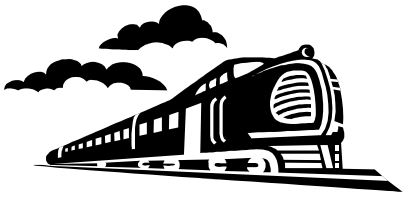


UNIT M 8- LOAD BOX TEST

OBJECTIVE

The objective of this unit is to make you understand about the following:

- What is load box test?
- Why, when and how it is conducted
- What are the types of load boxes used in Indian Railways and their relative merits
- What checks are conducted during load box test
- How to diagnose problem from load box results

STRUCTURE

1. Introduction
   1.1 What is
   1.2 Types of load box and their comparison
   1.3 Why, when and where to conduct
2. Load box procedure
   2.1 Preparation for starting Loco
   2.2 Starting
   2.3 Notch up
   2.4 Preload testing
      - Shut down condition
      - Running condition
   2.5 Preparation for load box
      - Mechanical
      - Electrical
   2.6 Break in test
3. Observation
4. Interpretation of load box observation
5. Summary
6. Self assessment Exercise

1. INTRODUCTION

1.1. WHAT IS?

This is a test to check the capability and performance of the engine by simulating the actual working condition of the locomotive at rated output, in static condition.

During load box test, the output of the engine is measured in terms of electrical parameter (volt and ampere).In this, the output of the generator is connected across a set of resistance (Load Resistance) instead of connecting it with the Traction Motors.The output of the engine is dissipated in terms of heat across the resistance during Load Box test.

1.2 TYPES OF LOAD BOX

They are of two types, based on the type of load resistance connected:

1) Grid Resistance Load Box. 2) Water Resistance Load Box.

COMPARISON

WATER RESISTANCE	GRID RESISTANCE
Merit	De-Merit
1) Load resistance can be varied at infinite stages; hence a continuous HP curve can be plotted through this.	1) Load Resistance can be changed only at limited stages (3 to 6). Hence a complete graph can not be plotted to understand the complete behaviour of the output.
2) Load resistance can be changed during loaded condition.	2) To change the load resistance in grid type, the locomotive requires to be stepped down to lower notch as such load test gets interrupted as many times the resistance required to be changed.
3) Water load box can be conducted for a longer duration because of better heat dissipation facility	3) Grid resistance load box can not be conducted for longer duration, as it gets heated up quickly causing hazardous environment and gives erratic reading.
De-merit	Merit
4) Requires permanent establishment to setup water load box, hence can not be shifted easily.	4) Comparatively handy and can be shifted with lesser effort

1.3 WHY, WHEN AND WHERE TO CONDUCT

Why

1) To see whether the engine gives designed output or not.
2) Whether all systems are functioning properly or not.
3) Whether any problem is connected to any system or component.

When

1) After new manufacturing
2) Before and after major repairs
3) Before and after major schedule.
4) To diagnose any specific problem existing in the engine

Where

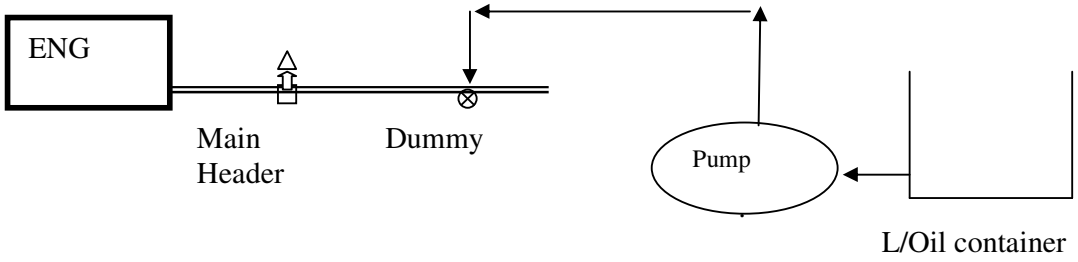
It is conducted on the specified Load Box area in the shed or in the workshop.
(In case of GM locomotive, the facility of Load Box Test exists within the loco itself)

2. PROCEDURE

2.1 PREPARATION FOR STARTING LOCO

1) Water filling
2) Fuel filling and bleeding test.
3) Supplement the engine with supplements e.g.T/G Gear Box oil, Gov. oil, Expressor Oil, Intake filter oil, Right Angle gear box oil and also greasing Rod fan bearings, Horizontal shaft coupling, universal shaft coupling, cardium compound filling in Expressor Coupling etc.
4) Pre lubrication.

Lube oil is not directly filled in the Engine sump. Instead , it is filled through an external pump by opening a dummy in the L/Oil main header (as shown in the figure below) so that the Lube oil can circulate through all the engine components and finally drops down to the sump. This is also termed as prelubrication. During prelubrication the following checks are necessary to carryout.



**During prelubrication Test filters are necessary to be fitted to arrest the worn out metal particles and the metal chips left out in the process of overhauling or manufacture.
9 Nos are fitted in place of S-Pipes and 2 Nos. in the secondary headers.

Check: during pre-lubrication

The flow of lubricant during prelubrication will be as per the following pattern:

Oozing : Con Rod bearings, M/Bearings, cam bush, valve lever bushes
Spray like jets: Piston
Pouring : F.P. Support, valve lever, Yoke
Dripping : Liners

Trickling : Cam Gear.

2.2 STARTING

1) Engine is started immediately after prelubrication and allowed to run for a minute or two. During running unusual sound or leakage is observed, if any.

2) If O.K, run the engine for 5 minutes and stop. Check the following

Check Main Bearing temperature, it should not vary more than 5°C from one bearing to another.
Check and rectify if any leakage is there in L/oil system (specially S pipes) or water system etc.
Check the lube oil sump strainer for any foreign particle, metal dust etc.

3) Run for 30 minutes; observe unusual sound, leakage, smoke etc. if any.

4) Stop engine and check M/Brg temperature, internal leakage of water, L/ oil etc. if any.
Exam crank case for any foreign material or worn out metals.

5) Continue run until temperature reaches 120°F and check between two stretches of runs.
6) Run the engine for 6 to 8 hours to complete idle run.

2.3 NOTCH UP

1) Engine is then notched up to 8 th notch with the continuation of 15 minutes run in each notch.
2) After notch up remove all the test filters and connect the original pipes before conducting load box. Check all the test filters for any foreign materials or worn out metal particles, if any. Take remedial measures accordingly.

2.4 PRE LOAD TESTING

- SHUT DOWN CONDITION

1) **Electrical testing**
   a) Conduct insulation test (Meggar test) between Power circuits to earth. Control circuit to earth. Power to Control and also in all cards.
   Range: 1 to 5 Mega Ohms

   b) Check all C- Brushes of rotating equipments.

2) **Mechanical testing**
   a)Exam crank case for the following:
   i) Foreign material split pin, loose nut etc.
   ii) Internal leakage, if any.

- RUNNING CONDITION

1) **Electrical testing**
   a) Notch wise voltage at No Load to be checked connecting voltmeter Across CK1&CK2 (fixed contact)
   b) Check engine speed notch wise.
   c) Check reference volt across wire No 29 A&4 : 24.4 volt (E type)

d) Check AC Volt across 31L-31M,31M-31N,31N-31L: 100 to 105 V on 8th notch.
e) Check Battery Volt (across CK1&CK2 moving contact): 72 ± 2 volt.
f) Check correct operation of LOPS, LWS, T1 T2 &ETS, PCS, GROUND RELAY, WSR etc.

2) **Mechanical testing**

a) Check correct setting of OST.

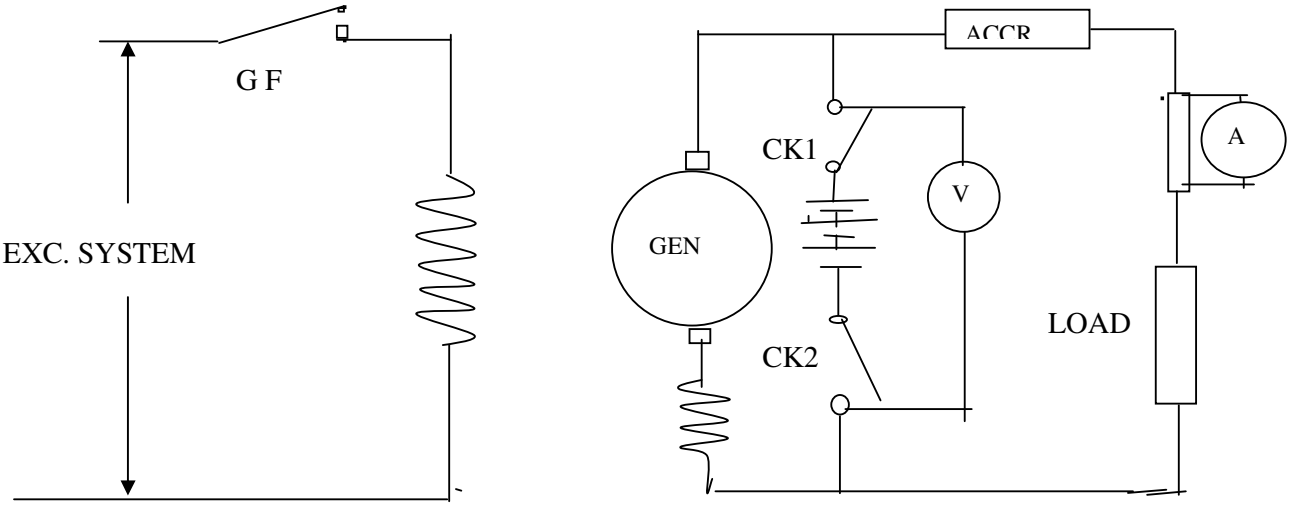
b) Check Turbo Rundown Test : 90 to 180 secs

2.5 PREPARATION FOR LOAD TESTING.

- **Mechanical**

i) Fit adopter for KIENE gauge removing all decompression plugs.
ii) Fit temperature gauge removing exhaust plugs.
iii) Fit temp gauge before and after TSC.
iv) Connect temp gauge before and after After Cooler.
v) Connect temp gauge before and after L/Oil Cooler.
vi) Fit Pressure Gauge before and after L/Oil Filter tank.
vii) Fit Pressure Gauge at Water Pump outlet and Water Headers.
viii) fit Vacuum Gauge at Expressor Crank case.
ix) Fit Water Manometer at crank case cover for measuring Crank case Vacuum. (Specially fabricated for taking crankcase vacuum.)

- **Electrical**



1. Disconnect 3 GA-2 cables from MG negative terminal. In their place connect 3, 2300/24 cables at the negative side of water load box.
2. Disconnect 3 motor armature cable A1, A2, A3 and 3 GA 11 cables running each to P1, P21and P31 from negative side of ACCR. Connect three 2300/24 cables instead of six to the positive side of the water box.
3. Connect voltmeter, ammeter according to the figure, as above.

2.6 BREAK IN ON LOAD

25% of rated load 60 min / 30 min (New / Overhauled Engine)
50% of rated load 60 min / 30 min (- do -)
75% of rated load 120 min/ 60 min (- do -)
100% of rated load 120 min/ 60 min (-do -)

3. OBSERVATION

Observation of load box test will be conducted as per the chart supplied.

LOAD TEST CHART

Loco No. Engine No Trac Gen No Date

Reason for load testing: Time started
Time completed
Name of supervisor Name of fitter (mech):
Name of fitter (elec):
Ambient Temp Altitude Fuel Temp Fuel density

Readings to be taken on each notch

(A)

Notch	Lube oil Pressure			Fuel oil Pressure	Booster Air pressure	Engine Speed RPM	Rack Position in mm	LCP position	Excitation current
	Eng	Com	Exh						
1	2	3	4	5	6	7	8	9	10
Idle 1st 2nd 3rd 4th 5th 6th 7th 8th									

Notch	Auxiliary Voltage	Reference Voltage	AC Voltage between 3φ			Load Current	Load Voltage	Horse Power	Corrected HP	Water Temp
	11	12	13	14	15	16	17	18	19	20
Idle & 8th notch										

Notch	Colour of smoke	Current limit	Specific Fuel Consumption	Efficiency	Crank case vacuum		Remarks
					Engine	Expr./ Comp	
	21	22	23	24	25	26	27
Idle & 8th notch							

A) Readings to be taken on 8th notch

Cyl. No	Compression Pressure	Firing Pressure	Exhaust Gas Temp	Cyl. No	Compression Pressure	Firing Pressure	Exhaust Gas Temp
1R				1L			
2R				2L			
3R				3L			
4R				4L			
5R				5L			
6R				6L			
7R				7L			
8R				8L			

Exhaust gas temperature

Before Turbo:
After Turbo:

Charge Air temperature

Before After Cooler:
After After Cooler:

Lubricating Oil temperature

Before Lube Oil Cooler
After Lube oil cooler

Lubricating Oil Pressure

Before Filter Tank
After Filter Tank

Cooling Water Pressure

At the pump outlet
At the header Rt. side
Lt. side

Water Temperature

Inlet to After Cooler
Inlet to lube oil cooler

Efficiency

After cooler

Lube Oil Cooler

Specific Fuel Consumption

D.E. Thermal Efficiency

Observation of the supervisors:

Signature

Remarks of Foreman:

Signature

Orders of the controlling officers:

Signature

4. INTERPRETATION OF LOAD BOX OBSERVATION

SL NO	RPM	RACK	HP	LCP	TROUBLED AREA	REMARKS
1	OK	OK	OK	I) Just active WW- 5:30 TO 3:00 GE -10:30 TO 9:00 II) More active	I) No trouble ii) Excitation Control	More movement of LCP in active / Load control zone indicates more loading by MG. Because of defect/ wrong adjustment of card No 186, 292, 254, 293, & ACCR.
2	OK	OK	LESS	Move towards load control	Diesel Engine and allied systems.	- Less TRD, low BAP indicate defective TSC/ After Cooler. - Fall in fuel oil pressure indicates choked filters, leaky system or inefficient Fuel Booster Pump. - Low compression and firing pressure indicate inefficient engine - Neither of these defects indicate faulty calibration of FIP.
3	OK	LESS	LESS	I) Active (Under load control) ii)Not in load control	i) Governor ii) Excitation control	i) LCP in load control zone with less rack and correct BAP indicates wrong adjustment of LCP in WW Gov LCPV should be adjusted both in 1st & 8th notch to get correct load control schedule. In GE Gov LCP brush arm must be set at 1:00(in dead condition) during o/hauling. ii) Less rack & less HP without load control indicate less loading by MG. The defect could be in 253,186,292,254,293 & ACCR. Defective MG & exc. may also cause this problem in isolated cases.
4	As per notch	More in lower notches	i) Less or ok ii) More		i) Diesel engine & allied systems ii) Excitation control	i) Incorrect FIP calibration ii) The MG is imposing more load in lower notches. This may be due to defect/ wrong adjustment of 186,292,293 & ACCR

SL NO	RPM	RACK	HP	LCP	TROUBLED AREA	REMARKS
5	**Bogging down or excess hunting**	**More in lower notches or unstable**	**More in lower notches or unstable**	Fluctuating	**Governor adjustment or LCP defective**	Short-circuited commutator segments of LCP or loose contact between commutator & brush arm lead to sudden load variation
6	**Drop in speed**	**Max**	**i) Slightly less** **ii) Less hp**	**GE: 7:00** **WW: minimum**	**i)Excitation control** **ii) DE & allied system**	i) Probable defect cards - 253,186 & 254 ii) Less TRD, low BAP indicate defective TSC/ after cooler -Fall in fuel oil pressure indicates choked filters, leaky system or inefficient fuel booster pump -Low compression and firing pressure indicate inefficient D/E -Neither of these defects indicate faulty calibration of FIP

5. SUMMARY

Load Box test is conducted to check and verify the capability and performance of the diesel engine by simulating the actual working condition in static condition of the locomotive. This is also used as a diagnostic tool to identify problems related to any system or component. At every maintenance depot POH shop and manufacturing unit there is a specified area to conduct load box test. Based upon the type of resistances used, they are of two types; Water and Grid resistance type Load Box. During load box test, the output of the generator is connected across a set of resistance instead of connecting it with the Traction Motors. The output of engine is measured in terms of electrical parameters i.e. volt and ampere, across the resistances connected in load box. Several other mechanical and electrical parameters are also recorded to diagnose problems related to engine performance, based on the observations made during load box test.

6. SELF ASSESSMENT EXERCISES

1. What is Load Box test? Why, when and where they are conducted?
2. What are the types of Load Boxes used in Indian Railways? Compare their relative merits?
3. What is Prelubrication? What checks are to be conducted during Prelubrication?
4. What mechanical and electrical checks are conducted as pre load test during Load Box?
5. What is calculated HP? And how is it corrected?