

## COMPREHENSIVE GUIDE FOR AN INSPECTING OFFICIAL ON FOOT PLATE OF A DIESEL ELECTRIC LOCOMOTIVE (FOR INSPECTION)

1. Diesel Electric Locomotives in maintenance sheds are generally examined without any load. As such they mainly depend upon the bookings made by the running staff (during the course of their working) as a guide for the troubles arising under load conditions. Many a time the running staff fail to book the repairs, out of fear or due to lack of their knowledge and even if they book some repairs they book them ambiguously. Hence the inspecting official has a greater responsibility in examining the Loco thoroughly and book repairs properly. He is also expected to judge the capabilities of the crew to operate the loco. He should keep the economy of fuel and lubricants in view.

The inspecting official should keep following personnel in view while making the footplate inspection:

- i) The Operating Crew.
- ii) The maintenance personnel
- iii) The train passing personnel (Transportation Department)
- iv) The permanent way personnel and
- v) Signal & Telecommunication.

In the following paras we will discuss what is expected of the above personnel one by one as to be guide for footplate inspection. The discussion shall be primarily restricted to the loco performance only.

### 1.0 THE OPERATING CREW

During the inspection the following things are to be kept in view:

- i) The operating ability of the crew.
- ii) Observation of safety rules by the crew designed for the safety of the locomotives, train and public.
- iii) Crews contribution for fuel economy.
- iv) The knowledge of the crew about the Locomotive working and the care taken by the crew with regards to the examination of the locomotive.
- v) Their knowledge about trouble-shooting.

vi) Their knowledge about locomotive lay-out.

vii) Their knowledge about booking repairs correctly.

## 1.1 DRIVER'S OPERATING ABILITY AND OBSERVANCE OF SAFETY RULES AND HIS CONTRIBUTION TOWARDS FUEL ECONOMY

1.1.1 A driver should be able to reach cruising speed within 2 to 3 minutes once he clears the points of the starting station by commissioning the full power of the engine.

1.1.2 Once he reaches the cruising speed of the section, he should notch down to suitable lower notch to maintain the sectional speed and should avoid frequent reversal of throttle. His aim should be working the train at constant speed. This will help in minimizing the fuel consumption.

1.1.3. He should use brakes to the minimum possible extent and he should avoid dropping of the loco speed as far as possible. Frequent drooping of speed and application of brakes will cause loss of momentum acquired by the train at the expense of some energy. This will adversely affect the fuel economy and will also reduce the life of some loco components such as wheels, brake blocks etc.

1.1.4. For train control on down gradients and checking of speed wherever necessary should be affected by using dynamic brakes. Vacuum brake should be used only to bring the train speed in the effective range of dynamic braking and to stop the train.

NOTE: The effective range of dynamic brake is between 16 to 95 KMPH. The maximum effectiveness of dynamic braking can be achieved at 35 KMPH. Above 35 KMPH and below 35 KMPH braking power tapers off proportionately with the increase/decrease of speeds.

1.1.5. While applying dynamic braking the driver should not exceed the braking current limit marked by a yellow dot on the load Akketyer Scale (i.e.600 amps in WDM-2 locomotive) while operating at speeds around 95 KMPH.

Before applying dynamic brake, it is essential to check braking current to go upto 900 amps. As the speed increases, the current will automatically reduce to 600 amps by the time the speed reaches to 95 KMPH. In case the current exceeds 600 amps, he should reverse the selector handle till the needle comes to below the yellow dot. If the speed is not getting controlled he should use A9 to reduce the speed of the locomotive. He should also use A9 to bring the train to stop since dynamic braking is not meant for stopping the train.

Use of dynamic brakes will not only reduce the wear and tear on the brake-blocks and wheels but also avoid failure of brakes due to over-heating of brake-blocks

While working on long down gradients. Need for faster pumping for quick recreation of vacuum is also not required. The loss of momentum is quickly restored the moment selector handle is brought back from braking zone to Motoring zone.

The automatically controlled range of dynamic braking (due to signal from the axle generator) is 15 KMPH to 100 KMPH with maximum braking effort of 900 amps at 35 KMPH. The driver is required to observe the load meter during dynamic braking. Dynamic braking will also help in fuel saving.

1.1.6 The driver should never use independent brake valve (SA9) or Emergency position of Automatic brake valve (A9) while working with a train. Use of SA9 or emergency position of A9 will not only result in increasing the flat wear on the loco wheels but also sometimes may cause train brake as a parking brake for the train. He should use emergency position of Automatic brake valve only to avoid accidents. To achieve maximum braking effort, dynamic braking should be used along with +A9 upto "over reduction" position. Intermittently the failure of vacuum brake power due to over heating is thus avoided.

Before application of dynamic brake alongwith A-9 vac-brake, proper working of D-1 pilot air valve to be ascertained since failure of D-1 pilot will cause flat wear on the loco wheels and over heating of motors.

1.1.7 While accelerating the Engine double notching should not be resorted to by the driver in his enthusiasm to make up time. The driver should allow enough time at every notch for the turbo rotor to accelerate and Engine speed to stabilise, say 15 to 20 seconds. Jumping up notches should be avoided. If the above is not rigidly followed hard carbon deposits will form on piston crowns, cylinder liner walls, and cylinder head exhaust valve seats due to incomplete combustion will burn in turbo and exhaust manifolds, the moment they come in contact with fresh air, thermally loading the above component which may result in cracking of exhaust manifold pipes and cracking, warping of turbo components. Double notching causes flash over on motors and generators leading to power grounds, such power grounds need prolonged attention in shed. The shed maintenance staffs are compelled to attend a messed up generator when the loco touches base depot.

1.1.8 The driver should not leave the throttle in between notches, this will cause loss of power and sparking at contactor tips etc.

1.1.9 The drivers are given instructions to notch down the throttle to 5th notch on facing points and level crossings to avoid power grounds.

They were also instructed to reduce the notch by one or two notches while transition is changing from series parallel to parallel operation to reduce the jerking during this period and also to avoid power ground.

1.1.10 The load ammeter situated on the driver's control stand is having two zones on its scale band. The first zone is called unlimited zone and is coloured with a green band. As the load meter needle is in the green zone the driver can work in that range for unlimited period. The moment the needle goes to limited zone the driver should be very careful and he should not exceed the time marked in minutes on the scale. If the needle is in between two time mark limitations, the drivers should estimate time proportionately. Once he used up some time in a higher time limit range and then passes on to a lower time limit range he should allow the needle to stay in that zone for only half the time marked at that lower time range. In case he uses up the time limit he should notch down the throttle till the load meter needle comes to unlimited zone and should wait for at least 20 minutes before crossing into limited zone otherwise the traction notches may accelerate the eventual failure of the engine components due to thermal disturbance or fatigue.

The inspecting official should carefully watch the driver's performance whenever a situation arises where load meter needle crosses into limited zone, in case such situation is not encountered during the course of his inspection he should make a point to question the driver on this aspect and correct him if he had any misgivings in this aspect.

1.1.11 The Drivers are supposed to check the brake power of the locomotives and train by applying brakes fully at the first opportunity i.e. on entering into the first block section which will enable him to assess the efficiency of the train suitably. The adherence of this rule will involve safety of the train, as such, inspecting official should note whether the driver had adhered to this rule or not. In case of failure the driver should be reprimanded.

While applying brakes a gradual application of automatic brakes are desirable. Random dropping of vacuum, jerky applications and releases may cause unproductive fuel consumption, flat wear on wheels and in some extreme cases train parting. Rather driver's operational ability can be judged by the skill of his brake application on train and locomotive. An interesting point is carefully observed.

Gradual application and release lead to speed check gradually. A good and experienced driver will not destroy the vac. to zero to bring the train to a stop.

This will always be conducive to gradual application without causing any discomfort to travelling public and shock loads on buffer rigging. This will also enable him to restore vac. Quickly. On the other hand sudden application of brakes without proper anticipation may lead to train parting.

## 1.2 TESTING THE KNOWLEDGE OF THE DRIVER, CONCEPTION OF LOCOMOTIVE LAYOUT AND HIS ABILITY IN TROUBLE SHOOTING

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A driver is supposed to have a moderate knowledge about the working of various locomotive components and should be able to troubleshoot. Trouble shooting guides to be issued to the drivers to enable them to rectify minor troubles to avoid road failures.

The best way to judge the driver's capabilities in these respects is to question them on various aspects at random and asking; them to identify the locations of some important components. A typical questionnaire with expected answers is attached as "Annexure-A".

Layout sketches of complete locomotive, nose compartment, drivers cab, drivers control stand, (long hood & short hood) Electrical control compartments etc. are also attached as "Annexure-B,C,D,E,F,G, & H" respectively for ready reference.

### 1.3 CREWS CAPABILITY FOR EXAMINING THE LOCO. PREPARATION FOR STARTING THE TRAIN AND CARE TO BE TAKEN BY THEM DURING THE WORKING OF TRAIN.

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The crew has to examine the loco while taking the charge either at the starting point or taking over from relieving crew. This examination is done by both driver and his Assistant distributing various items between them to save time. The preparation for starting the train is done by the driver himself, whereas care of the locomotive on run is mainly left to the driver assistant, though the driver is supposed to exercise supervision over the assistant's working. The details of examination, preparation and care to be taken on run are given below. The inspecting officer, if he happens to be at the site when driver is taking over charge, may observe the examination made by the drivers to judge the crew's knowledge.

1.3.1. While, taking over charge the driver should read the repairs booked by the previous driver and understand them for his guidance in taking care of the locomotive to avoid failures. He should also go through the various readings recorded by the previous crew to have a hang of the loco's condition. If he is starting from the Shed, he should ensure from the maintenance staff that the repairs booked by the previous driver were attended to promptly.

1.3.2 The crew should examine that supplies to the locomotive and their levels are in proper order. They are given below:-

- a) Fuel oil level in fuel tank. It should be minimum trip ration plus 500 litres.
- b) Oil level in main generator gear box. The level should be between "Add" and "Full" as marked on the bayonet gauge. He should not start the Engine if oil level touches empty marking, the bayonet gauge of MG gear case of DLW loco reads "Max. & Min." markings only.
- c) Electro hydraulic governor's oil level examined through sight glasses. The oil level should be full in the bottom glass and below black line in the upper glass. PG Woodward Governor oil level should be between the two black marks in the sight glass.

d) Diesel Engine crank case oil level to be checked by bayonet gauge (crank case exhauster should be off) level should be between high and low marks. He should not start the engine if the oil level is below 'Low' mark.

e) Oil level in the expressor crank case; some expressors are provided with bayonet gauge, some are provided with sight glass with colour code. The expressor provided with bayonet gauge should have a minimum of three marks of oil level and maximum upto "Full" marking. The expressor provided with sight glass should have oil level in "Green" Zone, "Yellow". Zone indicates that expressor requires addition of oil. When the oil level is in the "RED" zone the driver should not start the Engine.

NOTE: oil should never be overfilled in expressors.

f) Oil level in Air-maze Bath oil filters/panel type air filters. The oil level should be between "ADD" and "FULL" marks in the sight glasses in each of the filters. Non-visibility of oil does not warrant failing of the loco but oil level should not be more than "FULL" mark as this oil may be sucked by the turbo-supercharger along with intake air.

NOTE: Oil level should be examined 5 minutes after shutting down the Engine.

g) Cooling water level should be checked through glow rod/gauge glass. Water level should be less than 3/4" from the top of the glow rod. If no water is visible in the glow rod engine should not be started.

NOTE: In many locomotives water level is not visible properly on the glow rod. Hence it may be necessary to confirm the water level in the expansion tank from top of the locomotive provided there is no electric-traction on wire.

h) Battery Electrolyte in each of the 32 cells with a wooden stick (no metallic object should be used for checking electrolyte). The Electrolyte level should be 1.5" above the battery plate. Unless otherwise specified tap water should never be added in the batteries if electrolyte level is found low.

i) Quantity of sand in all four sand boxes should be satisfactory.

j) Oil level in the centre casting and supporting pad oil cups provided on truck frames. The cups should be full.

k) If pit is available the driver may check oil level in Traction motor suspension bearing cups and coat of cardium compound on the wheel. Bull gear to ensure that they are not dry. However it is not mandatory on the part of the driver to examine this. The inspecting officer may get it checked to know the attention paid by the maintenance staff.

l) It should be checked whether the fire extinguishers are kept in their proper places and sealed properly.

m) It should be examined that the driver's tool kit is supplied to the locomotive. No universal standard had been laid down for this tool kit. Different railways had different standards. Generally a driver's tool kit consists of the following:

- i) 14" pipe wrench.
- ii) 9" slide wrench.
- iii) An adjustable monkey wrench.
- iv) Hand hammer.
- v) Pin chisel.
- vi) Pin punch.
- vii) 3/8" / 5/16" Ring spanner.
- viii) 9/16" / 1/2" Ring and open spanner.
- ix) Taper pin.
- x) Cleaning Brush.
- xi) Emergency coupling etc.

a) Should examine whether MU electrical jumper cable is kept in Almirah or not.

Note: Apart from the supplies mentioned above pertaining to the locomotive, a driver is supposed to carry along with him fog signals working time table, drivers rule book, Trouble shooting guide, green and red flags and signal lamp etc. as prescribed by operating rules.

1.3.3 The driver should check for fire hazards and eliminate them.

1.3.4 The driver should ensure that there are no loose fittings. He should check that all covers are properly fitted and intact. (Crank case covers, cylinder head covers, fuel pump covers, and Traction motor gear case covers. Traction motor suspension oil filling cup covers, centre casting and supporting bracket oil cup covers right angle gear box oil filling plug, lubricating oil drain pipe and cooling water drain pipe dummy plugs etc. Missing or improper fitting of above cover and cups may result in a road failure and or may cause extensive damage to diesel Engine/Locomotive components). The driver should also look for missing clamps and should make a booking in the repair book if found missing or defective.

1.3.5 Should examine the tension of 'V' belts of rear traction Motor Blower by pressing down belts one by one. When one belt is pressed it should not go below 1/2" compared to the level of other belts. Any damage on the belts, if found, should be booked. He should also see the 'V' belt guard, expressor fan guard, E.C.C. Guard. E.C.C. slip ring guard is intact or not. If these are not intact, he should make a booking to this effect.

1.3.6 Drivers should ensure that all the multiple unit hoses and vacuum hose are intact and properly mounted on dummies. He should also check their angle cocks are

in correct position or not, He should also ensure that the cage in the vacuum hose on both ends is intact or not. This is a safety item.

1.3.7 Driver should examine the following whether they are properly sealed or not:

- a) GF cut out knife switch.
- b) Mechanical speedometer.
- c) Axle box bolts.
- d) Traction motor suspension bearing cap bolts.
- e) Traction motor gear case bolts.
- f) All manual bypassing/ isolating switches. If provided etc.

1.3.8 Driver should examine the performance of hand brake by applying it.

1.3.9 After examining the above items the driver should start the engine and check the engine and the locomotive for the following:

- a) Unusual sounds, keeping engine in idle (metallic knocks, fuel knock, Tappet knock, Noise or vibration due to loose fittings etc.
- b) Unusual vibrations keeping the Engine in idle and 8th notch.
- c) Leakages in (i) Fuel oil system (ii) Cooling water system (iii) Lubricating oil system (iv) Intake air and exhaust gas system (v) compressed air system (vi) Air and vacuum brake system etc., keeping the engine in 8th notch.

NOTE 1: The driver should not raise the engine speed from idle till cooling water temp rises above 1200° F (490 °C)

NOTE 2: The driver while booking leakages should mention the exact location/locations of leakage (Union joint, flange joint, Victaulic joint, dresser joint, slip on joint, snap on joint etc.)

1.3.10 The driver should examine for proper operation of radiator fan by raising the temperature of cooling water.

1.3.11 The driver should examine all the gauges and meters provided in driver cab, expressor compartment, Nose compartment for proper readings. For checking the load meter he keeps the independent brakes applied, puts on the G.F.switch, places Selection Handle in the Motoring No.1 position, Reverser in Forward direction, and then he will pull the throttle to 1st notch. The load meter shoot up, then the throttle should be brought back to idle and the reverser should be kept in reverse direction and throttle to be opened to first notch. The load needle should shoot up, and then put the throttle to idle.

In normal course the load meters should show 250 to 350 amps. on 1st notch with loco brakes ON. If the reading is more, besides checking the other reasons for

excessive 1st notch current, the operation of 5 power contactors should be checked (one of these power contactors may not be picking up) similarly in case of low reading of the load meters the causes of it may be checked.

1.3.13 The driver should check operation of independent brake valve (SA-9) and Automatic brake valve (A-9) by keeping their application handles in various positions. He should examine the operation of dynamic braking by bringing the selector handle to dynamic braking position. The Engine speed should rise to 4th notch speed and dynamic braking cooling blower should start working.

1.3.14 The driver should examine the operation of horns, wind shield wipers by operating respective operating valve.

1.3.15 Drivers should check the operation of both forward and reverse sanders separately.

Procedure for checking:

ECS should in run, selector handle in motoring zone GF switch on both the control stands ON, independent brake should be applied, reverser handle should be either in forward or reverse depending upon the direction in which the sanding gear has to operate. Throttle to be opened to 1st notch and then put back to idle. Now the sand operating valve has to be operated. Sand should be ejected between rail and wheels.

1.3.16 The driver should drain condensate by opening the drain cocks from the following:

- a) Both the Main Air reservoirs.
- b) Control air reservoir.
- c) Inter-coolers.
- d) Air compressor governor fitted drain cock etc.

1.3.17 He should check the brake piston travel on each brake cylinder. It should be 1.5". If it is more he should make a report to this effect in Drivers repair book.

He should also see that both truck brake cylinder cut out cocks in proper position (safety item).

1.3.17A Improper levelling of locomotive especially caused by breakage of one of the side bearer blocks can be best judged by looking at the distance (gap) between the loco frame plate/cooling coils and the brake cylinders.

1.3.18 Preparation for starting the train

The driver should open A-9 cut out cock on the operating control stand and close A-9 cut out cock on non operating control stand. He should change Automatic Brake handle, reverser handle to the operating control stand. He should put ECS in 'RUN'

position; GF switches of both the control stands 'ON'. Selector handles in No.1 Motoring position. He should give a long whistle and exchange alright signal with the guard. He should release all the brakes including the hand brake and should open throttle to Notch 1 and then gradually notch up the Engine as required. He should reach the sectional speed in minimum possible time by using the full power of the Engine and gradually notch down to maintain sectional speed. It is advisable to give a stabilizing time of 105 sec. in \_\_\_\_\_ meter above 4th notch.

#### 1.2.19 Care to be taken of the locomotive on run.

The crew are instructed to examine and record the readings of all the gauges, Throttle position and record their readings on the drivers report form. A Performa of the drivers report form is attached as Annexure-1.

Para 1.3.11 to be taken as a guide for correct values of the various readings. Apart from the gauges and meters mentioned in para 1.3.11 the driver has to observe the reading of Booster Air pressure gauge with respect to notch position and should record in drivers report form. The ideal values of booster pressures against each notch are given below alongwith rack position and LCP position, though it is not possible to examine the later two items possible for the crew to examine cooling water temperature and expressor oil pressure on run. However an enthusiastic inspecting official may remain in Engine room during run after entering it before its starting for recording of rack position and LCP positions on 6th, 7th, 8th notches, alongwith booster pressure. These readings are of immense value to maintenance staff.

Notch	Booster pressure	Rack position	LCP position of GE Governor	LCP of PG Gov
Idle	-	9 mm	3 clock	The
1st	-	9.11 mm	2.30 clock	LCP
2nd	-	13 mm	2.00 clock	should
3rd	0.5 PSI	18 mm	1.30 clock	be
4th	5 to 6 PSI	19 mm	1.00 clock	between
5th	9 to 10 PSI	21 mm	12.30 clock	530 &
6th	14 to 15 PSI	24 mm	12 clock	230 in
7th	18 to 19 PSI	26.5 mm	11.30 clock	all
8th	21 to 22 PSI	29.5 mm	11 clock	notches.

The driver should examine colour of the exhaust from turbo supercharger periodically. It should be colourless odourless, if it is not he should make a booking. The colour of the smoke and what it indicates is given below:

- a) A good Diesel Engine should give colour less smoke.

b) Black smoke indicates incomplete combustion. A black smoke accompanied with a light fire indicates starvation for combustion air; intermittent puffy black smoke indicates F.I. nozzle defects.

c) Thick column of black smoke accompanied by unusual metallic sound will indicate seizure of piston or turbo rotor or main / big end bearings.

d) Bluish gray smoke indicate burning of Engine lubricating oil in combustion chamber due to bad oil control rings, worn or oval cylinder liners or excessive clearance between valves and valve guides or carry over of oil from oil bath air filters.

e) A white smoke indicates contamination of fuel oil with water.

1.3.20 The driver should periodically look back at the train to ensure that it is running normally. If he feels some jerks during starting and stopping of the train, He should check and tighten the loose couplings and eliminate other defects which can cause jerks and train partings.

He should check the brake power of train and locomotive at the first opportunity by applying the brakes.

1.3.21. At every stoppage the driver and his assistant should get down after applying independent brake to examine the loco and the Engine.

a) They should observe the axle boxes for heat and discolouration.

b) They should observe the Traction motor bearings for discolouration

C) They should observe the smoke from the crank case exhauster.

i) No smoke indicates crank case exhauster is not working.

ii) Thick column of smoke indicates imminent seizure of piston or main or connecting rod bearings. Engine should be shut down and reason should be investigated.

iii) Formation of water bubbles indicate water contamination in lubricating oil due to liner leakage or cracked cylinder head. Engine should be shut down and reason should be investigated. In above case if any defect was noticed during investigation, loco should be sent to the home shed.

d) Expressor exhaust pipe smoke should be watched, Heavy oil throw from the exhauster's exhaust pipe indicate possible high expressor lube oil consumption. Driver should look for hanging vacuum hoses and should be very careful during course of working and check up oil level from time to time to

avoid damage to the expressor, Oily fumes from exhaust pipe are sucked by the radiator fan through the radiators making the radiators sticky. The atmospheric dust will get stuck on the fins causing choking of radiators (with the dust) thereby reducing the efficiency of water cooling.

e) Driver will have to drain condensate from both the main reservoirs, control air reservoir, 'J' Filter, compressor inter cooler etc. The draining of condensates is very essential, otherwise malfunctioning of brake equipment and electro pneumatic power contactors will result.

f) Driver should examine expressor oil pressure and cooling water temperatures and should record in report form. They should also examine whether radiator fans and automatic drain and check valve are functioning properly or not. They should also examine the Engine / and locomotive for unusual sounds, vibrations and fallen covers etc.

1.3.20 At the end of his trip the driver should summarise the troubles he encountered, defects he found during the course of the run and book them on drivers report form and Engine repair book without fail and correctly. It is quite probable that the driver may not be able to book the troubles in Technical terms and there is a tendency to avoid booking of repairs. Driver should be taught and encouraged to book the repairs in whatever way they can express. This will help in maintaining the locomotives in good fettle.

1.3.21 The driver also should examine at the stoppages and while taking over the following:

a) Water pump tell-tale pipe. There should be leakage from this tell-tale pipe. If water leakage is found from the tell-tale pipe, water seal is defective. He should carefully watch water level in expansion tank during the course of his working. If lubricating oil is found leaking it indicates oil seal is damaged. In both the cases the driver should inform the power controller that the loco to be sent to the home shed as early as possible after working a load, if leakage is not heavy.

b) Aftercooler tell-tale pipe. There should be a continuous leakage of Air from this pipe when engine is working with load on second notch and above or on 8th notch without load. If no leakage of air is found is dirty, if oil is found leaking that indicates that air Maze bath filter oil is carried over to the aftercooler by turbo, or Blower end oil seal is defective. If water is found leaking indicates that after cooler tubes are burst. Driver should make a booking in driver's repair book.

c) Cylinder head tell-tale holes: If there is a spray from these holes it indicates that high pressure line is not sitting properly on its seat in the nozzle.

## 2.0 MAINTENANCE PERSONNEL POINT OF VIEW

The maintenance personnel are responsible for maintaining the loco in good fettle. They are very much handicapped to take preventive measures as certain defects can be detected only when the loco is running with load. A careful analysis of non-schedule repairs and failures will indicate that a particular defect was existing for some time but could not be detected in shed as loco was tested without load and there was no booking in the driver's repair book. Hence the inspecting official should make a thorough examination and book every repair in detail to help the maintenance personnel to take preventive steps. The details given under para 1.3 to 1.3.23 should be taken as a guide for examination of the locomotive when stationary and on load. Apart from the items mentioned there the inspecting official may make the following examinations further.

### 2.1.1 Examination of fuel leak off from Fuel Injection Nozzles and Pumps:

About two drops per pump and nozzle per minute is normal leak off which comes out after lubricating the fuel injection equipment parts. Any thing above this should be treated as abnormal. The reasons for excessive leak off are defective nozzles or pump elements but in most cases heavy leak off is due to improper seating of high pressure lines in fuel injection nozzle seats. This is a point to be noted.

2.1.2 Originally the leak off oil is taken back to the fuel tank through a leak off gallery pipe but this pipe is disconnected in many locos by the sheds, as this leak off fuel is carrying lot of contaminants to the fuel tank thereby causing troubles in fuel oil system. The right side leak off gallery pipe elbow is just on the top of lub.oil bayonet gauge and hence fuel leak off is directly getting into crank core continuing the lube oil and there by reducing the viscosity.

### 2.1.3 Leakages in fuel oil system

The probable places of fuel leakage are given below:

- a) Fuel booster pump delivery pipe connection joint Secondary filter cover gasket joint and casing.
- b) Fuel booster pump air seal
- c) Flexible pipes and their joints.
- d) Fuel headers.
- e) Fuel tapping pipes for individual F.I.P.s from header.
- f) Relief valve, regulating valve piping joints.
- g) Gauge line and its joints.
- h) Oil return pipes and their joints.

## 2.2 Leakages in lubricating oil system

Examination of lubricating oil leakages is of most importance as the cost of the lube. oil is increasing in almost all sheds in Indian Railways (the ratio of lubrication oil consumption compared to fuel oil. Consumption originally is fixed by ALCOS as

0.9% and later it had been increased to 1.2% and then to 1.5% by RDSO). In most of the sheds the %age is above 2.9%. As such special care should be taken in examining the leakage colour of the smoke etc.

Sometimes oil throw from the turbo-exhaust is also observed, the reasons are:

- a) Defective turbine end oil seal.
- b) Air lock in turbo oil drain pipe.

### 2.3 Leakages in cooling water system

- a) The probable places of leakages in cooling water system are all piping joints either flange or Victaulic or dresser type.
- b) Water jumper gaskets and water riser gaskets which are quite frequent. They are visible only under on load condition.
- c) Radiators due to bursting of tubes.
- d) Some times lube. Oil is visible in cooling water in expansion tank gauge glass. This indicates cracked or punctured lubricating oil pipes.
- e) Internal leakages in cooling water system due to cylinder liner gasket failures or cracked cylinder heads can best be judged by observing the Engine Crank case oil level. The oil level will rise more than the normal level and colour of the oil will be grayish.

### 2.4 Leakages in Intake Air System:

The probable locations are as follows (the leakages can be observed only on load or on 8th notch of diesel Engine without load (but faintly) :

- a) Turbo after cooler expansion joint `O' ring gasket.
- b) After cooler bottom cover `O' ring gasket.
- c) Intake air elbow joint gaskets on block and cylinder head.
- d) Booster pressure gauge pipe connection etc.

### 2.5 Leakages in Exhaust gas System:

Exhaust manifold elbow joints, cracked exhaust manifold pipes. Turbo Inlet Casing and connector cracks. During inspection, special attention is to be given for the cleanliness of the locomotive. More than 50% of the troubles can be kept away by just keeping the loco clean. While checking cleaning and making booking the locomotive can be divided into the following compartments for making a reference:

- a) Nose compartment.
- b) Drivers Cab.
- c) Electrical Control compartment.
- d) Generator compartment.
- e) Engine room.
- f) Expressor compartment.

- g) Radiator compartment.
- h) Superstructure.
- i) Under Carriage.
- j) Front and rear truck bogies.

2.6 The inspection official should check the fuel oil level at the starting of the inspection and at the end of the inspection and note the fuel consumption during the trip. Excess fuel consumption and trip ration and other allowances degree of maintenance given to the Diesel Engine and its allied components. Apart from leakages in fuel system excess fuel consumption may be due to improper maintenance of fuel injection equipment cylinder heads pistons cylinder liners turbo supercharger, after cooler etc.

2.7 The Inspecting official should also note at what speed transition is taking place and he should also compare electrical and mechanical speedometers. The speed should not vary more than 5 KMPH.

WDM2	THREE TRANSITION	LOCOS	PICKUP	DROP
1st Transition	Series parallel shunt field.		29 KMPH	27 KMPH
2nd Transition	Parallel full field.		47 kMPH	45 KMPH
3rd Transition	Parallel shunted field.		82 KMPH	80 KMPH

2.8 If possible and time permits the inspecting official may examine the safety devices. The safety devices and their indications and method of checking are given below:

Safety Fittings for Engine safety

- (a) Oil Pressure Switch (O.P.S)

Method of checking: Shut the Engine down keeping ECS in RUN and observe lube. Oil pressure gauge and note the pressure at which alarm bell started ringing. Drop pressure 32 PSI / 2.3 kg/Cm<sup>2</sup> (Pick-up pressure 35 PSI while starting the Engine)

Indication: Alarm gong ringing. Green indication lamp should light-up (indication should disappear when ECS is put to idle). Engine should shut down.

In locomotives fitted with P.G. Governors this method is not suitable to check OPS working.

- (b) LOW Water level switch(LWS)

Method of checking: LWS Cut-out cock should be closed on a running engine.

Indication: Engine should shut-down, alarm gong should ring, and indication lamps should come-up. Indication should persist even after ECS put in idle.

NOTE: When LWS cut cock is opened again the indication should disappear and engine should take start when start.

(c) Over Speed Trip:

Method of checking: Trip over-speed trip manually, Engine should shut down. Re-set the handle engine should take start when started.

NOTE: This examination should be done provided the battery of the loco is in sound condition.

(d) Hot Engine Alarm:

Method of checking: Place a paper in R1, R2 raise the water temperature. Hot Engine indication should appear at 195 F (90). Remove the papers after check.

Alternate Method: Energise ETR manually, the indication should appear.  
Indication: Alarm gong should glow, Engine speed should come to idle.

NOTE: On Eastern Railway Patratu Diesel shed a modification is carried-out for the above indication, by introducing a calculated resistance in MLR Circuit, By this modification, Engine Speed will not come to idle. The excitation will be reduced by 40% on a running locomotive with load.

(e) Crank Case explosion cover: Can not be examined on line.

Safety fittings for electrical Equipment

(a) Ground Relay

Method of checking: Keep the engine at higher notches and then operate ground relay manually.

Indication: Engine speed should come to idle alarm gong should ring, while ground relay indication lamp should glow, Ground indication appears when reset button is pressed.

(b) Wheel Slip Relay:

Method of Checking: Apply brakes; put the reversor forward, GF switch on, selector handle in notch 1. Open the throttle to first notch, Load meter will indicate about 400 to 500 amps. Current, Operate wheel slip relay one by one.

Indication: Wheel slip-Buzzer should buzz, white wheel slip indication lamp should glow, and load meter should drop.

Safety devices in Brake system:

(a) PCS Operation in break-in-two:

Method of checking: Release all brakes. Notch up the engine, Open Emergency vacuum brake valve to create a drop of vacuum of about 5 to 7 inches. Indication: Engine speed should come to idle, loco brakes should also get applied (If 28 VB control valve is dummied loco brake will not get applied). 1st Notch Power will be available on run.

(b) PCS Operation on Emergency brake application Automatic brake application valve.

Methods of checking: Raise Engine Speed. Apply emergency brake with A9 automatic brake valve.

Indication: As described in Item (a) above.

(c) Vigilance Control: If operated Raise Engine speed by notching up, release all brakes do not operate vigilance control pedal wait for 45 seconds.

Indication: As described in item (a) above.

(ii) LOCOMOTIVE SAFETY

The safety fittings are head lights, classification lights Rail Guards, Cow catchers, Safety brackets etc. Their proper functioning and post should be examined and noted.

Any malfunctioning of Safety devices should be booked in Driver's Repair Book for rectification by maintenance staff.

TRAIN PASSING PERSONNEL; (Transportation Department)

While making foot plate inspection keeping transportation people in view, the following facts to be noted and observed.

(a) A Diesel engine when idling will cause an excess fuel consumption of 25 to 30 liters per hour which is unproductive.

(b) Every non-schedule stoppage of a fully loaded train will cause about fifty liters of extra consumption.

(c) A signal check (slowing down of the train due to Warner signal is ON, on a through passing station of even slowing down of train due to non-visibility of signal from adequate distance either due to dim signal lamps or improper placement of signals will cause about 25 to 30 liters.

(d) Slowing down the train for observing caution of passing a loop will also cause about 25 to 30 litres of extra fuel consumption.

(e) Loop passing will cause about 25 litres of extra oil consumption.

NOTE: These figures are collected from the trials made in Dhanbad Divn. for fuel economy drive during 1967 and above allowances are given for driver's trip ration. The trials were conducted with 2800 tons load on 1 in 200 gradients.

Hence, an Inspecting official should also note the lapses on the part of Transportation Deptt. and should take up them through appropriate authorities in the interest of fuel economy as 60% of the total budget of a shed is on fuel bill.

The Inspecting official should take note of the following:

(a) Whether a train detention in a yard or station is unavoidable or not. In some Divisions on Eastern Railway, there were standing instructions for ASM to inform the Driver if train is being to be detained for more than 30 minutes. On receipt of information, the driver should take a decision to shut the engine down or not depending upon the condition of his loco's starting Batteries etc. He should take appropriate precaution while shutting down to prevent from rolling.

(b) He should take note whether signals are visible for adequate distance or not and during nights whether signal lamps are burning bright or not.

(c) Whether the Warner is taken-off on through passing station through main line.

(d) Whether the non-schedule stops are un-avoidable or not.

(e) Is the load factor is more than 60% or less than 60%.

(f) On Single Line Section whether token is offered through the token post at stations and pick-up apparatus from Engine or the token is offered by hand, the driver has to slow down the loco which will cause extra fuel consumption but though some of the points appear insignificant they added upto 7.5% of total fuel consumption on Indian Railways as per RDSO miscellaneous report No.DSL-447/74 of March 1974.

4. PERMANENT WAY MEN: Improper maintenance of permanent way will not only cause extra fuel consumption but also reduce the life of loco components, such as axle bearings, wheels etc. Every rail joint will warrant few cc of extra fuel to overcome the joint resistance. A badly maintained joint or improperly packed sleeper will add to the fuel consumption. Jerks, vibrations due to badly maintained track will cause excessive wear on bearings and wheels. These will also cause loosening and falling out of track Bogies fasteners and pins. There are cases of development of cracks on track bogies. Loosening and falling of above mentioned fastenings will cause extensive damage to the traction motors and other track bogie components.

Too many caution orders in a particular section will put-up a continuous high torque demand on the Diesel Engine Adversely effecting the fuel economy.

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