
UNIT8 TROUBLE SHOOTING

OBJECTIVES

After going through this unit, you will be able to identify and understand:

- The locomotive troubles
- Troubles in dead and idling locomotives and the trouble shooting
- Trouble shooting in running locomotives

STRUCTURES

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 - 3.4.Loco starting with heavy jerk
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1. INTRODUCTION

A considerable portion of road troubles are experienced due to some defects in electrical components and machines, which can be rectified with very little effort. In some of the cases they be temporarily attended to save the road failure of the locomotive. As the road troubles are faced by the supervisors/officers first on foot-plate, it would be very much helpful if they rectify the fault on road (temporarily or permanently) and avoid the stalling of rolling stock.

Keeping in view all these situations, the Railway Officials are given brief knowledge of Diesel Electric Locomotives with circuit analysis, as the trouble shooting can not be really done without knowing their working etc.

This chapter includes the defects and possibilities of the place of defects with their remedial actions, which can only be rectified en-route. One smart and intelligent official on foot-plate can also attend the troubles, which have not been covered in this, with the help of the schematic diagram attached to this chapter.

2. TROUBLES

Road troubles may be classified in two categories :

1. Failure of component, which can not be rectified, but can be temporarily attended or by-passed to save or avoid a road failure.
2. Troubles due to accumulation of foreign particles like dirt, dust, etc, which leads to erratic or non-operation of the respective circuit and component. These faults can be rectified en-route, if they are pin-pointed.

Road troubles are experienced in three stages :

1. When the engine is dead and one driver is taking over charge.
2. Engine is idling, when driver is taking charge.
3. Fault or trouble is experienced while loco was hauling the load.

3. TROUBLES IN DEAD AND IDLING LOCOS

Normally when one driver takes charge of one locomotive at out-station, he gets the loco in engine idling condition, but sometimes locos are found in dead condition also. During checking of the locomotives, some troubles are faced. They are as under :

1. Engine can not be started
2. Some of the auxiliary machines are not running
3. Loco can not move (Not getting Power)
4. Loco starting with heavy jerk
5. Loco is moving but load-meter is showing zero or negative
6. Low Hauling Power

3.1. Engine not taking start

Before going to start the diesel engine, the driver is supposed to put on some of the breakers just to run some of the auxiliary machines and energise some circuits to make the fuel available to the fuel pump etc.

The switches and breakers to put on (STARTING SEQUENCE):

- a) Close the knife switch
- b) Put on the MB1 (Battery Breaker)
- c) Put on the MB2 (Control Breaker)
- d) Put on MCB1 & MCB2 (Master Control Breakers) fitted in the control stands - DMR should pick up
- e) Put on MFPB1 & MFPB2 (Master fuel pump breakers) - FPC should pick up
- f) Put on FPB (Fuel Pump Breaker)
- g) Put on AFPB (Addl. Fuel Pump Breaker.) - Fuel Pump Motor should run and fuel pressure should run and fuel oil pressure should develop
- g) Put on CEB (Crank case exhauster Breaker) - Crank case motor should run

Now engine is ready to take start

If any of the motors etc. are not functioning then the machines and respective wires etc. are to be checked according to starting circuit (Aux. Control Circuit)

3.1.1 Engine not cranking

To start the engine ECS to be kept in idle and engine start button is to push - CK1 & CK2 should pick up and engine should crank - if not check the interlocks in series with opt. coil of CK1 & CK2 namely, ESR4-N.C. (71-50T), ECS-close (50T-50C), P22-NC(43-43A), S1-NC (43A-43B).

If CK1 is picking up and CK2 is not then the interlock of CK1 (43B-43C) is to check for correct operation (it should make when CK1 is closed).

3.1.2 Engine cranking but shuts down with release of Start Button

If this fault is experienced, then it is clear that the condition mentioned in 1.1 is fulfilled.

The checking regarding this fault are :

- a) Whether the lube oil pressure is building up or not, operation of OPS (oil pressure switch) can be checked by the stop of glowing of engine start lamp provided near the start button.
- b) Water level may be inadequate or LWS (low water level switch) is defective - if LWS is in operated condition, then the alarm gong will sound both in idle and run position of ECS.

c) Tachometer generator may not be giving out put or taco-generator drive gear is worn out
- Tacho-generator wires should be checked for proper connection etc.

NOTE: In some cases if incoming driver stops the engine at 800c of cooling water temperature, then it takes excessive time to cool down (specially in summer). In that case also fresh driver (out going) could not start the engine because the lube oil pressure does not build up as needed (2 to 2.2 kg/cm²) till engine cools down and viscosity of lube oil increases.

3.2. Not running of auxiliary machines and leads to non-starting of the engine as discussed above in 1.1

3.3. Loco unable to move (Not getting power)

This defect is related mainly with problems in propulsion control circuit, power circuit and excitation circuit.

3.3.1 Not getting power due to defects in propulsion circuit

After putting on the GF switch and notching up the throttle to 1st. notch putting the Reverser handle either in forward or reverse, the GF cont. should close. With the closure of GF cont. the traction generator should produce voltage and the power is transmitted to the traction motors to move the wheels. Cause of not getting power to be checked according to the sequence as follows :

3.3.1.1 Check the GF Contactor's operation

If not operating - Check BKT1-NC (6-6A)
ECS RUN (6A-6B) close
GR-NC (6C-6D)
TR-NC (6D-6E)
CK1-NC (6E-6F)
CK2-NC (6F-6H)

Maximum possibility of non-operation, however, may be due to welding of either CK1 or CK2 contactor. Sometimes TR interlock (6D-6E) also remains in open condition due to accumulation of dirt.

3.3.1.2 Check the operation of S1, S21 & S31 power contactors

3.3.1.2.1 S1 is not picking up - details of interlocks can be seen through diagrams.

Maximum possibilities - (i) Contact of ECS (8D-18A) should remain closed
(ii) TR-NC (8E-8F)
(iii) P1-NC (8F-8M)

3.3.1.2.2 S21 is not picking up - (S1 picking up)

Maximum possibility - P21-NC (8M-8G)

3.3.1.2.3 S31 is not picking up - (S1 & S21 picking up)

Maximum possibility - P31-NC (8M-8G)

3.3.1.3 Position of BKTs and REVs is also to be checked

3.3.2 Power is not getting due to defect in power circuit

It is noticed very often that some of the power contactors through which electricity is fed to the traction motors do not operate due to defective magnet valves. Normally defective magnet valves can not be rectified en-route. However, bypassing one or more traction motors loco can be proceeded if possible. In such cases load meter may show or may not show. Power may also not be available due to wheel slip or power ground. Fault may be in the power circuit but the wheel slip and power ground will be described in separately.

3.3.3 Power not getting due to defects in Excitation Control Panel

The panel is to control the excitation of main generator. Normally the failure of the panel components / cards can not be rectified until there are separate cards available. However, it sometimes happens that two locos are failing with different reasons in one station or place. And if one loco is failing with some trouble in excitation circuit / panel causing no power, can be rectified replacing the cards taking from other loco.

a) It is advisable to replace all the excitation panel cards as a set to help the shed people in maintaining record. If any one becomes interested to identify the defective card, the cards are then to be replaced one by one and the result can be seen. Card 253 or 293 or 186 or 188 may be the defective one. Sometimes more than one card may also be found faulty.

b) Wire at FCP (field control panel) may get disconnected or burnt. FCP tubes are always hot. They should be allowed to cool down first and then proceed for repair. If it is clear that from which point the wire got disconnected, then they can be connected.

c) Sometimes BKR (braking relay) interlocks (22E-32D) and (32C-32D) do not make proper contact. They should be in closed condition during motoring. If there is any dirt accumulation, they can be cleaned.

d) LCP (load control potentiometer) in governor may not be touching with commutator and reference voltage increases causing low or no power.. Normally it is due loose brush arm mounting screw. However, before tightening the screw the commutator surface and the brush-arm should be cleaned thoroughly.

e) NO contacts of WSRs (10H-10T) also create this problem being closed. They should be separated if the concerned WSR is not operated.

f) If the exciter fails to generate voltage, Traction Generator does not produce output due to no excitation.

By checking the carbon brushes and connection on terminal board, its defect can be identified very often.

3.4. Heavy jerk experienced during starting the loco

Jerk is caused due to excessive 1st. notch current to the traction motors. The reason may be the following :(Remedial actions are also indicated)

3.4.1 GF interlock (61E-61EE) may be wrongly adjusted.

It should close when GF contactor is in open condition. If the interlocks are not getting closed properly, they can be rectified bending the finger. Sometimes they remain electrically separated due to accumulation of dirt. This fault can be rectified cleaning the contacts.

3.4.2 Defect in 188 card :

Due to sudden notching down, sometimes it happens that diode ERD20 & 21 get punctured (short circuited). It causes no current through suicide winding of PWM (pulse width modulator). By replacing this card with a healthy one the fault can be rectified. In this case availability of spare 188 card is the main factor.

3.4.3 Defect in other cards :

Card No. 253, 186, 254 may also create the problem of jerk. In all these cases by replacing the cards the fault can be rectified.

3.4.4 Current flow through PWM suicide winding may also get disrupted if the ER15 resistor inside control compartment gets open circuited and leads to jerk in 1st. notch. In such condition nothing can really be done en-route. It requires replacement.

3.5. Loco is moving but load meter is showing zero or negative

Load-meter indicates the current flow through traction motor no.1. S1 power contactor is related with this motor. If S1 does not operate or if there is an open circuit in the concerning circuits, then the load-meter may not show. But in that case full power (in fact the tractive effort) will also not be available.

In some of the cases due to ground fault in battery charging circuit or excitation circuit, polarity of main generator gets reversed and uncontrolled amount of current flows to

traction motors in reverse direction. Normally jerk is also experienced during starting of train or locomotive. Engine also sounds unusually due to overloading. Load meter shows negative. To save the traction motors, loco should be stopped as quick as possible. However, the driver can proceed in lower notches with a close watch to the load meter and the shed people is informed for assistance. Fault in excitation circuit also creates this problem.

3.6. Low hauling power

In maximum cases, such indication is due to inability of the engine. However, due to defect or mull-operation of the circuits, sometimes, may cause such problems. By checking the rack movement at 8th. notch on load, cause of low HP can be pin pointed. If the rack movement is not maximum as specified (29.5mm in WDM2), then electrical may be held responsible. Of course in case of PG Woodward governor the argument will not stand because insufficient booster pressure or even wrong adjustment inside the governor may also force the rack not to move full.

If the rack movement is less than the limit in 8th. notch, then check the following :

3.6.1 In motoring condition, BKR contact 32D-22E should remain closed. Contact can be assured cleaning the contact tip.

3.6.2 Breakage of FCP wire may cause the same problem

3.6.3 Movement (unwanted) of LCP in PG Governor causes this problem.

3.6.4 If the LCP brush-arm of GE Gov. becomes loose, same problem occurs. The mounting screw is to be tightened then.

3.6.5 Exciter should also be checked for proper brush fitting etc. In case, if the brush sets of brush gear is found defective, one set from another brush gear can be taken out and fitted in the defective gear. One set of brushes per brush gear is allowed in case of emergency. One set from auxiliary generator can also be taken out and fitted accordingly.

3.6.6 Operation of WSR also causes no or low power, which is dealt latter.

3.6.7 Defects in cards :

Card 254, 293, 186, 188 may also cause this problem on certain defective conditions.

4. FAULT EXPERIENCED WHEN THE LOCO WAS MOVING

In maximum cases locos do fail in this condition, and it has been seen that because of nervousness or inadequate knowledge of the crew, the fault could not be rectified though they should have been rectified en-route with minimum effort.

The failures of this condition can be classified in following categories :

- 4.8 Engine over-speeds
- 4.9 Engine not responding to throttle or speed is erratic
- 4.10 Engine hunting
- 4.11 Engine shuts down and crew unable to restart
- 4.12 Low HP
- 4.13 Engine bogs down under load
- 4.14 Operation of ground relay
- 4.8 Operation of wheel slip relay
- 4.9 GF not picking up
- 4.10 Operation of Power Contactors is erratic
- 4.11 Transition is picking up
- 4.12 Wheel slip indication in a particular transition
- 4.13 Hot engine indication
- 4.14 Battery charging stopped

DEFECT	CAUSE	REMEDY
4.1 Engine Over-speeds	No oil in Gov.	Top up
(In case of emergency only fuel oil can be used in PG Gov. and in GE Gov fuel oil and crank case oil with a ratio of 2:1 can be used)		
	Gov. Amphenol plug loose	Tighten
	Tacho gen. wire broken	Connect
	Wire form ECP broken	Connect
4.2 Engine not responding to TH (erratic speed)	Notch wise ESR oprations are not correct	Check the broken contact on ESR and connect Open the back cover of control stand and clean the fingers
(ESR operations - ESR1, ESR3, ESR1+3, ESR2+3+4, ESR1+2+3+4, ESR2+3, ESR1+2+3.)		

DEFECT	CAUSE	REMEDY
4.3 Engine hunting	Dirty Gov. oil -	Change
	Foaming of Gov. oil	Attend leakage
	Stab. Rheostat dirty or brush arm loose.	Clean & Tighten
	Wire on ECP or Gov. broken	Connect
	Cam of ECS broken	Separate 50L-50P
	ESR2interlock open (50L-50P)	Clean the tips
4.4 Engine shuts down and unable to restart There may be two conditions, either it shuts down on load or without load. If it shuts down on load, then can be restarted	Fuel Booster Pump is not working (pressure is not building up)	If the motor is working but pump is not working then coupler allen screw may be tightened. If the motor is not moving, check. carbon brushes, comm.and connection to motor
	Breakage of wire in ECP & Gov.	Connect
	Breakage of wire in Tach. gen.	Connect
	Failure of inter locks as indicated in para 1(Engine not cranking)	Attend as stated (Unable to start condition)
4.5 Low HP		Discussed in 6.
4.6 Bogs down on load -	NC of BKR (32C-32D)	Clean

DEFECT	CAUSE	REMEDY	
<p>4.7 GR Operation:- The operation may be during engine starting. Such ground fault is commonly known as starting ground and is difficult to rectify without adequate facility en-route. The loco may be allowed to run with this fault. But if it is a power ground The loco fails positively if not rectified. First check whether explosive or non-explosive</p>	<p>Explosive:</p>	<p>Check the source</p>	
	<p>if from main generator</p>		
	<p>(a) Dirty commutator</p>	<p>Clean surface with 00 sand paper</p>	
	<p>(b) Brushes are sticky inside pockets</p>	<p>Polish the brushes</p>	
	<p>(c) Pig tails worked out of brush and touching ground</p>	<p>Cut the pigtail and throw out</p>	
	<p>(d) Foreign particle on commutator</p>	<p>Throw it out</p>	
	<p>if from power contactor</p>		
	<p>(a) Metal deposition inside arc chute</p>	<p>Replace with parallel cont. arc chute.</p>	
	<p>*Loco should run at slow speed so that parallel contactors do not operate.</p>		
	<p>(b) Sluggish operation of Power Conts</p>	<p>Disconnecting the magnet valve on or two motors may be by passed, if the load permits.</p>	
	<p>(c) Foreign particles</p>	<p>Throw it out.</p>	
	<p>If from Traction Motor(s)</p>		
	<p>(a) Commutator dirty</p>	<p>Clean</p>	
	<p>(b) Broken or sticky carbon brush</p>	<p>Attend as T/Gen</p>	
<p>(c) Foreign material</p>	<p>- do -</p>		
<p>If from FS Contactors</p>		<p>To be attended as power contactors excepting magnet valve portion.</p>	

DEFECT	CAUSE	REMEDY
Non-Explosive:-		
(A man with knowledge of power circuit can only rectify this type of ground fault with adequate facility eg. Megger, Avometer etc. However, some effort still can be made to find out the faulty member and rectify, if possible, as stated below).		
	Foreign material inside Main Gen. Traction motor, BKTs, REVs, PCs,FS Conts, WSRR, WSRs,. FCP etc	Throw out the foreign material.
	Any broken wire touching ground if possible	Isolate or cut out the piece
	Traction motor cable(s) rubbing with motor cap(s) and the insulation is damaged (cut).	Separate them and tying with rope so that rubbing avoided
4.8 Wheel slip indication:-		
First locate, which relay is getting energised and at what speed to understand the motor combinations (transition).		
For 0 to 30KMPH (1st. Transition)	One or some of the FS contactors got welded.	Separate them manually. Also clean the tips.
WSR1	Unequal current flow in TM No. 1 & 4	Check BKT1, REV1 and S1 for proper operation Try to make them OK manually if any fault is noticed
WSR2	Unequal current in TM No. 2 & 5	Check BKT2, REV1 and S31 for proper operation. Attend as above
WSR3	Unequal current in TM No. 3 & 6	Check BKT1, REV1 and S21 for correct operation. Attend as above
All the relays are operating .	WSRR open circuited	Connect the broken wire if possible.

NOTE In some of the cases due to brake binding, wrong adjustment of slack adjuster, inadequate brake cyl. travel, oil dropping on particular wheel etc., wheel slip is experienced. They are also to be checked. Also in case of pinion slip same wheel slip indication will be experienced and can be found out on checking only.

DEFECT	CAUSE	REMEDY
Wheel slip experienced at speed range of 30 KMPH to 47 KMPH or at 30 KMPH only.	One or some of the FS contactors are not operating.	Check for Mechanical blocking. Check broken wire of opt. coil.
	FS22,23,24 & 26 not operating	Check FS21 interlock operation for closure during operation. Check broken wire from opt. coil & interlock.
Wheel slip at a speed of 47 KMPH and above WSR1 operating	Either P2 or P31 not operating	Check leakage on magnet valves
WSR2 operating	Either P22 or P32 not operating	-do-
WSR3 operating	Either P1 or P21 not operating	-do-

Other than these, if any of the six motors got defective, two motors can be isolated and loco can be run with four motors. In that case, S1 or S21 or S31 can be dumied putting wedge inside concerned magnet valve. Following chart will help to locate the concerned contactor for any motor with different WSR operations.

Combination	Contactors	Motors	WSRs
Series Parallel	S1	1 & 4	1
	S21	3 & 6	3
	S31	2 & 5	2
Parallel	P1 & P21	4 & 6	3
	P31 & P2	5 & 1	1
	P22 & P32	3 & 2	2

Finding out a faulty motor

Say, in one locomotive, in series parallel circuit (0 to 47 Kmph) WSR1 is getting operated. S1 magnet valve is to be disconnected or wedged first. If load permits, train speed increase. Transitions will take normally. But when it will attain a speed of 47 Kmph. and second transition will pick up, wheel slip will again be experienced. Check the relay getting operated. If WSR1 is getting operated again, then TM1 is faulty. Disconnect or wedge P2 magnet valve. Above 47 Kmph, the locomotive will run with 5 Motors. If WSR3 operates during parallel transition (above 47 Kmph), isolate TM4 wedging or disconnecting P1 magnet valve. This type of isolation helps in Mail/Express services, where loco runs with lesser loads.

DEFECT	CAUSE	REMEDY
4.9 GF not picking up	ECS cam broken, unable to put ECS in run	Short circuit 6A-6B (All RUN contacts should be shorted opening IDLE contacts)
	GR 6B-6C open	Make it close
	TR 6D-6E open	Short the contact.
	CK1 or CK2 welded	Get them separated Make sure that CK16E-6F & CK2 6F-6H are closed. (Sometimes due to wrong fitting of CK1/CK2 arc chutes causes this problem.)
	GF switch defective	Both GF switches can't be defective at a time. Find out the defective and short circuit it. Both the switches shouldn't be shorted
(GF contactor should not be closed with wedge, because it would give jerk in 1st. notch.)		

4.10 Operation of PC are erratic: It is dependent on magnet valve operation. Find out the faulty contactor and operate manually by wedging respective magnet valve armature. If it operates, then check the circuit if given :

DEFECT	CAUSE	REMEDY
S1 not operating	BKR 8C-8D (NC) open ECS 8D-18A (RUN) or P1 8F-8M (NC) open	Make them close or clean contact

DEFECT	CAUSE	REMEDY
S21 not operating but S1 operating	P21 8M-8Z (NC) open	-do-
S31 not operating S1&S21 operating	P31 8M-8G (NC) open	-do-
P1 P21 & P31 not operating	S31 8L-8S (NC) open	-do-
P2 not operating P22&P32 operating	S1 8K-8U (NC) open	-do-
P22 not operating P2&P32 operating	S21 8K-8W (NC) open	-do-
P32 not operating P2&P22 operating	S31 8K-8W (NC) open	-do-
P2, P22 & P32 not operating	GF 8L-8R (NC) open or excessive gap of P21 8E-8K (NO)	Adjust gap (not more than 1/8") and ensure proper operation

Sometimes Reverser magnet valves do not operate due to loss of contact in control stand. In that case, driver should work from other control stand. Driver should also try to operate from other control stand, in case of any trouble experienced in controlling engine speed.

4.11 Transition is not picking up

DEFECT	CAUSE	REMEDY
1st. Transition not picking up		
Operation of six FSR contactors is the indication of 1st transition. But to operate them, FSR must operate.		
	FSR not operating	Close P2 6T-6V (NC) Close S21 6V-6W (NO) Close TR 6W-6X (NC)
(If still not working, operate FSR usually because fault is inside first 210 card)		

DEFECT	CAUSE	REMEDY
	FSR picking up but FS Contactors are not picking up	Clean FSR 6-19H (NO) (contact can also be changed with spare)
	FS21 & FS25 are operating rests are not operating	FS21 13-19J (NO) is to be cleaned and broken wire etc. to be connected
2nd. Transition not picking up		
Operation of six parallel contactors is the indication of 2nd. transition. For their operation TR must operate.		
	TR not picking up	Fault inside 2nd. 210 card.
Operate TR manually. (If Manual switch is there, use it.)		
	TR operating but PCs not operating	Clean and make TR NO contact 8E-8L
	Parallel PCs are operating but GF not picking up	Make sure that P326C-6E (NO) is closing Adjust if required
3rd. Transition not picking up		
Operation of FS contactors is the indication of 3rd. transition.		
	FSR not operating	Clean and make TR6V-6X (NO) contact
If still FSR not picking up, defect is in 3rd. 210 Card.		

4.12 Wheel Slip Indication: - Covered in 3.8 in details.

4.13 Hot Engine indication:

It is experienced in summer season to the maximum extent. Normally locos do not fail en-route due to hot engine. But if the locomotive is equipped with ETR, the diesel engine comes to IDLE after ETS operation. As the viscosity of lube oil goes down with increase in temperature, due to sudden fall in engine speed, the lube oil pressure drops below the drop out setting pressure of OPS. As a result engine shuts down and could not be restarted, till the temperature of the diesel engine comes down, and the viscosity of lube oil goes up. Normally most of the sheds bypassed the ETR so that after operation of ETS, engine speed does not drop to idle. Driver gets the audio-visual indication only. Getting this indication, driver should notch

down to 6th. notch or so and slowly pass the blocked section. The alarm gong will go on sounding. As soon as he reaches the next station, he should notch down to 3rd. notch and not to IDLE. GF switch should be put off on 3rd. notch itself, so that the lube oil pressure is maintained at its safe value. After putting off GF, he should start FAST PUMPING. In summer, if engine gets shut down causing low lube oil pressure, it normally takes 1 hour or more to cool in a state when radiator fan does not work, and leads to loco failure.

4.14 Battery is not taking charge: (B.A. showing discharge)

It indicates failure of Battery Charging Circuit. Proceed to check the cause as follows :

Check VRP fuse	Renew with spare if doubtful.
Check AGFB	Reset if tripped.
Check VRP base for loose or cut wire	Tighten/connect.
Check Aux. Gen. brush gear and brushes.	Attend/replace as required.
Check BX-BN Card for proper placement.	Cards should be placed properly, after putting off AGFB.

5. Summary

Troubles experienced by the driver or other inspectors travelling in the footplate both in dead and idling locomotives have been dealt in this unit. What could be the probable reasons of troubles and how the trouble shooting should be done have been described in the form of charts. It is expected that this unit would help the officials in footplate to rectify the fault without taking assistance of maintenance people.

The reasons of road failures e.g. engine not taking start, not getting power, low hauling power, load meter showing zero, transition trouble, jerk in first notch, etc. which contribute about 70% of the electrical failures, have been described in this unit. Identification of probable areas, which normally go wrong, would help the Railway in minimising detentions, if appropriate actions are timely taken by the officials on footplate. There are some defects, which, perhaps, are difficult to rectify en-route, without proper assistance and spares, have also been incorporated in this write-up.

6. Self-assessment Exercises

1. Write the probable causes of automatic shut down and suggest en-route trouble shooting for them.
2. What could be the probable reasons of jerk in first notch? What actions could be taken en-route to rectify the defects?
3. How to proceed to rectify a fault of wheel slip?
4. How to identify the cause of low hauling power and what actions should be taken for these causes?
5. Writ down the steps of checking for battery not taking charge.