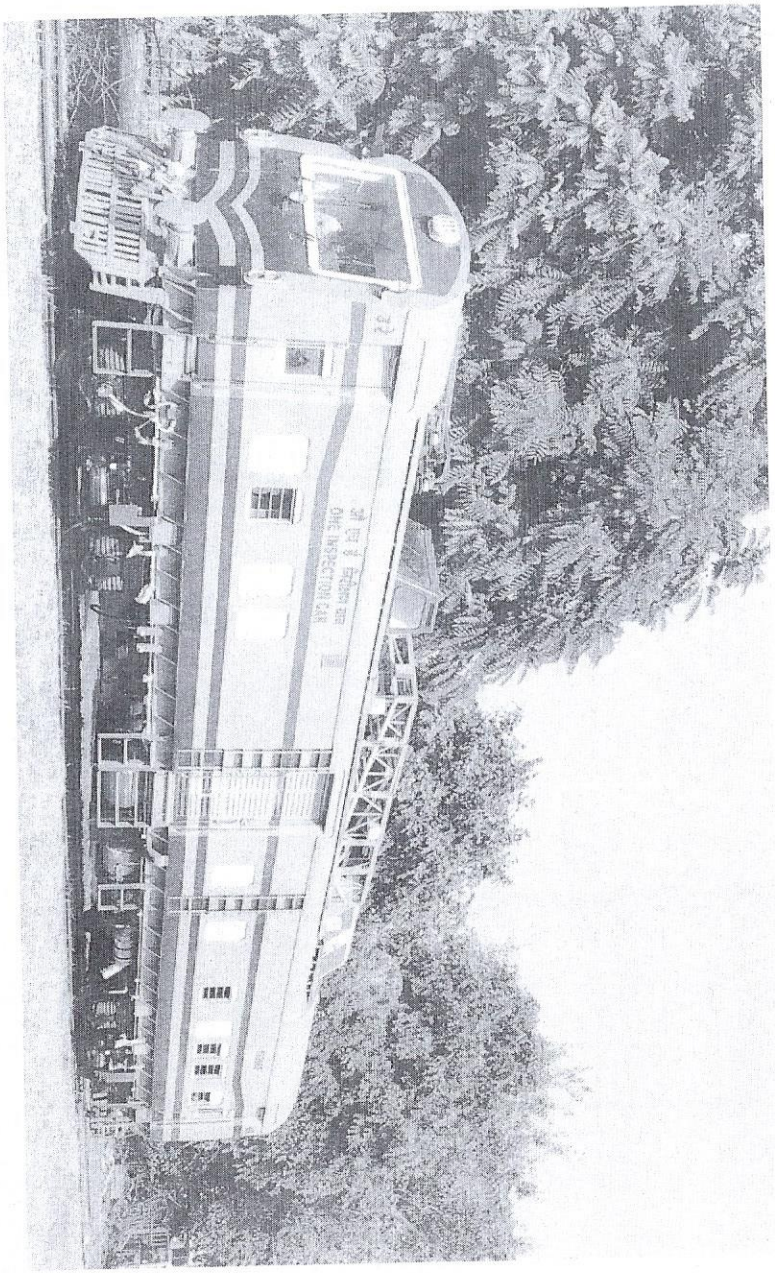




भारतीय रेल

INDIAN RAILWAYS

डीजल रेलइंजिन आधुनिकीकरण कारखाना, पटियाला  
DIESEL LOCO MODERNISATION WORKS, PATIALA



HISTORY & TESTING RECORD OF 3W-DIESEL  
ELECTRIC TOWER CAR

DETC NO.	: 190075
TYPE	: 3 WHEEL
RAILWAY/DIVISION	: NR
ELECTRIC TRACTION	: BHEL

निर्माण रिकार्ड



COMMISSIONING  
PROTOCOL – DIESEL  
ELECTRIC TOWER CAR

BHEL/CP/DETC/US/ICF R0

DETC - US



Project : Diesel Electric Tower Car with underslung propulsion

DMW patiala

Customer : ~~INTEGRAL COACH FACTORY, CHENNAI~~

DETC No. : M21

DETC User Railway No. : NR 190075

Date of dispatch : 13/11/2019

*only*  
(Vikas K. Gaur)  
BHEL representative

*Amil-Handilge*  
CIL representative

*R. Paulam*  
ICF representative  
DMW

*R. Paulam*

## DETC Equipment List

Equipment	Make	Serial No.
Diesel Engine 1	Cummins India Ltd.	25448215
Diesel Engine 2	Cummins India Ltd.	25448213
Traction Alternator 1	BHEL	4746077
Traction Alternator 2	BHEL	4746076
Power Rectifier 1	BHEL	582220103
Power Rectifier 2	BHEL	582220104
Traction Motor 1	BHEL	4919942
Traction Motor 2	BHEL	4919941
Traction Motor 3	BHEL	49199 00436
Traction Motor 4	BHEL	4919935
Auxiliary Alternator 1	BHEL	190971310
Auxiliary Alternator 2	BHEL	190971316
Rectifier Regulator Unit 1	BHEL	A062U215
Rectifier Regulator Unit 2	BHEL	A062U216
Control Cubicle 1	BHEL	190 CAB 1008
Control Cubicle 2	BHEL	190 CAB 2008
Driver Desk 1	BHEL	19000 DD 015
Driver Desk 2	BHEL	19000 DD 016
Master Controller 1	BHEL	05190350
Master Controller 2	BHEL	05190342
Driver Control Switch 1	BHEL	6577
Driver Control Switch 2	BHEL	6569
MSGC	BHEL	1900MSG 007
Resistor Panel	BHEL	582220101702



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## 1. SEQUENTIAL TEST

### 1.1 Purpose

Sequence test of control circuits

### 1.2 Measuring and testing equipment, Auxiliary equipment

- Digital Multimeter
- Continuity Tester
- Wago/Phoenix/Weidmuller connector
- DCS key
- Master Controller unlock key
- DC Ammeter
- Insulation Tester
- All electric schematic circuits

### 1.3 Test Status

Individual test performance is recorded against each test performed

### 1.4 Test implementation

The fully completed routine test record is the only valid document to demonstrate that the routine test has been successfully completed. The performed OK column in this routine test instruction merely serve the purpose of engaging the tester to verify the test progress.

All test steps in a chapter must have been successfully performed. If a test has been unsuccessful, the cause or causes must be established and remedied so that the test item can be subsequently be tested with possible result. Before testing sequence test, all continuity test points are to be cleared.

#### Procedural notes:

- Disconnect all electronic system prior to Megger, Hi pot test and during welding
- Use Digital Multimeter only to check continuity and to read test point voltages
- Ensure that test lead does not touch body or ground during measurement of low voltage sources

#### 1.4.1 Visual Inspection

##### 1.4.1.1 Rotating equipment

Operation	Performed
• Inspect the rotating equipment for the following (Traction Alternators, Traction motors, Auxiliary alternators)	<input checked="" type="checkbox"/>
• No unwanted materials should be lying inside the machines	<input checked="" type="checkbox"/>
• No loose wires / terminals should be available near the machines	<input checked="" type="checkbox"/>
• Ensure that the mounting bolts have been properly torque checked and marked	<input checked="" type="checkbox"/>
• Ensure that high voltage electrical terminals are not exposed	<input checked="" type="checkbox"/>
• Check availability of warning boards	<input checked="" type="checkbox"/>



#### 1.4.1.2 Control equipment and wiring

Operation	Performed
• There should not be any loose hanging wires near the equipment / terminal boards	<input checked="" type="checkbox"/>
• Ensure all components are loaded and connections are intact	<input checked="" type="checkbox"/>
• Ensure all connectors are coupled tightly	<input checked="" type="checkbox"/>

#### 1.4.1.3 Checking of TM chain cleat arrangement between TM junction box to TM

Sl.No.	Equipment	Available	Not Available
1.	Traction Motor 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.	Traction Motor 2	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3.	Traction Motor 3	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4.	Traction Motor 4	<input checked="" type="checkbox"/>	<input type="checkbox"/>

#### 1.4.1.4 Checking of end fitting

Sl.No.	Equipment	Quantity	Available	Not Available
1.	Traction Alternator 1	3+1	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.	Traction Alternator 2	3+1	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3.	Power Rectifier 1	3+4	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4.	Power Rectifier 2	3+4	<input checked="" type="checkbox"/>	<input type="checkbox"/>
5.	TM Junction Box 1	5+5	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6.	TM Junction Box 2	5+5	<input checked="" type="checkbox"/>	<input type="checkbox"/>
7.	TM Junction Box 3	5+5	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8.	TM Junction Box 4	5+5	<input checked="" type="checkbox"/>	<input type="checkbox"/>
9.	TM1 inlet		<input checked="" type="checkbox"/>	<input type="checkbox"/>
10.	TM2 inlet		<input checked="" type="checkbox"/>	<input type="checkbox"/>
11.	TM3 inlet		<input checked="" type="checkbox"/>	<input type="checkbox"/>
12.	TM4 inlet		<input checked="" type="checkbox"/>	<input type="checkbox"/>
13.	Auxiliary Alternator 1	4	<input checked="" type="checkbox"/>	<input type="checkbox"/>
14.	Auxiliary Alternator 2	4	<input checked="" type="checkbox"/>	<input type="checkbox"/>



#### 1.4.1.5 Inspection of air ducts & bellows before lower DETC on bogies

Operation	Performed
• Traction motor ducts are free from dirt and any foreign particle	<input checked="" type="checkbox"/>
• No welding pore holes found in the TM bellows	<input checked="" type="checkbox"/>
• Traction motor bellows are free from damages	<input checked="" type="checkbox"/>

#### 1.4.1.6 Inspection of availability and integration of fuses

Sl.No.	Location	Fuse rating	Available	Not Available
1.	CC1, 311-307341	32A	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.	CC1,322-336	63A	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3.	CC1 EQ Panel, 307-328, 308	63A	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4.	CC1,300-320	63A	<input checked="" type="checkbox"/>	<input type="checkbox"/>
5.	Power rectifier 1, <del>FR1,FR2, FR3, FY1, FY2, FY3, FB1, FB2, FB3, F1,F2,F3,F4,F5,F6,F7,F8,F9</del>	725 550 A	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6.	Power rectifier 2, <del>FR1,FR2, FR3, FY1, FY2, FY3, FB1, FB2, FB3, F1,F2,F3,F4,F5,F6,F7,F8,F9</del>	725 550 A	<input checked="" type="checkbox"/>	<input type="checkbox"/>

#### 1.4.2 Continuity test

Note : CP and Driver desk are pre wired and continuity is already checked. Only external wiring and sensor cable continuity needs to be checked.

##### 1.4.2.1 Grounding cables check

Sl.No.	Equipment	Quantity	Available	Not Available
1.	Traction Alternator 1	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.	Traction Alternator 2	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3.	Power Rectifier 1	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4.	Power Rectifier 2	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>
5.	Traction Motor1	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6.	Traction Motor2	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>
7.	Traction Motor3	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8.	Traction Motor4	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>
9.	Control Cubicle 1	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>
10.	Driver Desk 1	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>
11.	Control Cubicle 2	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>
12.	Driver Desk 2	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>



13.	MSGC	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>
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### 1.4.3 Insulation resistance test

#### 1.4.3.1 Preparation

##### 1.4.3.1.1 Control circuit

Operation	Performed
• Disconnect battery cables at the battery terminals of control battery	<input checked="" type="checkbox"/>
• Close the battery switch BIS110	<input checked="" type="checkbox"/>
• Keep battery switch (BCS 24) in open condition	<input checked="" type="checkbox"/>
• Switch on all switches and circuit breakers on the CP and DD	<input checked="" type="checkbox"/>
• Open ground cut out switches GRCO-1 & 2	<input checked="" type="checkbox"/>
• Insert DCS key and turn ON	<input checked="" type="checkbox"/>
• Insert MC key and turn ON	<input checked="" type="checkbox"/>
• Move ECS switch to RUN position	<input checked="" type="checkbox"/>
• Move reverser handle to FORWARD or REVERSE position	<input checked="" type="checkbox"/>
• Move the Master Handle (MH) to 6 <sup>th</sup> notch position on DD	<input checked="" type="checkbox"/>
• Remove LCC1 and LCC2 connections	<input checked="" type="checkbox"/>
• Disconnect LED panel from the circuit	<input checked="" type="checkbox"/>
• Remove connector for Power Rectifier 1 & 2	<input checked="" type="checkbox"/>

##### 1.4.3.1.2 Power circuit

Operation	Performed
<u>Rectifier</u>	
• Disconnect positive (+ive) and negative (-ive) cables at the rectifier	<input checked="" type="checkbox"/>
• Short rectifier positive (+ive) and negative (-ive) terminals	<input checked="" type="checkbox"/>
• Short all the cables which are disconnected from rectifier	<input checked="" type="checkbox"/>

#### 1.4.3.2 Procedure

##### 1.4.3.2.1 Control circuit

The insulation resistance test is carried out with 500V Megger. Measure insulation resistance between wire terminals 300 / 100 and body.

Insulation Tester Sr.No. :

Make :

##### 1.4.3.2.2 Power circuit – Rectifier

The insulation resistance test is carried out with 1000V Megger. Measure insulation resistance between shorted power cables at rectifier and body.

Insulation Tester Sr.No. :



Make :

#### 1.4.3.3 Observation

Sl.No.	Test Condition	Acceptance Criteria	Observed
1.	Control circuit (DC 110V and 24 V)	>1M Ohm	OK
2.	Traction Motor 2	>5 M Ohm	OK

#### 1.4.4 High voltage test

##### 1.4.4.1 Procedure

##### 1.4.4.1.1 Control circuit

High voltage test is carried out at 1300 V AC voltage. The test voltage is applied between wire terminals 300 / 100 and body and should with stand for 1 minute.

HV Tester Sr.No. :

Make :

##### 1.4.4.1.2 Power circuit

High voltage test is carried out at 2.5 kV AC voltage. The test voltage is applied between shorted power cables at rectifier and body and should with stand for 1 minute.

HV Tester Sr.No. :

Make :

#### 1.4.4.2 Observation

HV tester should not trip within 60 seconds in each of the above tests

Parameter	Control circuit		Power circuit	
	Acceptance Criteria	Observed	Acceptance Criteria	Observed
Voltage applied	1200V AC	OK	2500V AC	OK
Leakage current	100 mA	OK	100 mA	OK
Time applied	60 seconds	OK	60 seconds	OK

Tested By: SHRI NIWAS

Witnessed By:

*[Signature]*



#### 1.4.4.3 Post test operations

Operation	Performed
• Remove all shorting wires on the terminals	<input checked="" type="checkbox"/>
• Remove all power cable connections	<input checked="" type="checkbox"/>
• Connect all the removed connections	<input checked="" type="checkbox"/>

#### 1.4.5 Batteries (110V and 24 V)

Operation	Performed
• Ensure that interconnecting cables between each battery is connected and are tight	<input checked="" type="checkbox"/>
• Check the polarity of each battery and ensure that all are connected in series	<input checked="" type="checkbox"/>
• Connect the battery cable 308 at battery positive and 300 at battery negative terminal for 110V	<input checked="" type="checkbox"/>
• Connect the battery cable 201 at battery positive and 200 at battery negative terminal for 24V	<input checked="" type="checkbox"/>
• Measure the voltage of the battery at equipment panel or at battery charging socket using digital multimeter. The voltage should be more than 100 volt across 308 and 300 terminals	<input checked="" type="checkbox"/>
• Measure the voltage of the battery at equipment panel or at battery charging socket using digital multimeter. The voltage should be more than 24 volt across 201 and 200/210 terminals	<input checked="" type="checkbox"/>

#### 1.4.6 Circuit breakers and switches

##### Preliminary check

Wait for one or two minutes after switching on each circuit breaker and observe for any overheating symptoms like smell, smoke, temperature etc. from the wire bunches. If any such symptoms are noticed, there might be short circuit in the wire bunch. Check continuity in the suspected area. Switch on the following circuit breakers and ensure circuit functionality is correct.

#### 1.5 Auxiliary circuit

Sl.No.	Operation	Effect	Location	Performed
1.	Turn 110V BCS in 3 o Clock position and measure voltage between cable no 311 and 300	- =110V	311 as positive	<input checked="" type="checkbox"/>
2.	Turn ON EL+ MCB and check voltage between wire EL+ with respect to EL-	=110V	EL- as negative	<input checked="" type="checkbox"/>
3.	Turn ON CFD MCB and CFDS toggle switch	=110V	Cab fan driver side should operate	<input checked="" type="checkbox"/>
4.	Turn ON LLD MCB and LLDS toggle switch	=110V	Cab light driver side should operate	<input checked="" type="checkbox"/>
5.	Turn ON SPLD/SPLG MCB followed by SPLDS&SPLGS toggle switch	=110V	Spot light driver side should operate Spot light guard side should operate	<input checked="" type="checkbox"/>



6.	Turn ON Aux MCB and HLS, SM,V MCB and switch on 110V voltmeter toggle switch	=110V	The voltmeter should read 110V approx. Speedometer should turn ON 110V supply should be available at HLS on control cubicle and driver desk Horn push button on Driver side and guard side should operate Foot operated horn switch should work	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
6.1	Turn on Aux MCB and tail light / Flasher light MCB and switch on tail light toggle switch on driver desk	=110V	Tail light should operate	<input checked="" type="checkbox"/>
	Turn on flasher light toggle switch on driver desk		Flasher light should operate at both converters	<input checked="" type="checkbox"/>
6.2	Turn on Aux MCB and marker light MCB and marker light toggle switch on driver desk	=110V	Marker light should operate	<input checked="" type="checkbox"/>
6.3	Turn on Aux MCB and head light MCB and head light toggle switch on driver desk	=110V	Head light should ON/OFF in converter 1 and Dim / bright.	<input checked="" type="checkbox"/>
			Head light should ON/OFF in converter 2 and Dim / bright	<input checked="" type="checkbox"/>
6.3.1	Turn on Aux MCB and head light MCB and toggle switch in driver desk and turn off tail light toggle switch in rear cab	=110V	Tail light should ON/OFF in rear side (Conv 1)	<input checked="" type="checkbox"/>
		=110V	Tail light should ON/OFF in rear side (Conv 2)	<input checked="" type="checkbox"/>
6.4	Turn on Aux MCB and HT sensor MCB	=110V	Green LED should glow in HT sensor display unit	<input checked="" type="checkbox"/>

#### 1.6 Control circuit functionality

Sl.No.	Operation	Condition	Performed
1.	Ensure 110V supply across cable nos. 1600 & 320	Supply (+) from battery +BCS (4pole) ON + System control MCB ON & supply (-) from battery through 63A fuse.	<input checked="" type="checkbox"/>
2.	Supply to Master Controller (MC)	Operation 1 + Control MCB ON + Control ON/OFF switch ON (Ensure the +110V supply at 1602)	<input checked="" type="checkbox"/>
3.	EMY relay (EMR) ON	Operation 1 + Control MCB ON + Control ON/OFF switch ON+EMY traction cut off PB ON	<input checked="" type="checkbox"/>
4.	DMR Relay ON	Operation 1 + DMMV MCB ON (Ensure 110V + available at cable nos. 1732 and 1734)	<input checked="" type="checkbox"/>
5.	Dead man valve active	Operation 1 + DMMV MCB ON+ Dead man relay ON + operate F/R switch on MC + operate master handle on MC	<input checked="" type="checkbox"/>



6.	Gov1 EXC relay (ER1) ON	Operation 1 + EXC MCB ON +DCS ON+TSS(Test)+EXC ON/OFF switch ON+ECS(run)+Gov1 control MCB ON+EMR ON+R11 relay ON+S11 ON	<input checked="" type="checkbox"/>
7.	Gov2 EXC relay (ER2) ON	Operation 1 + EXC MCB ON +DCS ON+TSS(Test)+EXC ON/OFF switch ON+ECS(run)+Gov2 control MCB ON+EMR ON+R12 relay ON+S12 ON	<input checked="" type="checkbox"/>
8.	EXC control relay 1 (ECR1) ON	Operation 1 + control MCB ON + control ON/OFF switch ON+ operate F/R in MC + MC (notch 1 to 8)+ ALT EXC MCB ON+GFR inoperative+ ER1 ON+SR1 OFF+{LC1(CLOSE)/LC3(CLOSE)}	<input checked="" type="checkbox"/>
9.	EXC control relay 2 (ECR2) ON	Operation 1 + control MCB ON + control ON/OFF switch ON+ operate F/R in MC + MC (notch 1 to 8)+ ALT EXC MCB ON+GFR inoperative+ ER2 ON+SR2 OFF+{LC1(CLOSE)/LC3(CLOSE)}	<input checked="" type="checkbox"/>
10.	RCFR1 relay ON	Operation 1 + Fault indication MCB ON+DCS ON+RCFR-1 toggle switch (SS-4 switch ON)	<input checked="" type="checkbox"/>
11.	Safety relay 1 ON	Operation 1 + Fault indication MCB ON+DCS ON+{LPR relay ON / RCFR1 relay ON / R11 relay ON / RL21 relay ON}	<input checked="" type="checkbox"/>
12.	RCFR2 relay ON	Operation 1 + Fault indication MCB ON+DCS ON + {SS-5 switch ON}	<input checked="" type="checkbox"/>
13.	Safety relay 2 ON	Operation 1 + Fault indication MCB ON+DCS ON+{LPR relay ON / RCFR2 relay ON / R12 relay ON / RL22 relay ON}	<input checked="" type="checkbox"/>
14.	Parking brake application magnet valve active	Operation 1 + Parking brake MCB ON+ DCS ON+ Press parking brake application push button	<input checked="" type="checkbox"/>
15.	Parking brake release magnet valve active	Operation 1 + Parking brake MCB ON+ DCS ON+ Press parking brake release push button	<input checked="" type="checkbox"/>
16.	Compressor 1/2 unloader valve active	Operation 1 + compressor unloader MCB ON+ compressor governor active	<input checked="" type="checkbox"/>
17.	Air drier active	Operation 1 + compressor unloader MCB ON+ compressor governor inactive	<input checked="" type="checkbox"/>
18.	Cut out relay (COR1 & 2) ON	Operation 1 +Operation 2 +MC (Notch 4 &8)+MCS1 / MCS2 operate	<input checked="" type="checkbox"/>
19.	Panto magnet valve active	Operation 1 + Control MCB ON+ DCS ON+ Panto UP/DOWN pressure switch ON+ Panto up indication	<input checked="" type="checkbox"/>
20.	Supply to camera unit	Operation 1 + CCTV MCB ON	<input checked="" type="checkbox"/>
21.	Supply to telephone exchange system	Operation 1 +Telephone exchange MCB ON+ Aux MCB ON	<input checked="" type="checkbox"/>
22.	CFG ON	Operation 1 +[F+] MCB ON+CFG MCB ON+CFG switch ON	<input checked="" type="checkbox"/>
23.	LLG ON	Operation 1 + [L+] MCB ON+ LLG/CL MCB ON+ LLGS switch ON	<input checked="" type="checkbox"/>
24.	CLS ON	Operation 1 + LLG/CL MCB ON+CL switch ON	<input checked="" type="checkbox"/>
25.	BM1 Motor ON	Ensure supply at cable no 305 &300+ BM1 MCB ON	<input checked="" type="checkbox"/>
26.	BM2 Motor ON	Ensure supply at cable no 305 &300+ BM2 MCB ON	<input checked="" type="checkbox"/>



27	AAFR1 Relay ON	Ensure supply at cable no 301 & 300	<input checked="" type="checkbox"/>
28	AAFR2 Relay ON	Ensure supply at cable no 301 & 300	<input checked="" type="checkbox"/>
29	Battery charging 120AH	Operation 1	<input checked="" type="checkbox"/>
30	Supply to heater unit	Operation 1 + Heater MCB ON	<input checked="" type="checkbox"/>
31	AEFR Relay ON	Operation 1 + Fault indication MCB ON + DCS ON +AEFR -AUX(OFF) +AEFRCO CLOSE	<input checked="" type="checkbox"/>
32	AEFR-Aux Relay ON	Operation 1+DCS ON+ Fault indication MCB ON+ AEFR Relay ON	<input checked="" type="checkbox"/>
33	Supply to charging socket	Operation 1 + Charging socket MCB ON	<input checked="" type="checkbox"/>
34	Supply to charging socket (DESK)	Operation 1 + Charging socket MCB ON	<input checked="" type="checkbox"/>
35	Supply to 24V system	Supply to battery charger + BIS(CLOSE)+ENG1 protection MCB ON+ ENG2 protection MCB ON +Ensure 24 V across cable no 201 & 210	<input checked="" type="checkbox"/>
36	FOG light ON	Operation 35 + 24V -ive Aux MCB ON + FGL MCB ON +Turn ON FOG light toggle switch	<input checked="" type="checkbox"/>
37	Search light ON	Operation 35 + 24V -ive Aux MCB ON + SL MCB ON +Turn ON search light toggle switch	<input checked="" type="checkbox"/>
38	Battery charging ammeter 1 reading	Supply to battery charger + BIS(CLOSE)	<input checked="" type="checkbox"/>
39	Battery charging ammeter 2 reading	Supply to battery charger + BIS(CLOSE)	<input checked="" type="checkbox"/>
40	Supply to SPU1	Operation 35 +R81 relay ON+R91 relay ON+ S11 relay ON + TR11 timer (OFF)+ ENG1 SPU MCB ON	<input checked="" type="checkbox"/>
41	Supply to SPU1	Operation 35 +R82 relay ON+R92 relay ON+ S12 relay ON + TR12 timer (OFF)+ ENG2 SPU MCB ON	<input checked="" type="checkbox"/>
42	Local reset relay 1 (LRR1) ON	Operation 35 +LOCAL/REMOTE switch1(L)+ Local ENG1-OFF PB(OFF)+Press local reset PB ENG1(US)	<input checked="" type="checkbox"/>
43	Local reset relay 2 (LRR2) ON	Operation 35 + LOCAL/REMOTE switch2(L)+ Local ENG2-OFF PB(OFF)+Press local reset PB ENG2(US)	<input checked="" type="checkbox"/>
44	Local ON/OFF relay1 R81 ON	Operation 35 +FC21 relay(OFF)+LOCAL/REMOTE switch1(L)+Local ENG1-PB (OFF)+ Press local ENG1 ON PB(US)	<input checked="" type="checkbox"/>
45	Local ON/OFF relay2 R82 ON	Operation 35 + FC22 relay(OFF)+LOCAL/REMOTE switch2(L)+Local ENG2-PB (OFF)+ Press local ENG2 ON PB(US)	<input checked="" type="checkbox"/>
46	Remote ON/OFF relay 1 (R91) ON	Operation 35 +LOCAL/ REMOTE switch1(R)+ Operate DCS ENG-1 ON switch +S11 relay ON	<input checked="" type="checkbox"/>
47	Remote ON/OFF relay 2 (R92) ON	Operation 35 + LOCAL/ REMOTE switch2(R)+ Operate DCS ENG-2 ON switch +S12 relay ON	<input checked="" type="checkbox"/>
48	TR11 timer (ON)+ TR21 timer(ON)+ HM1(active)	Operation 35 +R81 relay(ON) / R91 relay (ON)	<input checked="" type="checkbox"/>



49	TR12 timer (ON)+ TR22 timer(ON)+ HM2(active)	Operation 35 + R82 relay(ON) / R92 relay (ON)	<input checked="" type="checkbox"/>
50	R31 relay (HCWT-1 IND) ON	Operation 35 + ENG1 safety MCB1 ON +TS11(91°C) contact(CLOSE)	<input checked="" type="checkbox"/>
51	R32 relay (HCWT-2 IND) ON	Operation 35 + ENG2 safety MCB1 ON +TS12(91°C) contact(CLOSE)	<input checked="" type="checkbox"/>
52	R11 relay (HCWT-1) ON	Operation 35 + ENG1 safety MCB1 ON +TS11(96°C) contact(CLOSE)+(RR1 Relay(ON)/LRR1 Relay(ON))	<input checked="" type="checkbox"/>
53	R12 relay (HCWT-2) ON	Operation 35 + ENG2 safety MCB1 ON +TS12(96°C) contact(CLOSE)+( RR2 Relay(ON)/LRR2 Relay(ON))	<input checked="" type="checkbox"/>
54	R41 relay (LLOP-1) ON	Operation 35 + ENG1 safety MCB1 ON +{RR1 Relay(ON)/LRR1 Relay(ON)/PS11 Contact(CLOSE)}	<input checked="" type="checkbox"/>
55	R42 relay (LLOP-2) ON	Operation 35 + ENG2 safety MCB1 ON +{RR2 Relay(ON)/LRR2 Relay(ON)/PS12 Contact(CLOSE)}	<input checked="" type="checkbox"/>
56	R51 relay (OS-1) ON	Operation 35 + ENG1 safety MCB1 ON +RR1 Relay(ON)/LRR1 Relay(ON)+LM Connector to be connected in LCC B1	<input checked="" type="checkbox"/>
57	R52 relay (OS-2) ON	Operation 35 + ENG2 safety MCB1 ON +RR2 Relay(ON)/LRR2 Relay(ON)+LM Connector to be connected in LCC B1	<input checked="" type="checkbox"/>
58	R71 relay (HOF-1) ON	Operation 35 + ENG1 safety MCB1 ON +RR1 Relay(ON)/LRR1 Relay(ON)+Limit switch at hydraulic tank de-engaged	<input checked="" type="checkbox"/>
59	R72 relay (HOF-2) ON	Operation 35 + ENG2 safety MCB1 ON +RR2 Relay(ON)/LRR2 Relay(ON)+Limit switch at hydraulic tank de-engaged	<input checked="" type="checkbox"/>
60	FC-21 relay (ENG-1 Trip) ON	Operation 35 + ENG2 safety MCB1 ON +{R21relay(OFF)/ R41 relay(OFF)/ R51 relay(OFF)/ R61 relay(OFF)/ R71 relay(OFF)}	<input checked="" type="checkbox"/>
61	FC-22 relay (ENG-2 Trip) ON	Operation 35 + ENG2 safety MCB1 ON +{R22relay(OFF)/ R42 relay(OFF)/ R52 relay(OFF)/ R62 relay(OFF)/ R72 relay(OFF)}	<input checked="" type="checkbox"/>
62	R21 relay (LHOL) ON	Operation 35 + ENG1 safety MCB2 ON+ RR1 relay(ON) /LRR1 relay(ON)	<input checked="" type="checkbox"/>
63	R22 relay (LHOL) ON	Operation 35 + ENG2 safety MCB2 ON+ RR2 relay(ON) /LRR2 relay(ON)	<input checked="" type="checkbox"/>
64	R61 relay (LCWL-1) ON	Operation 35 + ENG1 safety MCB2 ON+ RR1 relay(ON) /LRR1 relay(ON)	<input checked="" type="checkbox"/>
65	R62 relay (LCWL-2) ON	Operation 35 + ENG2 safety MCB2 ON+ RR2 relay(ON) /LRR2 relay(ON)	<input checked="" type="checkbox"/>
66	S11 relay (ENG-1 ON) ON	Operation 1 + Engine control supply MCB(ON) + DCS(ON) + ECS(IDLE) + Operate ENG-1 ON Switch(ON) + FC21 relay(OFF)	<input checked="" type="checkbox"/>
67	S12 relay (ENG-2 ON) ON	Operation 1 + Engine control supply MCB(ON) + DCS(ON) + ECS(IDLE) + Operate ENG-2 ON Switch(ON) + FC22 relay(OFF)	<input checked="" type="checkbox"/>
68	RR1 +RR2 relays (remote ready to start) ON	Operation 1 + Control MCB(ON) + Ready to start MCB(ON) + ensure +110V supply at cable no 1661 + Operate ready to start switch in DCS	<input checked="" type="checkbox"/>



69	S13 relay (ENG-1 OFF) ON	Operation 1 + Engine control supply MCB(ON) + DCS(ON) + ECS(IDLE) + Operate ENG-1 OFF Switch in DCS	<input checked="" type="checkbox"/>
70	S14 relay (ENG-2 OFF) ON	Operation 1 + Engine control supply MCB(ON) + DCS(ON) + ECS(IDLE) + Operate ENG-2 OFF Switch in DCS	<input checked="" type="checkbox"/>
71	Traction Control supply on LED(ON)	Operation 1 + Control MCB(ON) + Lamp test MCB(ON) + Lamp test switch (ON) + Control ON/OFF switch (ON)	<input checked="" type="checkbox"/>
72	Engine 1 ON LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + S11 relay(ON)	<input checked="" type="checkbox"/>
73	Engine 2 ON LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + S12 relay(ON)	<input checked="" type="checkbox"/>
74	Engine -1 TRIP LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + FC21 relay(ON)	<input checked="" type="checkbox"/>
75	Engine -2 TRIP LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + FC22 relay(ON)	<input checked="" type="checkbox"/>
76	Motor earth fault LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + GR relay(ON)	<input checked="" type="checkbox"/>
77	Parking brake application LED	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + Operate PBG appl switch	<input checked="" type="checkbox"/>
78	Alter. 1 excitation ON LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + ECR1 relay(ON)	<input checked="" type="checkbox"/>
79	Alter. 2 excitation ON LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + ECR2 relay(ON)	<input checked="" type="checkbox"/>
80	HCWT Eng1 LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + R31 relay(OFF)	<input checked="" type="checkbox"/>
81	HCWT Eng2 LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + R32 relay(OFF)	<input checked="" type="checkbox"/>
82	Aux Alter. 1 failure LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + AAFR1 relay(OFF)	<input checked="" type="checkbox"/>
83	Aux Alter. 2 failure LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + AAFR2 relay(OFF)	<input checked="" type="checkbox"/>
84	Rect.1 fuse failure LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + RL11 relay(ON)(In rect.1)	<input checked="" type="checkbox"/>
85	Rect.2 fuse failure LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + RL12 relay(ON)(In rect.2)	<input checked="" type="checkbox"/>
86	Rect.1 cool fan failure LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + RCFR1 relay(OFF)	<input checked="" type="checkbox"/>
87	Rect.2 cool fan failure LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + RCFR2 relay(OFF)	<input checked="" type="checkbox"/>
88	Gov.1 supply failure LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + ER1 relay(OFF)	<input checked="" type="checkbox"/>
89	Gov.2 supply failure LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + ER2 relay(OFF)	<input checked="" type="checkbox"/>
90	Traction motor overload LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + {MOLR1/MOLR2/MOLR3/MOLR3} relay(ON)	<input checked="" type="checkbox"/>



91	Panto. UP LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + Panto. Governor contact CLOSE relay(ON)	<input checked="" type="checkbox"/>
92	Dead man brake applied LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + DMR relay (ON)	<input checked="" type="checkbox"/>
93	Aux. earth fault LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) +AEFR ON + AEFR Aux relay(ON)	<input checked="" type="checkbox"/>
94	Low lub. Oil pressure Eng1 LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + R41 relay(OFF)	<input checked="" type="checkbox"/>
95	Low lub. Oil pressure Eng2 LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + R42 relay(OFF)	<input checked="" type="checkbox"/>
96	Eng1 IDLE LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + ECR1 relay(OFF)+ S11relay(ON)	<input checked="" type="checkbox"/>
97	Eng2 IDLE LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + ECR2 relay(OFF) + S12relay(ON)	<input checked="" type="checkbox"/>
98	EMY traction Cut off LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + EMR relay(ON)	<input checked="" type="checkbox"/>
99	Lub. Oil temp. too high Eng1 LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + Lub. Oil temp switch Eng1 (OPEN)	<input checked="" type="checkbox"/>
100	Lub. Oil temp. too high Eng2 LED(ON)	Operation 1 + Fault indication MCB (ON) + Lamp test MCB(ON) + DCS(ON) + Lub. Oil temp switch Eng2 (OPEN)	<input checked="" type="checkbox"/>
101	REV1 FOR(ON)	To give external air pressure (5-7 Kg/ Sq.cm) to equipment governor + Operation1 + Operation 2+ ECS RUN(CLOSE)+ Master Controller (19-20)	<input checked="" type="checkbox"/>
102	REV1 REV(ON)	To give external air pressure to equipment governor + Operation1 + Operation 2+ ECS RUN(CLOSE) / TSS(ON)+ Master Controller (23-24)	<input checked="" type="checkbox"/>
103	LC1 + LC3 (ON)	To give external air pressure to equipment governor + (Operation 99 / Operation 100) + SS1 ON+ SS2 ON + SS3 ON +Ground Relay(OFF)+Safety Relay1(OFF)+MOLR1(OFF)+/ MOLR3(OFF)+ MCS1(OFF)	<input checked="" type="checkbox"/>
104	LC2 + LC4 (ON)	To give external air pressure to equipment governor + (Operation 99 / Operation 100) + SS1 ON+ SS2 ON + SS3 ON +Ground Relay(OFF)+Safety Relay2(OFF)+MOLR2(OFF)+/ MOLR4(OFF)+ MCS2(OFF)	<input checked="" type="checkbox"/>



### 1.7 Engine cranking prerequisites

1. Check for oil level
2. Check for coolant level. Ensure DCA 4 coolant is filled in the system
- 3.

Operation	Effect / Observation	Location	Performed
Switch BCS 110V to power up the 110V control circuit		CC1	<input checked="" type="checkbox"/>
Switch BCS 24V to power up the 24V control circuit		CC1	<input checked="" type="checkbox"/>
Switch all the control and aux MCBs (24V & 110V)	Availability of power supply at the input terminals of LCCs	CC1	<input checked="" type="checkbox"/>
Turn ON DCS key	LED panel will power up and display the default indications	DD	<input checked="" type="checkbox"/>
Keep the ECS in IDLE position		DD	<input checked="" type="checkbox"/>
<b>Ensure the following</b>			<input checked="" type="checkbox"/>
Excitation control switch is OFF		DD	<input checked="" type="checkbox"/>
Check 24V battery status	24V voltmeter should show 24V approx..	CC1	<input checked="" type="checkbox"/>
Check 110V battery status	110V voltmeter should show 110V approx..	CC1	<input checked="" type="checkbox"/>
Check the Master Controller	Master Controller handle should be at 0 position	DD	<input checked="" type="checkbox"/>
Check engine RPM meters	'ENGINE RPM' should indicate 0	CC1	<input checked="" type="checkbox"/>
There should be no active faults in the system	No fault indications in the LED panel	DD	<input checked="" type="checkbox"/>
Operate Ready to Start toggle switch for a second to reset and release	All the relays will retain their healthy status	CC1	<input checked="" type="checkbox"/>
	All fault indications will disappear in LED panel	DD	
Operate Engine 1 START toggle switch for 3 to 4 seconds and release	Engine 1 will crank and Engine RPM shows 700 in the RPM meter	DD	<input checked="" type="checkbox"/>
	Engine 1 ON relay picks up	CC1	<input checked="" type="checkbox"/>
	Engine 1 ON and Engine 1 IDLE indication will appear in LED panel	DD	<input checked="" type="checkbox"/>
Repeat the above procedure for Engine 2			

#### 1.7.1 Engine shutdown procedure

Operation	Effect / Observation	Location	Performed
Take the Master Controller Handle to 0 notch and Reverser Switch to Neutral position	Engine 1 RPM will reduce to 700 viewed at RPM meter and Engine	CC & DD	<input checked="" type="checkbox"/>



	1 IDLE indication will appear in LED panel		
Operate Engine 1 OFF toggle switch	Engine 1 TRIP indication appears in the LED panel	DD	<input checked="" type="checkbox"/>
Repeat the above procedure for shutting down Engine 2			

### 1.7.3 Engine safety checks

#### Low Hydraulic Oil Level fault test

Operation	Effect / Observation	Location	Performed
Ensure Engine 1 is running	Engine 1 ON and Engine 1 IDLE indication in the LED panel	DD	<input checked="" type="checkbox"/>
Connect a jumper wire between Cable no. LHOL 1A and LHOL 1 B at level sensor end	LHOL indicator displays LO	CC1	<input checked="" type="checkbox"/>
	Engine will shut down		<input checked="" type="checkbox"/>
	Engine 1 TRIP indication will be displayed in the LED panel	DD	<input checked="" type="checkbox"/>
Remove the jumper wire	In LHOL, LO indication disappears	CC1	<input checked="" type="checkbox"/>
Re crank the Engine as per above mentioned procedure			<input checked="" type="checkbox"/>
Repeat the procedure for Engine 2			

#### High Coolant water temperature fault test

Operation	Effect / Observation	Location	Performed
Ensure Engine 1 is running	Engine 1 ON and Altr 1 Exc. ON indication in the LED panel	DD	<input checked="" type="checkbox"/>
Disconnect the TS11 and TS12 at engine end	HCWT-1 indicator appears, Engine 1 excitation will cut off and engine 1 IDLE indication will appear.	DD	<input checked="" type="checkbox"/>
Restore TS11 and TS12 at the engine and re crank the engine	Engine Trip indication will disappear in the LED panel and Engine 1 ON and Engine 1 IDLE indication will appear	DD	<input checked="" type="checkbox"/>
Repeat the procedure for Engine 2			

#### Low Lub oil pressure fault test

Operation	Effect / Observation	Location	Performed
Ensure Engine 1 is running	Engine 1 ON and Engine 1 IDLE indication in the LED panel	DD	<input checked="" type="checkbox"/>
Disconnect the PS11 at engine end	Low Lub Oil Pressure Eng-1 indication will appear in the LED panel	DD	<input checked="" type="checkbox"/>
	Engine will shut down		<input checked="" type="checkbox"/>



	Engine 1 TRIP indication will be displayed in the LED panel	DD	<input checked="" type="checkbox"/>
Restore the PS11at Engine end and engage Ready to Start switch in DCS	Low Lub Oil Pressure Eng1 and Eng1 TRIP indication disappears	DD	<input checked="" type="checkbox"/>
Re crank the Engine as per above mentioned procedure			<input checked="" type="checkbox"/>
Repeat the procedure for Engine 2			

#### Low Coolant Level fault test

Operation	Effect / Observation	Location	Performed
Ensure Engine 1 is running	Engine 1 ON and Engine 1 IDLE indication in the LED panel	DD	<input checked="" type="checkbox"/>
Connect a jumper between Cable no LCWL 1A and LCWL 1B at level sensor end	LCWL indication displays LO	CC1	<input checked="" type="checkbox"/>
	Engine will shut down		<input checked="" type="checkbox"/>
	Engine 1 TRIP indication will be displayed in the LED panel	DD	<input checked="" type="checkbox"/>
Remove the jumper wire.	In LCWL the LO indication disappears.	CC1	<input checked="" type="checkbox"/>
Re crank the Engine as per above mentioned procedure			<input checked="" type="checkbox"/>
Repeat the procedure for Engine 2			

## 2. LOAD TEST

Load test is carried out to check the performance of power pack installed in the DETC coach along with interconnected control system. It ensures that the power pack delivers rated output in each notch at rated speed as per the designed requirement.

Load test can provide valuable information about the engine performance and possible faults such as low horse power, exhaust black smoke, hunting under load, power circuit grounding (Grounding of alternator, rectifier and cables up to CP)

Diesel engine, Traction Alternator, Rectifier along with LCC shall be used for this test. After setting up the load bench, move Master Handle (MH) from IDLE to 8<sup>th</sup> notch in step while keeping Reverser Handle (RH) in F/R position. In load test, notch wise engine rpm and power in kW is maintained by the LCC under power limit mode.

### 2.1 Test status

Record test results in the format given below.

### 2.2 Test equipment

- Digital Multimeters
- Wago/phoenix/Wiedmuller Connector
- DCS key
- Master Controller Unlock key
- DC Clamp meter



### 2.3 Test program

#### 2.3.1 Test preparations

Operation	Performed
• Ensure that engine is OFF and all circuit breakers and battery isolator switches are OFF	<input checked="" type="checkbox"/>
• Connect the load bank between wire no P5(Eng-1)/ P6(Eng-2) and G0	<input checked="" type="checkbox"/>
• Connect the Digital Multimeters (10A) in LCCs for measuring Actuator and Field Current	<input checked="" type="checkbox"/>
• Connect the Digital Multimeter for voltage and Digital Clamp meter for current measurement at the load bank	<input checked="" type="checkbox"/>
• Crank the engine as per the instructions provided above	<input checked="" type="checkbox"/>
• Allow the engine to run for 15 minutes before loading	<input checked="" type="checkbox"/>

#### 2.3.2 Traction alternator load test

##### 2.3.2.1 Notch wise load test

Operation	Performed
• Start the engine at 0 <sup>th</sup> notch with load bank plate slightly dipped into the water and adjust the plates so that voltage and current LED in the LCC does not glow.	<input checked="" type="checkbox"/>
• Turn on the excitation switch and change the notch position to 1 <sup>st</sup> . Measure the DC current / DC voltage and calculate the power output ie kW reading.	<input checked="" type="checkbox"/>
• If the kW is lower than required, rotate the kW pot in LCC against 1 <sup>st</sup> notch in the clockwise direction (Load ramp up LED glows while adjusting the knob in the LCC) until kW matches with the required value. If kW is not increasing after 2-3 rotations, dip the plate into water to increase the load capacity and again check the kW.	<input checked="" type="checkbox"/>
• If kW is greater than required, rotate the kW pot against the 1 <sup>st</sup> notch in anti-clockwise direction (Load ramp down LED glows) until the kW output matches the required value.	<input checked="" type="checkbox"/>
• Repeat the above steps for each of the notches.	<input checked="" type="checkbox"/>
• Cross check the readings after restart and in both ascending and descending orders of notches.	<input checked="" type="checkbox"/>
• Record actuator current, excitation current, load voltage and load current	<input checked="" type="checkbox"/>

##### 2.3.2.2 Notch wise load test report

##### 2.3.3.2.1 Load test engine A

Diesel Engine S.No	25448215	Traction Alternator S.No	2746077
LCC control module S.No	F2500N2009	LLC power module S.No	E480MBN033



### Engine Safety Check

Item	Action	Remarks
HWT1	LED Indication	OK
HWT2	Excitation OFF	OK
LLOP	Engine Trip	OK
OS	Engine trip	OK
LCWL	Engine trip with delay	OK
LHOL	Engine trip with delay	OK
HOFF	Engine trip	OK
RCFR	Excitation OFF	OK
RFF	Excitation OFF	OK

### Prior to load testing ensure the following

- For open loop hydraulic system -Hydraulic oil pressure should be between 130-160 bar at 1800 rpm
- For Closed loop hydraulic system -Hydraulic oil pressure should be between 170-200 bar at 1800 rpm

Notch	Eng. speed rpm	V ref	V	I ref	I	P ref	P	P(ref) kW		Upper limits				I actuator	I field
		V	V	A	A	kW	kW	Lower limit	Upper limit	V ref	V msrd	I ref	I msrd		
1	700	100	150	150	155	15	23	14.6	15.5	130	175	350	390	1.1	0.62
2	1000	150	175	210	220	31	39	30	32	230	260	400	450	1.18	0.49
3	1200	170	230	420	350	71	81	69	73	330	360	460	510	1.28	0.77
4	1300	200	280	490	380	98	106	95	101	400	450	500	570	1.32	1.06
5	1400	230	360	565	390	130	140	126	134	460	490	580	630	1.36	1.30
6	1500	260	400	620	425	162	170	157	167	533	550	650	700	1.39	1.49
7	1650	300	420	626	470	188	197	182	194	620	600	720	770	1.43	1.52
8	1800	330	440	630	490	208	216	202	214	640	690	780	810	1.46	1.41

### LCC parameters:

AACEL	50	RESET	70	GAIN	50
DECEL	50	DROOP	0	STAB	50
L STAB	50	L RAMP	70	L GAIN	50
L DERIV.	0	WHEEL SLIP	0		

After setting power, voltage and current; include thermostatic valve and operate engine in full power. Run engine till full hydraulic pressure is attained. During this time, monitor engine coolant temperature. NO temperature fault should pop up. Note down final reading of following gauges:



Gauge	Value	Unit
EWT	75	°C
LOT	80	°C
LOP	40	psi

Tested By: *Amir Shandeh*

Witnessed By: *Rajh*

### 2.3.3.2.1 Load test engine B

Diesel Engine S.No	25448213	Traction Alternator S.No	4746076
LCC control module S.No	F140NKD004	LLC power module S.No	E510MPK010

### Engine Safety Check

Item	Action	Remarks
HWT1	LED Indication	OK
HWT2	Excitation OFF	OK
LLOP	Engine Trip	OK
OS	Engine trip	OK
LCWL	Engine trip with delay	OK
LHOL	Engine trip with delay	OK
HOFF	Engine trip	OK
RCFR	Excitation OFF	OK
RFF	Excitation OFF	OK

### Prior to load testing ensure the following

- For open loop hydraulic system -Hydraulic oil pressure should be between 130-160 bar at 1800 rpm
- For Closed loop hydraulic system -Hydraulic oil pressure should be between 170-200 bar at 1800 rpm

Notch	Eng. speed rpm	V ref	V	I ref	I	P ref	P	P(ref) kW		Upper limits				I actuator	I field
		V	V	A	A	kW	kW	Lower limit	Upper limit	V ref	V msrd	I ref	I msrd		
1	700	100	150	150	155	15	23	14.6	15.5	130	175	350	390	1.1	0.62
2	1000	150	175	210	220	31	39	30	32	230	260	400	450	1.18	0.49
3	1200	170	230	420	350	71	81	69	73	330	360	460	510	1.29	0.77
4	1300	200	280	490	380	98	106	95	101	400	450	500	570	1.32	1.07
5	1400	230	360	565	390	130	140	126	134	460	490	580	630	1.36	1.30



6	1500	260	400	620	425	162	170	157	167	533	550	650	700	1.39	1.48
7	1650	300	420	626	470	188	197	182	194	620	600	720	770	1.43	1.52
8	1800	330	440	630	490	208	216	202	214	640	690	780	810	1.46	1.42

LCC parameters:

AACEL	50	RESET	70	GAIN	50
DECEL	50	DROOP	0	STAB	50
L STAB	50	L RAMP	70	L GAIN	50
L DERIV.	0	WHEEL SLIP	0		

After setting power, voltage and current; include thermostatic valve and operate engine in full power. Run engine till full hydraulic pressure is attained. During this time, monitor engine coolant temperature. NO temperature fault should pop up. Note down final reading of following gauges:

Gauge	Value	Unit
EWT	76	°C
LOT	80	°C
LOP	42	psi

Tested By:

Witnessed By:

*Chint Shandelya*

*Roph*



### 3. TRACTION MOTOR HEAT RUN TEST

#### 3.1 Checklist (physical) for bogies to be ensured for the heat run test

Ref. drawing				
Sl. No.	Description	Status		Remarks
Pre check before starting Heat run test				
a	Cable orientation at the motor terminal box ( A;AA;FF;F;E)	Ok	Not Ok	ok
b	Ensure the correct size of hardware used, tightness done and torque marking / sealing at every mounting point.	Ok	Not Ok	ok
c	Open top inspection cover and check 4 numbers of brushes are impact	Ok	Not Ok	ok
d	Ensure there is no foreign materials are present inside	Ok	Not Ok	ok
e	Ensure the arching horn is tight enough	Ok	Not Ok	ok
f	Open bottom inspection cover and repeat all the above checks done from the top side	Ok	Not Ok	ok
g	Close the inspection covers	Ok	Not Ok	ok
Gear case mounting				
(i)	Gear case top and bottom Square Head bolts 2 nos M 30x100 and 2 nos M30x140	Ok	Not Ok	ok
(ii)	Gear case top and bottom Hexagonal bolt 1 No M30x100 and 1 NO M30x130	Ok	Not Ok	ok
(iii)	Filling of 3.5 kg cardium compound	Ok	Not Ok	ok
MSU mounting				
(i)	8 nos hex head bolt M30x200 8.8	Ok	Not Ok	ok
(ii)	Sandwich to bogie mounting bolts 4 nos M24x90 with plain washer & split pin to be provided	Ok	Not Ok	ok
(iii)	Motor to sandwich bolts 2 nos M24x170	Ok	Not Ok	ok
(iv)	Terminal box cover bolts 4 nos M10x20	Ok	Not Ok	ok

Tested By:

Witnessed By:




3.2 TM heat run test for Cab 1 side bogie with motor 1 & 3  
Bogie no: DETC / US -

Date:


Traction Motor 1 S.No.:

Traction Motor 3 S.No.:

Normal Direction of rotation

TIME	Amb. Temp °C	Motor 1		Motor 3		 Remarks
		NDE °C	DE °C	NDE °C	DE °C	
						Heat run test started at    hrs
						Heat run test completed at    hrs

Reverse Direction of rotation

TIME	Amb. Temp °C	Motor 1		Motor 3		 Remarks
		NDE °C	DE °C	NDE °C	DE °C	
						Heat run test started at    hrs
						Heat run test completed at    hrs

IR values of motors after completion of heat run test (in MΩ)

In between	Motor 1	Motor 3
A & E		
F & E		
A & F		

Tested By:

Witnessed By:




3.3 TM heat run test for Cab 2 side bogie with motor 2 & 4  
Bogie no : DETC / US -

Date :


Traction Motor 2 S.No. :

Traction Motor 4 S.No. :

**Normal Direction of rotation**

TIME	Amb. Temp °C	Motor 2		Motor 4		 Remarks
		NDE °C	DE °C	NDE °C	DE °C	
						Heat run test started at    hrs
						Heat run test completed at    hrs

**Reverse Direction of rotation**

TIME	Amb. Temp °C	Motor 2		Motor 4		 Remarks
		NDE °C	DE °C	NDE °C	DE °C	
						Heat run test started at    hrs
						Heat run test completed at    hrs

**IR values of motors after completion of heat run test (in MΩ)**

In between	Motor 2	Motor 4
A & E		
F & E		
A & F		

Tested By:
Witnessed By:



#### 4. MOVEMENT TEST

##### 4.1 Purpose

To ensure DETC movement in right direction as per reverse handle position

##### 4.2 Measuring equipment and test setup

- Multimeter
- Wago connector
- DCS key
- Master controller unlock key

##### 4.3 Test status

Record the test results in the table given below

##### 4.4 Test implementation

Forward and reverse movement about 10kmph has been taken with all Traction Motors. Individual Traction Inverter data is recorded by performing the bogie cutout of each line contactor in MSGC. Forward and reverse movement of Traction motors performed and data is recorded. Based on recorded data, we verified the performance of the motor during movement test.

##### 4.5 Local movement test from Cab1

Date :

SN	Test	Reading/Result	Remarks
1.	Forward movement with engine-1 in ON condition +TM-1 traction motor only included (10kmph) Notch-1	TM-1 <u>350</u> A	
2.	Reverse movement with engine-1 in ON condition +TM-1 traction motor only included (10kmph) Notch-1	TM-1 <u>350</u> A	
3.	Forward movement with engine-1 in ON condition +TM-3 traction motor only included (10kmph) Notch-1	<input checked="" type="checkbox"/>	
4.	Reverse movement with engine-1 in ON condition +TM-3 traction motor only included (10kmph) Notch-1	<input checked="" type="checkbox"/>	
5.	Forward movement with engine-1 in ON condition + both traction motors included (10kmph) Notch-1 TM-1 Current	TM-1 <u>150</u> A	
6.	Reverse movement with engine-1 in ON condition + both traction motors included (10kmph) Notch-1 TM-1 Current	TM-1 <u>150</u> A	
7.	Forward movement with engine-2 in ON condition +TM-2 traction motor only included (10kmph) Notch-1	TM-2 <u>350</u> A	
8.	Reverse movement with engine-2 in ON condition +TM-2 traction motor only included (10kmph) Notch-1	TM-2 <u>350</u> A	
9.	Forward movement with engine-2 in ON condition +TM-4 traction motor only included (10kmph) Notch-1	<input checked="" type="checkbox"/>	
10.	Reverse movement with engine-2 in ON condition +TM-4 traction motor only included (10kmph) Notch-1	<input checked="" type="checkbox"/>	
11.	Forward movement with engine-2 in ON condition + both traction motors included (10kmph) Notch-1 TM-2 Current	TM-2 <u>225</u> A	

12.	Reverse movement with engine-2 in ON condition + both traction motors included (10kmph) Notch-1 TM-2 Current	TM-2 <u>225</u> A	
13.	Forward movement with both engines in ON condition + all traction motors included (10kmph) Notch-1	TM-1 <u>150</u> A TM-2 <u>150</u> A	
14.	Reverse movement with both engines in ON condition + all traction motors included (10kmph) Notch-1	TM-1 <u>150</u> A TM-2 <u>150</u> A	
15.	Speedometer overspeed alarm function working (Ensure WD: 952mm)	<input checked="" type="checkbox"/>	
16.	Breaking performance SA9	<input checked="" type="checkbox"/>	
17.	Breaking performance A9	<input checked="" type="checkbox"/>	
18.	Dead man breaking performance	<input checked="" type="checkbox"/>	
19.	Emergency breaking performance	<input checked="" type="checkbox"/>	
20.	Power ground fault in power pack 1 and resetting	<input checked="" type="checkbox"/>	
21.	Power ground fault in power pack 2 and resetting	<input checked="" type="checkbox"/>	
22.	Control circuit earth fault ( + & - )	<input checked="" type="checkbox"/>	
23.	Functioning of movement restriction within 10kmph interlocks while lifting platform is in up condition (excitation off)	<input checked="" type="checkbox"/>	
24.	Headlight both beams glowing with proper focusing	<input checked="" type="checkbox"/>	
25.	Driver and guard side both tail lights glowing	<input checked="" type="checkbox"/>	
26.	Driver and guard side both marker lights glowing	<input checked="" type="checkbox"/>	
27.	Flasher lights working properly	<input checked="" type="checkbox"/>	
28.	Search light glowing	<input checked="" type="checkbox"/>	
29.	Fog light glowing	<input checked="" type="checkbox"/>	

#### 4.6 Local movement test from Cab2

SN	Test	Reading/Result	Remarks
1.	Forward movement with both engines are in ON condition +all traction motors are included (10kmph) Notch-1	TM-1 <u>150</u> A TM-2 <u>150</u> A	
2.	Reverse movement with both engines are in ON condition +all traction motors are included (10kmph) Notch-1	TM-1 <u>150</u> A TM-2 <u>150</u> A	
3.	Headlight both beams glowing with proper focusing	<input checked="" type="checkbox"/>	
4.	Driver and guard side both tail lights glowing	<input checked="" type="checkbox"/>	
5.	Driver and guard side both marker lights glowing	<input checked="" type="checkbox"/>	
6.	Flasher lights working properly	<input checked="" type="checkbox"/>	
7.	Search light glowing	<input checked="" type="checkbox"/>	
8.	Fog light glowing	<input checked="" type="checkbox"/>	



4.7 HV sensor, HL-TL and local On/Off performance

SN	Test	Reading/Result	Remarks
1.	Head light – Tail light interlock performance	<input checked="" type="checkbox"/>	
2.	HV sensor performance	<input checked="" type="checkbox"/>	
3.	Engine 1 local ON-OFF function	<input checked="" type="checkbox"/>	
4.	Engine 1 local ON-OFF function	<input checked="" type="checkbox"/>	

Tested By: VINOD

Witnessed By: *[Signature]*

Remarks

Lined area for writing remarks.



Lined paper template with horizontal ruling lines.

**DIESEL LOCO MODERNISATION WORKS ,PATIALA**  
**DETC NO. 21 ( 190075)**

Sr.No.	Description	MAKE	Sr. No.
1	CAB HEATER (CAB-1)	Top grip	559
2	CAB HEATER (CAB-2)	Top grip	530
3	SPEEDOMETER (CAB -1)	Telpro	1910080
4	SPEEDOMETER (CAB -2)	Telpro	190051
7	HEAD LIGHT	Signatron	—
8	FLASHER LIGHT	scs	—
9	ROOF LIGHT(21 Nos)	D R Auto	—
10	FAN (06 Nos) (big size)	Vidisha	—
11	Fan (04 Nos) (small size)	SPJ Nova	—
12	Equipment panel	A.R.ENGG	—
13	Local on/off engine 1&2	BHEL	—

  
SSE/TRS

  
JE/TRS



**DIESEL LOCO MODERNISATION WORKS, PATIALA**

**DETC-NR/ 190075(M-21)**

S.NO.	Description	Make	MFG. DATE & SN
1	SHELL	EC BLADES PVT LTD	
2	HYDRAULIC PLATFORM	COVAAI	2019 & 18
3	LIFTING RAM	ORION HYDRAULIC LTD	52157
4	STARTER BATTERY CHARGER	RAMYAA ELECTRO-GEAR(P) LTD.	06/19 & 3907
5	RECTIFIER REGULATOR UNIT	KERALA ELECTRICAL & ALLIED ENGG. CO. LTD.	1909.23.486
6	RECTIFIER A & B	BHEL	09/19 & 190971C306 , 190671C315
7	MOTOR SWITCH GROUP CUBICAL	BHEL	2019 & 582220103, 582220104
8	AUX. ALTERNATOR-1 &2	----	09/19 & 1900MSG001
9	ENGINE 1 & 2	CUMMINS INDUSTRIES	190971C10 , 1900971C10
10	ALTERNATOR 1 & 2	BHEL	25448213
11	CONTROL CUBICAL-1	BHEL	4740070 & 4740077
12	CONTROL CUBICAL-2	BHEL	
14	10 KV GENERATOR SET	AMPLE CORP. PVT LTD	09/19 & 190CAB2008
16	RADIATOR		08/19 & AMPL/ES/0221
18	DRILLING MACHINE	SIDDHAPURA MACHINE TOOLS	47-09-2019 PART NO 5559002/P004/147827
20	FUEL TANK	SBB	2017/04/19
22	RESISTANCE PANEL	BHEL	24
			58222010/102

Sign.....

SSE/DETC

Sign.....

JE/DETC

# **Air-brake equipments details of DETC- M21**

S.No.	Description	QPL /Nos.	Supplier	Item Sr. no.	Warranty
1	Distributor Valve	1	Escorts	1905A0330	As per IRS/PO conditions
2	A9 brake Valve	2	Escorts	-	
3	SA9 brake valve	2	Escorts	-	
4	Air Dryer	1	Prag	2007-07-19	
5	C2 Relay Valve	1	Escorts	013-07-19	
6	Auto Drain valve	3	Escorts	-	
7	Air whistle	4	Escorts	-	
8	Wiper motor	4	Elgi	-	
9	Three way magnet valve(Parking)	2	Rotex	-	
10	Three way magnet valve(Horn)	2	Rotex	-	
11	Two way magnet valve(MR)	1	Rotex	-	
12	Two way magnet valve(Compressor)	1	Rotex	-	
13	N1 Reducing valve	3	Escorts	-	
14	PRV Limiting valve	1	Escorts	-	
15	Safety valve	1	Faiveley	-	
16	Pantograph assembly	1	Contransys		
17	Servo Motor	1	Contransys		

  
 SE/ABS  
 17/6/2020

  
 SSE/ABS



## DIESEL LOCO MODERNISATION WORKS

<b>DETC No.</b>	<b>190075</b>	<b>Rly:</b>	<b>NR</b>	<b>Month:</b>	<b>Oct.,19</b>
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### 1. BOGIE FRAME:

BOGIE	FRAME NO	Make	PL No.	PO No. & dt.	Warranty Period
Panto side	SL-54	ECBT	10992169	566432	As per PO/IRS conditions
Radiator Side	SL-67				

### 2. Hydraulic Dampers (Vertical and Lateral) Make: IAI

### 3. AXLES:

LOCATION	1	2	3	4
S.NO	N-0465	N-0642	N-1059	N-1068
Ultrasonic Testing	OK	OK	OK	OK

### 4. WHEEL DISCS NO. AND TYPE

LOCATION	1	2	3	4
GEAR END	19/1529	19/1514	19/1513	19/1298
Ultrasonic Testing	OK	OK	OK	OK
FREE END	19/1519	19/1518	19/1516	19/1517
Ultrasonic Testing	OK	OK	OK	OK

### 5. AXLE ROLLER BEARING (PL No. 31020513, Warranty: As per PO/IRS conditions )

LOCATION		1	2	3	4
Gear End	MAKE	FAG	FAG	FAG	FAG
	PO NO. & dt	566542	566542	566542	566542
Free End	MAKE	FAG	FAG	FAG	FAG
	PO NO. & dt	566542	566542	566542	566542

### 6. WHEEL DISC PRESSING (PRESSURE IN TONNES): SPECIFIED 77.2-115.6 T

AXLE NO	1	2	3	4
BULL GEAR END	90	96	100	100
FREE END	100	99	80	98

DETC No.	190075	Rly:	NR	Month:	Oct., 19
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**7. DIAMETER AFTER PROFILE TURNING: SPECIFIED 952-955 mm**

AXLE NO.	1	2	3	4
DIA IN mm GE	952	952	953	952
DIA IN mm FE				
WHEEL PROFILE GAUGE (1600±1mm)	OK	OK	OK	OK

**8. SUSPENSION TUBE & ITS TAPER ROLLER BEARING:**

AXLE NO.		1	2	3	4
S.T.	MAKE	BHEL	BHEL	BHEL	BHEL
G.E. BEARING	MAKE	Timken	Timken	Timken	Timken
F.E. BEARING	MAKE	Timken	Timken	Timken	Timken

**9. GEAR CASE & BACKLASH:**

AXLE NO.	1	2	3	4
MAKE	BHEL	BHEL	BHEL	BHEL
BACKLASH (0.200 – 0.700mm)	0.500	0.550	0.600	0.550

**10. TRACTION MOTOR : (PL No. 30906313, Warranty: As per PO/IRS conditions)**

LOCATION	MAKE	PO No. & date	S. NO.
1	BHEL	566640	4919942
2	BHEL	566640	4919941
3	BHEL	566640	4919936
4	BHEL	566640	4919935

SSE/ Bogie Shop