrication is divided, generally speaking, into two parts :-

(i) Lubrication by oil or grease gun. The lubrication chart shows all the points to be lubricated and the type of lubricant to be used for each point. Nipples or lubricants will be wiped clean before the gun is applied and the lubricant will be injected until it commences to come out from ends of the bearing or joint being lubricated. If the lubricating fails to pass, it indicates a defective lubricator or a blocked oil way which should be attended to early.

(ii) Oil can lubrication – The oil can is intended for lubricating small bearings for which no oil gun arrangements are provided. These are usually enclosed bearings of electric assemblies, such as synamos, self starters, magnetos and exposed joints which should be wiped clean and few drops of oil inserted between the jaws of the joint. The procedure for the lubrication of electrical accessories is given in the next paragraph.

Colour –coding in lubrication

31. Every nipple, and oil filter caps should be colour coded. Such colour codes should indicate: -

- (a) Periodicity
- (b) Responsibility
- (c) Lubricant
- (d) Location.

An operator without looking at any document, should be able to lubricants his equipment. On a prominent place in as equipment, the number of lubrication points to be lubricated with different lubricants will be stenciled.

Lubrication of electrical accessories.

32. Dynamos, self-starters and magnetos should be lubricated very sparingly. Two or three drops of oil the same specification as used in the engine every two month or 1000 miles/hours are sufficient. Over lubrication of an elsotrical assembly will cause the oil to penetrate on to the commentator and into the armature, causing damage to the insulation of the winding.

Maintenance of Engines

33. Maintenance by the driver comprises the following tasks :-

- (a) Cleaning the engine.
- (b) Maintenance of gas, water and oil tight joints.
- (c) Periodical changing of engine oil.

- (d) Attention to oil filters, sparking plugs and fan belts.
- (e) Lubrication of external working parts.
- (f) Ensuring that all nuts and bolts other than cylinder head nuts and nuts fitted with split pins are kept tight.

34. **Maintenance of gas tight joints**

(a) Gas tight joint comprise the cylinder head joint, sparking plug joints, carburetors and the exhaust and inlet manifold joints. It is unnecessary continually to check these for tightness, once they are properly tightened they require little or no attention. The unit tradesman should under take this task.

Note : Over tightening will NOT cure defective gaskets.

(b) Care should be taken when replacing sparking plugs particularly the small type plug that under force is not used otherwise the plug will be damaged.

(c) When it is necessary to tighten the exhaust manifold nuts under force should not be used otherwise damage to the studs will result. Only the spanner provided for a particular nut or bolt should be used.

Water – tight joints

35. This normally entails keeping the clips securing the hose connections and nuts securing flanges tight.

Oil –tight joints in engine

36. External oil joints usually take the form of a flanged joint or a union and nipple. In the case of the former, Special oil resisting jointing or cork sheet is used, the oil tight joint being obtained by tightening the flange securing the joint. Oil tight joints which requires watching for leaks are :-

- (a) Sum joints.
- (b) Sump drain joints.
- (c) Timing case joint.
- (d) Rocker cover.
- (e) Tappet cover.

Oil filters

37. Maintenance of oil filters necessitates periodical draining of the filter to remove sediment and periodical dismantling of the filter to clean the elements. The nature of the work is dependent on the type of filter used and instruction books or service instructions should be followed. **OIL FILTER ELEMENTS MUST BE CHANGED AT THE FREQUENCY LAID BY MAKERS.**

Injector Pump and Injectors

37. **Injector Pump**

The injector pump and injectors must not be dismantled or interfered with in any way by drivers.

39. Maintenance in the unit comprises the following :-

- (a) Ensure that there are no leaks from the injector pump or from the fuel pipes and unions between the injector pump and the injectors.
- (b) The oil in the injector pump sump must be kept to the level on the dip stick. This should be checked and topped up every month.

- (c) Oil level in the governor should be checked every month and topped up if necessary.
- (d) Inspect the securing bolts and tighten if necessary.
- (f) Adjustment of slow running and uneven firing at low speeds. Tradesman will adjust this only.

Any defects will be reported for attention.

40. **Filters**

- (a) Fuel ore-filters will be cleaned every 3,200 kilometer with the help of unit tradesman.
- (b) **Twin fuel Filter**
 - (i) Every 1,600 Km, fuel will be drained through plug (If fitted) till clear fuel flows.
 - (ii) Every 3,200 Km, primary stage filter element will be cleaned and final stage filter element replaced.

External Parts

41. Lubrication of external parts comprises lubricating the controls which only require an occasional drop of oil on joints.

Nuts and Bolts

42. These should be kept securely tightened at all times. The operator will normally attend to all nuts and bolts that are not fitted with split pins with the exception of cylinder head bolts. Where nuts are split-pinned these will be attended to by unit tradesman or workshop mechanics. Nuts and bolts will only be tightened as far as possible with the standard spanner for the nut. Box spanners used in conjunction with double-ended spanners to obtain additional leverage will not be used. Care should be exercised when tightening bolts securing flexible engine mountings. These should be firmly bolted but not over-tightened. These will be attended to by unit tradesman or workshop mechanics.

Maintenance of Ignition system

43. **Maintenance by the operators – Sparking plugs**

- (a) Keep the plugs tight in the engine. Do not use undue force in tightening, particularly with the smaller type plug i.e, 14 and 10 mm size.
- (b) Keep the insulator clean, dry and free from oil or grease.
- (c) Dismantle plug and clean, if necessary. Ensure washer is replaced on plug when assembling.
- (d) Adjust points, to the gaps specified in the maintenance manual. (This will be done by EME or unit tradesman).
- (e) Replace unserviceable terminal clips, copper and asbestos washers.

44. **High tension leads**

- (a) Keep the terminal tight.
- (b) Keep the leads dry and free oil grease.
- (c) Secure leads away from hot parts or engine, or where dubbing may cause leads to fray.
- (d) Wrap frayed, burnt, or cracked insulation with insulation taps and report for renewal or lead as soon as possible.

45. **Coil and distributor**

- (a) Keep clean and free from oil.
- (b) Keep all nuts, screws and terminals tight.
- (c) Examine low tension leads for defective insulation rectify if necessary with insulation tape, report early for replacement of leads.

46. **Maintenance of Batteries**

One of the most important points affecting the satisfactory operation of equipment is the condition of the battery. It is the foundation of the electrical system and if not in perfect condition will affect the economic operation of the equipment.

47. The systematic check of the battery is of the greatest importance and the operator should carry this out once a week.

48. The following procedure for battery maintenance should be followed: -

- (a) Clean the top battery, to remove dirt that might drop into the cells when the vent caps are removed.
- (b) Remove caps and place them upside down on the side of the battery.
- (c) Check level of electrolyte in battery and add distilled water is necessary. The level of the electrolyte should be ¼" above the plates. Examine battery for leaks.
- (d) Examine battery connections. Wipe away any signs of corrosion around the terminals with a wet cloth. If terminals have corroded to the extent that the metal has been eaten away report for replacement. Ensure that connections are not loose, not overlooking the earth connections. Liberally smear the terminals with lanoline or petroleum jelly. If not available leave perfectly dry. GREASE WILL NOT BE USED UNDER ANY CIRCUMSTANCES.

Maintenance of Tyre Equipment and wheels (Every 2000 Miles)

(Refer General Maintenance Instruction No. 4 also)

49. **Tyre**

- (a) The precaution to be observed to prolong the 'life' of tyres are given below:-
 - (i) Avoid violent braking,
 - (ii) Avoid violent acceleration,
 - (iii) Reduce speed when turning corners,
 - (iv) Avoid curb-stones,
 - (v) Careful driving over freshly laid and up rolled gravel and road metal. When traveling over such surfaces the vehicle should be driven at the driven at the lowest possible speed.
- (b) The importance of correct tyre pressure cannot be over stressed. Operators will check daily tyre pressures with the pressure gauge. Correct tyre pressures are painted on the mud wings or on the body above each tyre.
- (c) Operators should periodically examine tyres for bad cuts, nails and embedded stones. Nails and stones. Should be removed as they tend to cause further damage to tyres. Severe cuts should be reported.

(d) In order to ensure that all tyres wear evenly, tyres including spare wheel, these should be changed over periodically as per the reference given in the log books.

(e) In the event of a burst of tyre or puncture drivers should bring the vehicle to a standstill slowly and not by the vigorous application of brakes. In the case of Run flat tyres only in an emergency will drivers continue to drive the vehicle with a flat tyre.

(f) Tyres should be replaced before they reach the limit of wear at which re treading is not possible, i.e, when the depth of the tread pattern at the crown of the tyre is approximately 1/8" in depth.

(g) Exposure to the sun is harmful to tyres. Whenever possible the vehicles should be parked in the shade.

(h) Tar, oil and grease are also harmful to tyres, and care must be taken to prevent tyres becoming contaminated with these substances.

(i) The painting of the walls of tyres with white oil based paint for ceremonial is strictly prohibited.

50. **Tubes**

When tubes are issued as spare, they will be very slightly inflated, dusted with French chalk and carried in such a way that they are not damaged by coming into contact with other items of equipment.

51. **Wheels**

(a) Ensure that wheels are always tight, and that wheel nuts are tightened up evenly.

(b) Use only the correct tools for removing and re-fitting tyres.

(c) Report severe dents in wheel rims or buckled wheels.

(d) Once every six months remove tyres and treat rim with paint plu black Anti-Corrosive Acid and Alkali Resisting.

52. **Well base rims**

Wheels with well base rims are used extensively on light vehicles and generally in conjunction with wire wheels. When the tyre is removed from the rim, drivers should check for points (c) and (e) above.

53. **Detachable clinch tyre or three pieces wheel**

These are used extensively on heavy vehicles in conjunction with the normal tyre equipment. The wheel assembly comprises the following parts: -

(a) A "Flange" or 'Fined Clinch" fitted on one edge of the rim.

(b) The flat base of the wheel disc proper, over, which the tyre fits closely.

(c) A detachable flange which slides over the un flanged portion of the rim. This is held position by a spring ring.

(d) After the tyre is assembled on the detachable flange, which is held in position by the split ring, locate the tyre in position on the rim.

(e) Operators should pay particular attention to the flat surfaces of the rim. This should be kept clean and treated with graphite. Considerable difficulty will be experienced in removing and re-fitting tyres if rims are allowed to rust.

54. **Two pieces or dividable wheels**

(a) Certain vehicles are fitted with two-piece wheels. Each wheel comprises two halves, which when fitted to a tyre are clamped together by special studs and nuts. These special studs and nuts are in addition to the studs and nuts, which hold the wheel on to the hubs.

(b) To remove the outer cover from the wheel it is first necessary to remove the complete wheel from the hub by unscrewing the inner circle of nuts. Removing the valve core should then deflate the tyre. The outer ring of nuts should then be removed and the two halves of the rims separated. It will be necessary to use the special tools provided for this purpose and the instructions for their use should be strictly followed.

(c) When assembling the tyre must not be inflated until the two halves of the rim have been tightly bolted together.

(e) The special nuts for holding the two halves of the rim together are painted red. It is of greatest importance that the tyre be deflated before these nuts are removed otherwise the air pressure in the tyre will blow the rims apart with the possibility of a serious accident.

55. **Maintenance of Tracks**

(a) Inspect and tighten, loose bolts, nuts, cap screws, on track roller brackets guard nuts, track adjustment spring cover bolts.

(b) Check for damage to grease fittings and replace where necessary.

(c) Check for damage to idler rollers.

(d) Examine for excessive wear of link pins and broken track chain.

(e) Check track tension, and adjust if necessary.

56. **Maintenance of Compressors**

Compressors are very important construction equipments. The following maintenance tasks will be carried out every week :-

(a) Check the compressed air line and joints and ensure that there is no leaking.

(b) The air pressure gauge, oil pressure gauge and safety valve will be checked for its marking every day.

(c) The air filter element will be checked and changed for suction of dust free air.

(d) The mounting bolts of the compressor and the cylinder head should be checked by unit tradesman for its tightness and serviceability of pad/gasket.

(e) Correct lubricating oil will be used and changed at specified hours.

57. **POINTS FOR MAINTENANCE IN EXTREME COLD WEATHER**

In principle, the care and maintenance of equipment should be carried out in the same manner as would be done under normal environments. But the extreme cold weather conditions warrant that special importance is given to certain existing points for maintenance and that certain additional precautions are observed to combat the peculiar conditions. These points are detailed in the following paragraphs.

58. **Washing and Cleaning**

Though general cleanliness is imperative, never spray water on equipment outdoors when the temperature is below the freezing point. Even when water can be sprayed in a heated room or shelter, the equipment must be dried off before it is taken outdoors. After the equipment is dried out externally, it must be driven over a short distance with frequent application to brake and clutch, so the any water that would have found access to these components is squeezed dried out before it has a chance to freeze.

59. In case general washing of the equipment cannot be done, loose snow and dirt should be brushed off. Do not knock off ice, as this will damage the paintwork underneath. However, ice must be scrapped off the glass panels, driving mirrors, number plates etc.

60. Dry cleaning of the equipment, particularly of components, which gets warmed up during a run, must be done when these are still warm after the run.

Cooling system

61. Water in the cooling system will freeze when sub zero temperatures are encountered. Anti-freeze as indicated in the succeeding para should be used.

62. A solution containing 45% of Ethylene Glycol is to be used for temperature up to minus 35°C (minus 31⁰; below this temperature this solution must have 60% Ethylene Glycol. These ratios must be strictly adhered to.

Caution: An increase in the proportion of Ethylene Glycol beyond its "Eutectic" composition will only result in a higher freezing point of the coolant. Undiluted Ethylene Glycol freezes at minus 12⁰ C (Plus 10⁰F) only.

63. Frozen radiators, and failure of the engine to reach normal operating temperatures are the two most common failures in sub zero operation. If instructions for the use of anti-freeze are scrupulously observed, radiator freezing will not occur. However, should this happen the affected vehicle will be placed in a heated shelter, or covered and heated until the coolant thaws. Under no circumstances will the engine be started until the frozen radiator has thawed. If on starting an engine, a sudden rise in temperature is recorded by the temperature gauge, a frozen radiator can be one of the causes. In such a case; therefore, the engine should be switched off immediately and the condition of coolant checked.

64. Failure of engine to reach its normal operating temperature may be due to maladjustment of the Radiator Muff. To rectify this check the Bonnet cover and Radiator Muff for correct adjustment, fitting and state if serviceability. Torn or damaged covers or muffs must be repaired or replaced immediately. If despite this, the correct operating temperature is not reached, report to the dependent Field Workshop.

Fuel system

65. Successful operation of equipment at extreme-low temperature will depend, to a large extent, on the condition of the fuel used. Water in engine fuel causes serious difficulties. Even at temperature a little above the freezing point of water, the water content in fuel can form ice ground the throttle valve and in the jet of the carburetor. This would obstruct the passage of fuel through the carburetor. It is thus, essential that the fuel used be completely free from water. The following precautions must therefore, be implemented.

(a) Caps of fuel containers will be kept tightly closed to prevent ingress of snow, ice or dirt.

(b) Wipe off all snow around filter caps of fuel through a chamois skin to prevent passage of water.

(c) When topping up fuel tank, strain the fuel through a chamois skin to prevent passage of water.

(d) Fuel tanks will be topped up every day after day's work. This drill become more important at low temperatures since it minimizes fuel tanks "Breathing" and the resultant moisture condensation over –night. If trouble is still encountered due to formation of ice in the fuel system, mis 1% Methyl Alcohol with fuel at the time of refueling.

Lubrication system

66. It is possible that due to various factors rapid sludge formation in the engine oil may be experienced in certain areas. The condition of the engine oil must, therefore, be checked frequently when equipments are operated at low temperatures. In case of doubt the advice of maintenance Field Workshop must be sought.

67. In LADAKH Particularly dust contamination of the lubricating oil will be more repaid due to the extreme dustiness of the terrain. The periodicity of oil change has, therefore, to be increased. Whist the extent of this increase in various sectors will be specified by the SO 1/SO 2 (EME), the following increases may be used as a rough guide.

(a) Engine oil : At half the mileage in normal terrain.

(b) Transmission oil : At 75% of the mileage in normal terrain.

68. Other precautions necessary to ensure proper lubrications are as follows :-

(a) Check air cleaners frequently for proper functioning. Clean or replace elements and oil at specified frequencies, and whenever a neck reveals necessity for cleaning or replacement.

(b) Carry out chassis lubrication only immediately after a run.

(c) If heating of greasing points becomes necessary to facilitate re greasing, this should be done by bathing the affected part in hot water with the help of rages. Lubrication moreover, would be facilitated, if the grease gun in kept in a heated place e.g the engine compartment. Heating of grease points with direct flame should never be done. Rapid heating decomposes the grease which then becomes unserviceable. This also damages grease nipples resulting in inability of the valves to seal the grease which has been pumped in.

Electrical system

69. One of the major problems affecting the case of starting an equipment in extreme cold arises from the fact that the batter is called upon to withstand heavier loads at a time when the battery capacity is materially reduced by low temperatures. Care and maintenance of battery, therefore, gains added importance at low temperature. Besides normal maintenance, it is essential that precautions detailed below are meticulously absorbed: -

(a) The specific gravity of each cell must be checked before starting every day at atmospheric temperatures, below 0°C.

(b) In case the level of electrolyte is found to be lower than the correct level, water should never be added to a cold battery; add the water only when the battery is warm and is being charged. Distilled water may, therefore, be added after the equipment has been run for some time and the battery has warmed up and is receiving charge. If water is added to a cold battery at sub zero

temperatures, which is not under charge, the layer of water will stay at the top and freeze before it has a chance to mix with the acid.

Caution : If water is added to a battery between temperatures of plus 32° to plus 50° F, do not fill to the normal level since the electrolyte will expand as it gets heated, and the battery will flood. At these temperatures top up the battery only to the level of the top edge of the plates.

Parking of Vehicles

70. Equipments may have to be parked or garaged outdoors out of necessity. This exposes them to the effect of wind-chill and service cold. This makes it all the more imperative that certain precautions are observed before parking. These precautions will also facilitate re-use of the equipments after over-night parking.

(a) To ensure that wheel tyres and tractor-tracks do not freeze to the ground, equipments will be run up on to a prepared bed of tree branches or planks or even paper. It is particularly important that if parking in water or sludge cannot be avoided, the wheels must be placed on a bed of tree branches or the like. If prolonged periods of idleness are envisaged vehicles must be moved a little once a day. This may not be possible for non-runner tractors but it should always be possible for soft equipments.

(b) The cooling system of equipment is so designed that it can emit heat quickly. Consequently, after the engine has been stopped, it quickly cools down to the temperature of the outside air. By covering up the engine and setting up screens against the prevailing wind, this cooling can be restricted considerably.

(c) Parking brakes should not be left in "no" position.

(d) If a prolonged period of idleness is envisaged, the clutch should be left in disengaged position.

(e) Batteries should preferably be stored in living accommodation. This is particularly important if the battery is not likely to be out to use for a few days.

(f) With a view to use the engine as a brake, coming down an incline must be accomplished in the same gear as would have been necessary for going up that incline. Using the brakes only to control the speed results in fading away of the brakes in a very short time, and involves the danger of skidding on slippery surfaces.