

THREE PHASE LOCOS



MATERIAL

PREPARED BY
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INDEX

TECHNICAL DATA

DATA	WAP 5	WAP 7	WAG 9	WAG 9H
SERIES NUMBER	30000-30200	From 30201 From 37000 From 39000	From 31000 ... From 32000 ... From 34000 ... From 41000 ... From 91000 ...	
Type of Service	Passenger	Passenger	Freight	Freight
Axle arrangement	Bo-Bo	Co-Co	Co-Co	Co-Co
Gear Ratio	17:35:67	20:72	15:77 / 21:107	21:107
Gauge	1676 mm	1676 mm	1676 mm	1676 mm
Length over Buffer	18162 mm	20562 mm	20562 mm	20562 mm
Overall Width	3142 mm	3100 mm	3152 mm	3152 mm
Max. Height with Pantograph Locked	4255 mm	4255 mm	4255 mm	4255 mm
Wheel Diameter				
New	1092 mm	1092 mm	1092 mm	1092 mm
Worn	1016 mm	1016 mm	1016 mm	1016 mm
Total Weight	78 T	123 T	123 T	132T
OHE Voltage				
Nominal	25 KV	25 KV	25 KV	25 KV
Minimum	17.5 KV	17.5 KV	17.5 KV	17.5 KV
Maximum	30 KV	30 KV	30 KV	30 KV
OHE Frequency				
Nominal	50 Hz	50 Hz	50 Hz	50 Hz
Minimum	45 Hz	45 Hz	45 Hz	45 Hz
Maximum	55 Hz	55 Hz	55 Hz	55 Hz
Power Supply to Auxiliary Frequency	415 V ± 10% 0 to 59 Hz	415 V ± 10% 0 to 59 Hz	415 V ± 10% 0 to 59 Hz	415 V ± 10% 0 to 59 Hz
No. of Auxiliary converters	Aux. Conv. 1,2,3	Aux. Conv. 1,2,3	Aux. Conv. 1,2,3	Aux. Conv. 1,2,3
Battery Voltage	110 V	110 V	110 V	110 V
Power Supply to TMs	2180 V	2180 V	2180 V	2180 V
No. of Power Converters	2	2	2	2
Type of Traction Motor	3 Ø Induction Motor	3 Ø Induction Motors	3 Ø Induction Motor	3 Ø Induction Motor

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No. of Traction Motors	4 (6FXA7059)	6 (6FRA6068)	6 (6FRA6068)	6 (6FRA6068HT)
Power of TM	1563HP	1156 HP	1156 HP	1156 HP
Tractive Effort	258 KN	322.6 KN	458 KN	520KN
Braking	Regenerative , Pneumatic, Parking,	Regenerative , Pneumatic, Hand brake	Regenerative , Pneumatic, Parking,	Regenerative, Pneumatic, Parking,
Braking Effort	160 KN	260 KN	260 KN	260KN
Parking Brakes:	Wheel No. 1, 4, 5 & 8	(hand brake provided.)	Wheel No. 2, 6, 7 & 11. Some locos hand brake provided	Wheel No. 2, 6, 7 & 11. Some locos hand brake provided
Horse Power	5440 HP	6120 HP	6120 HP	6120 HP
Maximum Speed	160 Kmph	140 Kmph	100 Kmph	90 Kmph
Main Reservoir	3 Nos	2 Nos	2 Nos	2 Nos
Hotel Load	Available	Few locos available	Not available	Not available
Loco brakes	On Disc 5kg/cm ²	On Wheel 3.5 kg/cm ²	On Wheel 3.5 kg/cm ²	On Wheel 3.5 kg/cm ²

ABBREVIATIONS

ALG	Drive Control Unit - Drive Inverter and Line converter Control
ASC	Converter Control
ASR	Drive Converter
BL	Key switch
BLCP	Semi Spring-loaded switch for Main compressors
BLDJ	Spring-loaded switch for Main circuit breaker
BLHO	Spring-loaded switch for Hotel load (not active on WAG-9)
BLPR	Switch Headlights
BPCS	Illuminated push-button, green for Constant speed control
BPFA	Illuminated push-button, yellow for acknowledgement all fault Messages
BPFL	Illuminated push-button, yellow Emergency flashlight
BPPB	Illuminated push-button, red for parking brake
BPVG	Push-button, green for Vigilance
BPVR	Push-button, illuminated yellow for resetting vigilance
BUR	Auxiliary Converter
BZ-V-O- F	Buzzer for vigilance, over speed and fire
CEL	Central Electronics

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CSC	Constant Speed Control
DDS	Diagnostic Data Set
DIA	Diagnostic Control- Fault generation and fault log.
FBV	Vehicle Bus Administrator-routing signals
FLG	Vehicle Control Unit
GTO	Gate Turn Off
HB	Cubicle Auxiliary Circuits
HBB	Processor
HRA	Switch Cab blower/heating
LSAF	Indication lamp, red for Train parting
LSCE	Indication lamp, amber for over temperature CEL
LSDJ	Indication lamp, red for Main Circuit Breaker
LSFI	indication lamp, red for Fault message, priority 1
LSHO	Indication lamp, yellow Hotel load (Not active on WAG-9)
LSP	Indication lamp, yellow for Wheel slipping
LSVW	Indication lamp, yellow for Vigilance Warning
MCB	Main Circuit Breaker
MCE	MICAS-S2 Control Electronics
MEMOTEL	Speed Recorder and Indicator
MR	Machine Room
MUB	Over voltage Protection Unit
NSR	Line Converter
Pan	Pantograph
PCLH	Socket Hand Lamp
PP	Pneumatic Panel
SB	Cubicle Control Circuits
SLG	Converter Control Unit
SR	Traction Converter
SS	Subsystem
STB	Low Voltage Cubicle Control
TCN	Train configuration net work
TE/BE	Tractive / braking effort
UBA	Voltmeter Battery Voltage
VCB	Vacuum Circuit Breaker - Main Circuit Breaker
VCU	Vehicle Control Unit
ZBAN	Switch- Banking operation
ZBV	Train Bus Administrator
ZLC	Switch for Loco pilot's cab lighting

ZLDA	Switch for Assistant Loco pilot's desk Illumination
ZLDD	Switch for Loco pilot's desk illumination
ZLFR	Switch for Marker lights, red
ZLFW	Switch for Marker lights, white
ZLH	Switch for Socket hand lamp
ZLI	Switch for Instrument lighting
ZPRD	Switch for Headlights, intensity
ZPT	Spring-loaded switch for Pantograph
ZTEL	Switch for Maximum Traction limitation
ZK	DC link

FEATURES OF THREE PHASE LOCO

Advanced Technological Features: -

In addition to the provision of latest 3-phase traction drive system; the 3-phase locomotives have certain improved technical features as compared to the conventional locomotives so being used on IR. Some major features are listed below.

1. Digital electronics based real time traction control System:

To obtain precise control over tractive effort and speed in the normal mode and constant speed control mode of operation respectively.

2. Electrical weight transfer control system:

To automatically reduce the tractive effort in the leading bogie and increase the same in the trailing bogie to take care of weight transfer effect.

3. On-board fault diagnostics system:

To eliminate/ elaborate trouble-shooting by engine crew and also to help maintenance staff to trace faults. The fault diagnostics system provides for automatic isolation of faulty equipment/ subsystems.

4. Simulation mode of operation:

To facilitate a complete functional testing of the locomotive without raising pantograph.

5. An exclusive harmonic filter circuit:

To reduce harmonics in the loco power circuit.

6. Static auxiliary converter:

To supply auxiliary 3-phase motors. The auxiliary converter, depending on the traction load, operates at an optimum frequency to minimize power consumed by auxiliaries

7. Electronic speedometer: - Paperless speed recording system. An over speed alarm system is built in.

8. Electronic energy meter:

For information of energy generated and energy consumed

9. Fire detection and alarm system: For the machine room.

10. Low traction bar arrangement between bogie and body to reduce weight transfer:

Unidirectional mounting of traction motors to further reduce weight transfer effect.

11. Ergonomically designed and spacious driving cabs:

To provide comfort and relief to crew.

12. Use of dust filters: -

Pressurized machine room to prevent entry of dust into sensitive equipment in the machine room.

13. Electronic brake system: -

For precise and fast control of braking effort, blending between electrical brake and pneumatic brake on the locomotive.

14. Triplet pneumatic brake panel :

To minimize piping and provide single- place location of all pneumatic equipment.

15. Use of tread brake units: (In WAP 7 removed and some of WAG9 also removed)

To reduce maintenance

16. Spring loaded parking brake system (In WAP 7 removed and some of WAG9 also removed)

Instead of handbrakes, spring loaded parking brakes are provided on this loco, these brakes can be operated from loco and remain applied without pressure by spring.

17. Over-charge feature in the brake system for quick release of brakes

For faster release of train brakes after recreation, BP is charged to 5.5 kg/ cm² for short time with restricted dropping rate to 5.0 kg/cm².

18. Electronic controlled vigilance system

To keep the loco pilot alert Vigilance system is provided, As per this system, loco pilot has to do predetermined task once within 60 seconds, otherwise VCD will apply emergency braking.

19. Wheel Flange lubrication system®Removed)

To reduce energy consumption and wheel wear.

20. Under-slung compressors:

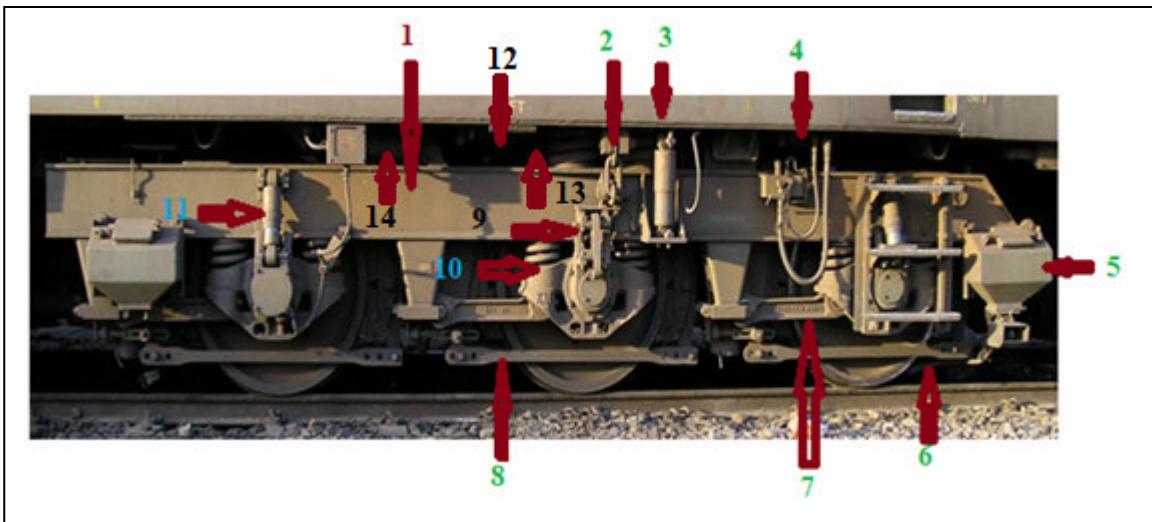
To eliminate oil fumes and oil spillage inside the machine room, which is potential cause for fire hazards.

Mechanical Features of 3 Ø AC Loco

- Two bogie assemblies support the entire weight of the 3-phase locomotive and provide a means for transmission of the tractive effort to the rails.
- An important function of the bogie is to absorb and isolate shock caused by variations in the track bed.
- Traction force developed by TMs is in turn transmitted through the axle journal boxes and **wheel set guide rods** to the bogie frame.
- The **traction link** connected between the bogie transom and loco under frame, transmits the tractive and braking forces to the loco body.
- Isolation and absorption of shock loads and vibration is performed by the primary and secondary suspension.
- Movement between the loco body and bogie is smoothly controlled by the primary and secondary suspension. Although the springs permit free movement in any direction, **lateral buffers** and **dampers** limit the amount and rate of lateral movement. **Rebound limit chains** and **vertical dampers** limit the amount the rate of vertical rebound of the locomotive loco body.
- **Yaw (longitudinal) dampers** control the loco body pitch rate.
- **Primary suspension**, located between the axles and the bogie frame, is provided by twin coil springs on the axle journal box fore and aft of the axle line.
- **Vertical hydraulic dampers** are used to dampen the rebound rate of the springs.
- **Secondary suspension** is also provided by coil springs and vertical hydraulic dampers located between the bogie frame and the locomotive under frame on each side of the bogie.
- The weight of the loco body is carried by the secondary suspension springs. The "Flexi Float" arrangement of the secondary suspension allows the loco body to move both laterally and vertically within certain limits relative to the bogies.

EQUIPMENT OF LOCO

Bogie equipment:



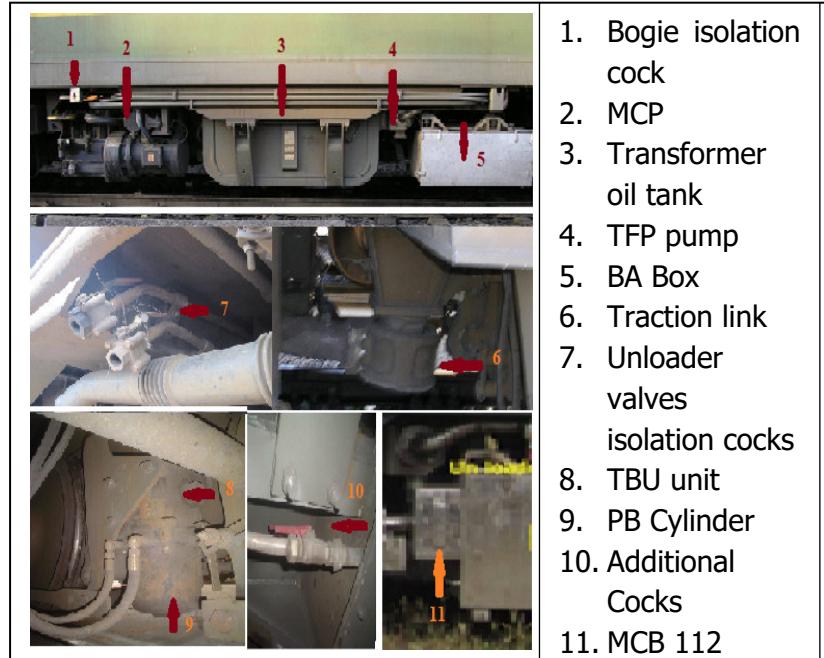
1. Bogie frame
2. Safety chain
3. Secondary vertical damper
4. Anti compounding valve
5. Sand box
6. Brake blocks
7. Wheel set guide rod
8. Brake guide rod
9. Safety link
10. Primary helical springs
11. Primary vertical damper
12. Secondary horizontal damper
13. Secondary helical springs
14. Secondary vertical damper



Under frame equipment:

Under MR-1, From Cab-1 to Cab-2:

- ❖ Behind cattle guard; DBE and MRE additional cocks.
- ❖ Air dryer with D-IN, D-OFF, D-OUT COCs
- ❖ MCP1
- ❖ Bogie isolation vent cock -1,
- ❖ BA Box-1



1. Bogie isolation cock
2. MCP
3. Transformer oil tank
4. TFP pump
5. BA Box
6. Traction link
7. Unloader valves isolation cocks
8. TBU unit
9. PB Cylinder
10. Additional Cocks
11. MCB 112

- ❖ Transformer oil pump-1
- ❖ BP and FP addl. cocks behind cattle guard

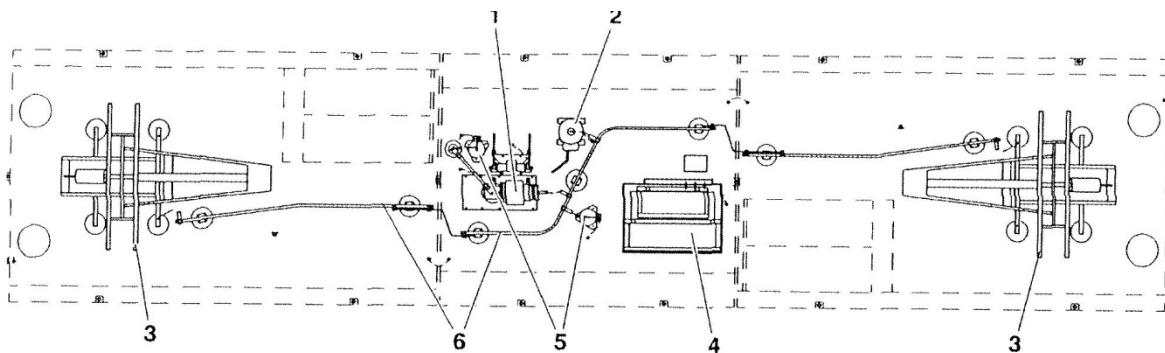
Between two bogies:

- # Traction link one end to loco body and other end connected to bogie- 2 nos.
- # Transformer oil tank

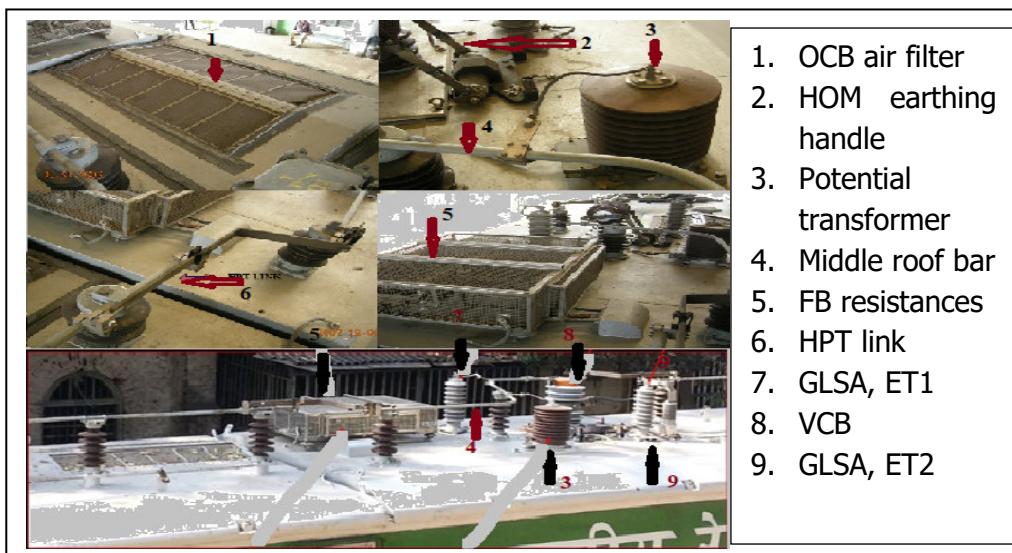
Under MR-2 , From Cab-1 to Cab-2:

1. Behind cattle guard; DBE and MRE additional cock.
2. BA Box-2
3. Unloader valves isolation cocks
4. MCB112
5. Transformer oil pump-2
6. MCP-2
7. Bogie isolation vent cock-2
8. BP and FP addl. cocks behind cattle guard

ROOF LAYOUT



- | | |
|------------------------|----------------------------|
| 1 Main circuit breaker | 2 Potential transformer |
| 3 Pantograph | 4 Resistor harmonic filter |
| 5 Surge arrestor | 6 Roof line |



In front of loco Both sides

- Flasher light
- Horn Hooters
- Head light
- Marker lights White & Red
- UIC socket
- Cattle guard
- Rail Guard
- CBC with TS coupling
- CBC operating handle
- BP & FP hose pipes
 - MRE & BCE pipes
- Hotel load connectors in WAP5& WAP7 locos (Modified)



CAB OVER VIEW: Cab equipment is divided into four parts:



- Panel-A
- Panel-B
- Panel-C
- Panel-D

In addition to above panels other equipment provided are

1. Brake handle direct loco brake (SA9)
2. Brake handle automatic train brake (A9) Removable in E70 brake system(Fixed with locking device in CCB2.0 brake system with electronic display)
3. Mode switch in CCB2.0 brake system.
4. PTDC in CCB2.0 brake system
5. Crew fan LP & ALP side
6. Desk lamp LP & ALP side
7. Horn knob LP & ALP side with High & Low tones

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8. Rotary switch (cab heater/Cooling blower); ALP side
9. TE/BE Throttle
10. Reverser
11. Foot switches: from left side PSA, PVEF and PVCD
12. Wipers operating knob with Osc & park, ALP side
13. MEMOTEL
14. RTIS in modified locos in cab 1
15. Behind ALP, cubicle for CO₂ 25 Kg fire extinguisher and spare small F/E & hose pipes etc.

PANEL-A



1	UBA	BA Voltmeter
2	U	OHE Voltmeter
3	BOGIE 1	TE/BE meter - Traction / braking effort, bogie 1
	BOGIE 2	TE/BE meter - Traction / braking effort, bogie 2
4	LSDJ	Indication lamp, red - Main circuit breaker
5	LSHO	Indication lamp, yellow - Hotel load "ON" (In WAG 9 locos used for sanders)
6	LSP	Indication lamp, yellow - Wheel slipping
7	LSAF	Indication lamp, red - Train parting
8	ZBAN	Spring loaded switch – Banking operation "ON" / "OFF"
9	LSVW	Indication lamp, yellow - Vigilance warning
10	LSCE	Lamp, amber - Over temperature CEL
11	BL	Key switch - Activation of Loco pilot's cab
12	ZPT	Spring-loaded switch – UP & DN Pantograph
13	BLDJ	Spring-loaded switch – VCB "ON" / "OFF"
14	BLCP	Semi Spring-loaded switch - Main compressors AUTO , MAN & OFF(W/O spring)
15	BLHO	Spring loaded switch, Hotel load 'On'& 'OFF'(In active in WAG9 loco.)

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16	ZTEL	Switch - Max. Traction limitation
17	BPCS	Illuminated pushbutton – green-constant Speed control
18	BPPB	Illuminated push-button- red - Parking brake (Removed in WAP 7 locos)
19	BPVR/VCK Ack	Push-button, yellow Resetting vigilance/VCD Ack also in modified locos.
20	ESPB	Red color, Emergency stop

PANEL-B (Pn.Gauges)

- 1 BC Gauge
 - 2 MR&FP Gauge
 - 3 Air Flow Meter
 - 4 BP gauge
- # In Wag 9 locos PB gauge also provided.



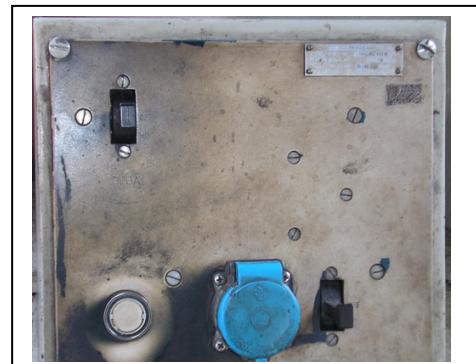
PANEL-C



1	Screen	Display of messages & diagnosis
2	LSFI	Indication lamp, red - Fault message, priority 1
3	BPFA	Push - button, yellow - Acknowledgement all fault messages & P2 message
4	ZLC	Switch - Loco pilot's cab lighting OFF&ON
5	ZLI	Switch - Instrument lighting, OFF&ON
6	ZLDD	Switch - Loco pilot's desk illumination, OFF&ON
7	BZ-V-O-F-	Buzzer - Warning signal, 3 frequencies
8	BLPR	Switch - Head Light, Bright, OFF, F & R
9	ZPRD	Switch - Headlights, Dim, FULL & DIM
10	ZLFW	Switch - Marker lights, white, OFF&ON
11	ZLFR	Switch - Marker lights, red, OFF&ON
12	BPFL	Rotating switch, yellow – for flasher light

PANEL-D

- ✚ Asstt Loco pilot Desk Lamp
- ✚ Vigilance Ack push button (Removed)
- ✚ 110V DC socket
- ✚ 110 V socket ON/OFF button
- ✚ PT PHONE (WAP-5 LOCOs)
- ✚ VCU/MCE reset PB switch in some locos.



OTHER EQUIPMENT IN CAB:



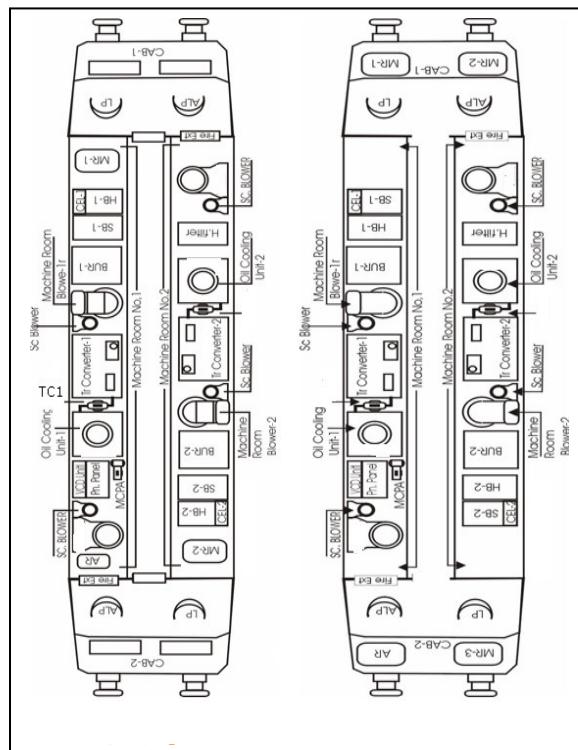
From left: 1. EBV with PTDC handle in CCB2.0; 2.A9 in E70locos;3.PB gauge;4. Pedal switches;5.SA9 in E70 locos; 6.Throttle & Reverser handle; 7.Memotel SPM; 8. Modified display

MACHINE ROOM LAYOUT :

Machine Room-1 Equipment:

From cab-1 to Cab-2:

- ✚ MR1: Main Reservoir-1(In hotel load WAP7 locos shifted to MR-2, from Cab-1)
- ✚ HB-1 Cubicle (In hotel load WAP7 locos shifted to MR-2, from Cab-1)
- ✚ SB-1 cubicle
- ✚ Bur-1: Auxiliary converter-1
- ✚ Machine room blower-1
- ✚ 1Ø Scavenging blower-1
- ✚ Traction converter-1
- ✚ Traction converter oil pump-1
- ✚ Oil cooling unit-1
- ✚ Pneumatic panel (E-70/CCB2.0)



- ⊕ MCPA
- ⊕ 3Ø Scavenging blower-1
- ⊕ Traction Motor Blower-2
- ⊕ AR: Auxiliary reservoir (Behind HB2 in hotel load locos)
- # Before SB-1 hotel load converter-1 provided in WAP7 locos.

Machine Equipment Room-2

From cab-2 to Cab-1:

- ⊕ MR2:Main Reservoir-2 (In hotel load WAP7 locos shifted to MR-1, from Cab-2)
- ⊕ HB-2 Cubicle (In hotel load WAP7 locos shifted to MR-1, from Cab-2)
- ⊕ SB-2 cubicle
- ⊕ Bur-2: Auxiliary converter-2&3
- ⊕ Machine room blower-2
- ⊕ 1Ø Scavanging blower-2
- ⊕ Traction converter-2
- ⊕ Traction converter oil pump-2
- ⊕ Oil cooling unit-2
- ⊕ Harmonic filter cubicle
- ⊕ 3Ø Scavenging blower-2
- ⊕ Traction Motor Blower-1

Before SB-2 hotel load converter provided in WAP7 locos.



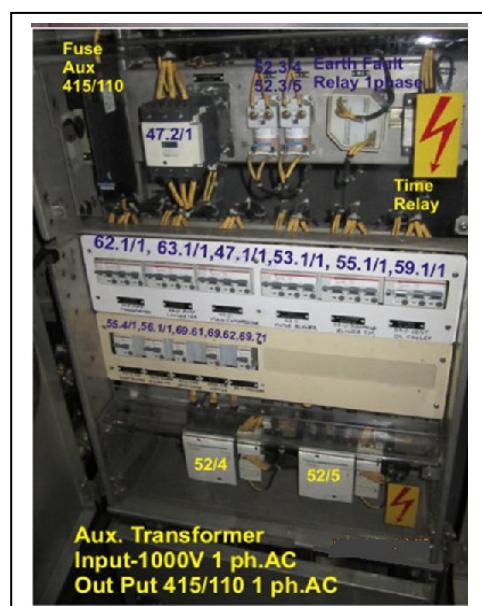
Cubicle HB-1: MCBs provided in HB-1

Three phase 415 Volt Aux. circuit breaker

1. 62.1/1 : Transformer oil pump-1
2. 63.1/1 : Traction Converter oil pump-1
3. 47.1/1 : Main compressor-1
4. 53.1/1 : Traction motor blower-1
5. 55.1/1 : 3Ø scavenging blower-1
6. 59.1/1 : Oil cooling Blower-1

Single phase 415 /110 Volt Aux. circuit breaker

1. 54.1/1 : Machine room blower-1
2. 56.1/1 : 1Ø scavenge blower-1
3. 69.61 : Cab ventilation for both cabs



4. 69.62 : Cab heaters for both cabs
5. 69.71 : Crew fan for both cabs

Other equipment

1. 1000/415 V 1Ø Transformer
2. 52/4 and 52/5 power contactors
3. Earth fault relay 1Ø circuit
4. 52.3/4 and 52.3/5 110 V DC auxiliary contactors for 52/4 and 52/5.
5. 47.2/1 MCP-1 power contactor.

NOTE: In some locos MRB-2 is changed as three phase auxiliary.

Control Cubicle- SB1: Switches in SB1:

Switch	Name of switch	Positions	Purpose
152	Failure mode operation	0 &1	0: Normal; fine mode 1; failure mode (Throttle)
154	Bogie cut-out	NORM, I,II & I+II	NORM: Both bogies in service I: Bogie-1 isolated II: Bogie-2 isolated I+II: Both bogies isolated
160	Configuration	1 &0	1: Normal, normal speed 0: 15 kmph speed only
237.1	VCD	1 & 0	1: VCD in service 0: VCD bypassed



MCBs provided in SB1:

1.	127.9/1	Central electronics, supply to FLG1, STB1
2.	127.9/2	Central electronics, supply to HBB1
3.	127.22/1	Electronics, Auxiliary converter-1
4.	127.2/1	Monitoring aux. contactors of HB1 MCBs and harmonic filter
5.	127.11/1	Power supply Gate Units related to SR-1
6.	127.1/1	Electronics Traction converter-1

7.	310.1/1	Cab-1 Head light
8.	127.91/1	Power supply 24V/48V, cab-1 pilot lamps, VCD buzzer & desk lamps
9.	127.12	Pantograph/VCB Control
10.	127.3/1	Cab-1 BL switches
11.	RTIS	RTIS MCB (newly provided)

Contactors in SB1:

1.	136.4	Auxiliary contactor VCB
2.	126.7/1	Power supply cab-1 contactor
3.	218	Control electronics contactor
4.	126	Control circuits contactor
5.	338.1	Cab-1, Head light contactor
6.	126.5	CE 'OFF' contactor
7.	136.3	Time relay for VCB



Other equipment:

1. PT fuse ; 2amp.(Glass tube), In some locos HRC type provided.
2. Spare fuses
3. VCU/MCE reset PB switch. In some locos.
4. Simulation socket
5. Configuration PB switch(161).(Not in use)
6. Minimum Voltage relay (MVR 86)
7. Over current relay (OCR 78) with target.
8. Earth fault relay of control circuits, 89.7
9. ECPSW switch: Whenever HBB2 fails to run compressors.
10. 411: Central electronics-1
11. Train Bus.



MVR 86 & OCR 78

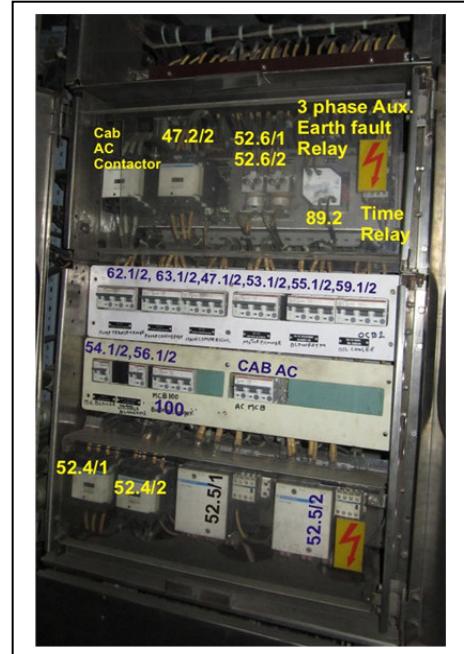
Cubicle HB-2: Circuit breakers provided in HB-2

Three phase 415 Volt Aux. circuit breaker

1. 62.1/2 : Transformer oil pump-2
2. 63.1/2 : Traction Converter oil pump-2
3. 47.1/2 : Main compressor-2
4. 53.1/2 : Traction motor blower-2
5. 55.1/2 : 3Ø scavenging blower for traction motor blower and oil cooling
6. 59.1/2 : Oil cooling Blower-2
7. 100 : CHBA input MCB (in IGBT locos provided on BUR-2)
8. Cab AC MCB also provided in few locos
In ABB make IGBT locos MCB 100 not provided outside.

Single phase 415 /110 Volt Aux. circuit breaker

1. 54.1/2 : Machine room blower-2
2. 56.1/2 : 1Ø scavenge blower-2



Other equipment:

1. 52.4/1 and 52.4/2 power contactors of 3Ø scavenging blowers
2. 52.5/1 and 52.5/2 power contactors for oil pumps
3. 47.2/2 power contactor , MCP-2
4. 52.6/1 and 52.6/2 110 v DC auxiliary contactors to 52.4 and 52.5

Cubicle SB-2: MCBs provided in SB-2

1.	127.81	Circuit breaker 126 Commissioning 1, cab1&2 activation contactors 126.7/1 & 126.7/2
2.	127.15	Vigilance control (VCD)
3.	127.7	Pneumatic panel (Brake electronics)
4.	127.82	Commissioning 2-48.2 control, LSCE, VCD
5.	48.1	Auxiliary compressor (MCPA)
6.	127.3/2	Cab-2 BL switches
7.	127.91/2	Power supply 24V/48 V, cab-2 pilot lamps, FDU, VCD buzzer and DC fans of MCE
8.	310.7	Marker lights both sides
9.	310.1/2	Cab-2 Head light
10.	310.4	Machine room lights
11.	127.1/2	Electronics traction converter-2
12.	127.11/2	Power supply Gate Units of SR-2
13.	127.2/2	Monitoring aux. contactors of HB2 MCBs.
14.	127.22/2	Electronics auxiliary converter-2

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15.	127.22/3	Electronics auxiliary converter-3
16.	127.9/3	Central electronics supply to FLG2 & STB2
17.	127.9/4	Central electronics supply to HBB2
18.	127.92	MEMOTEL (speedometer)
19.	110	CHBA output breaker
20.	112.1	Control circuits, locomotive
21.	128.1	Air dryer
22.	129.1	Hotel load in WAP 7 locos

Contactors in SB-2:

1	126.7/2	Power supply driver's cab-2
2	130.1	Pantograph
3	48.2	Auxiliary compressor
4	338/2	Head light
5	211	Temp. control of CE
6	126.6	CE 'ON' contactor

Others:

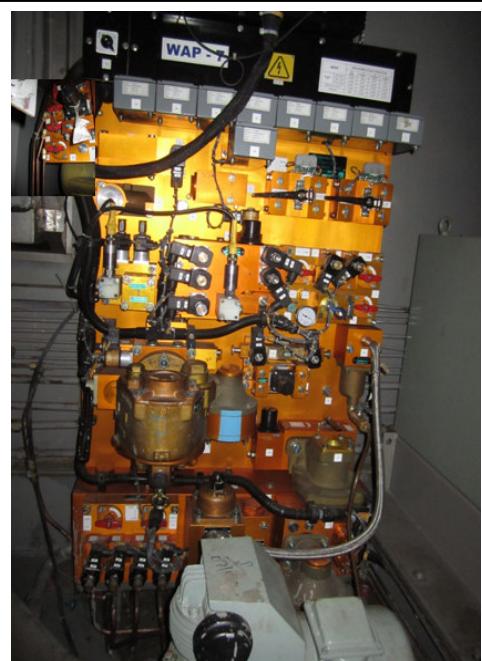
1. 212: Fire detection equipment
2. 412: Central electronics-2



PNEUMATIC PANEL:

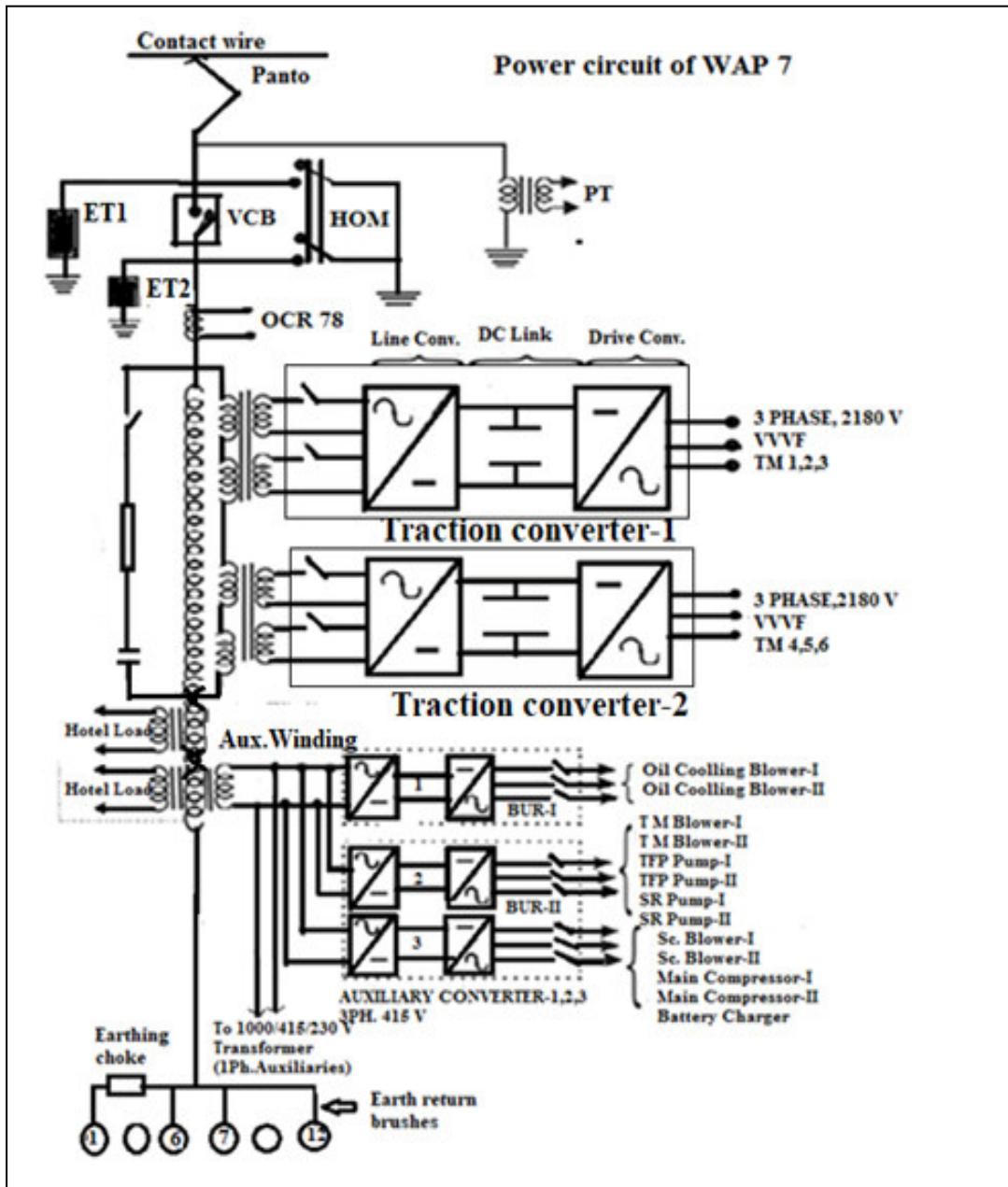


KNORR BRAKE CCB2.0 LOCO



E-70 LOCO

POWER CIRCUIT (WAG9 & WAP7):



WAG 9 locos- No hotel load.

Power circuit equipment:

1. Pantographs-2
2. Roof bars-3
3. HPT links-2
4. Potential transformer
5. ET1 & ET2 Gap less surge arrestors
6. HOM
7. Vacuum circuit breaker
8. Over current relay, OCR 78

9. Main transformer winding
10. Secondary windings of traction converters and auxiliary converters.
11. Harmonic filter
12. Traction converters-2
13. Auxiliary converters-3
14. Hotel load
15. 1Ø aux, transformer winding
16. 3Ø Ac squirrelcage induction motors-6
17. Battery charger

Description of power circuit

Pantographs:

1. Two pantographs are provided on loco roof and same design as conventional loco.
2. One spring loaded switch ZPT with UP & DN positions on LP's desk and panto selector switch (Auto, I & II) provided on Pn.Panel.
 - ⊕ In 'AUTO' position irrespective of cab only rear panto raises.
 - ⊕ In 'I' position only cab-1 side panto raises (Panto-2 will isolate).
 - ⊕ In 'II' position only cab-2 side panto raises (Panto-1 will isolate).
3. To EP valves & PT1&2 Pn. COC provided on Pn. panel. Normal position is horizontal.i.e. open position.
4. IG-38 key is provided on Pn.panel. Normal position is horizontal. i.e. open position. (In CCB2.0 Brake system it is vertical position)
5. A gauge is provided on Pn.Panel to indicate panto reservoir pressure.
6. Raising pantograph:
 - ⊕ Ensure loco is under OHE. When BL is kept on 'D' mode if pressure is less in PR, MCPA starts automatically. Pressure should be above 7.0 Kg/cm².
 - ⊕ When FLG 504 Node information appears on Display screen then LP has to press ZPT downside (UP) and releases.(In cooling mode no node information since CE OFF)
 - ⊕ Now rear panto raises provided PSS on 'AUTO' position and PT COC kept open.
 - ⊕ After giving command by ZPT, If panto is not raising, by pressing panto contactor 130.1 (in SB-2) panto can be raised.(Ensure PR pressure is above 5.5 kg/cm²)

HPT links: To isolate damaged panto electrically two HPT links provided to middle roof bar towards both pantos.

Roof bars: Three roof bars are provided on loco roof to receive the OHE supply from panto and to connect to VCB.

Vaccum Circuit breaker:

- Construction and operating is same
- To close VCB; In 'D' mode FLG 550 node information should appear.
- To close VCB, On Pn. Panel VCB Pn.COC should be open condition
- To close and open VCB in Panel A, spring loaded switch BLDJ with ON & OFF positions, is provided.
- To close VCB LP should press BLDJ down (ON) for 1 sec.
- When VCB closes LSDJ lamp extinguishes.
- **After giving command by BLDJ, If VCB is not closing, by pressing VCB contactor 136.4 (in SB-1) VCB can be closed.(Ensure panto is raised condition)**
- In 'C' mode also VCB can be closed.

Potential transformer:

- It is located on loco roof and connected to middle roof bar.
- It step down the 25 KV into 200-230 V AC.
- 2 amps. Fuse is provided in SB-1, with spare fuses.
- Out put of PT is given to
 - Main converter electronics = 4 volt AC
 - Catenary voltmeters on the Loco pilot's console = 10 volt DC
 - Minimum voltage relay, 86.
- When panto is raised and touched to OHE through Potential transformer U meter deviates and shows OHE voltage.
- If PT fuse is required to change ensure panto is lowered fully.

Main Transformer:

General: 25 KV, 1-phase, AC Supply is taken from OHE catenary/ contact wire through pantograph, roof equipment and VCB (DJ). The same supply is fed to charge the "parallel induction transformer" where it is stepped down to different operating voltage. The tank is filled with transformer oil in order to increase the insulation strength and to dissipate the heat.

A spy glass is provided in each machine room to check the oil level of transformer oil.

There are 6/8 secondary winding:

- a. Convertor secondary winding/Traction winding.(4 Nos.)
- b. Aux. Convertor secondary windings.(1 Nos.)
- c. Harmonic filter secondary winding.(1 Nos.)
- d. Hotel load (2 no.) in WAP-5 & some WAP-7 locos.

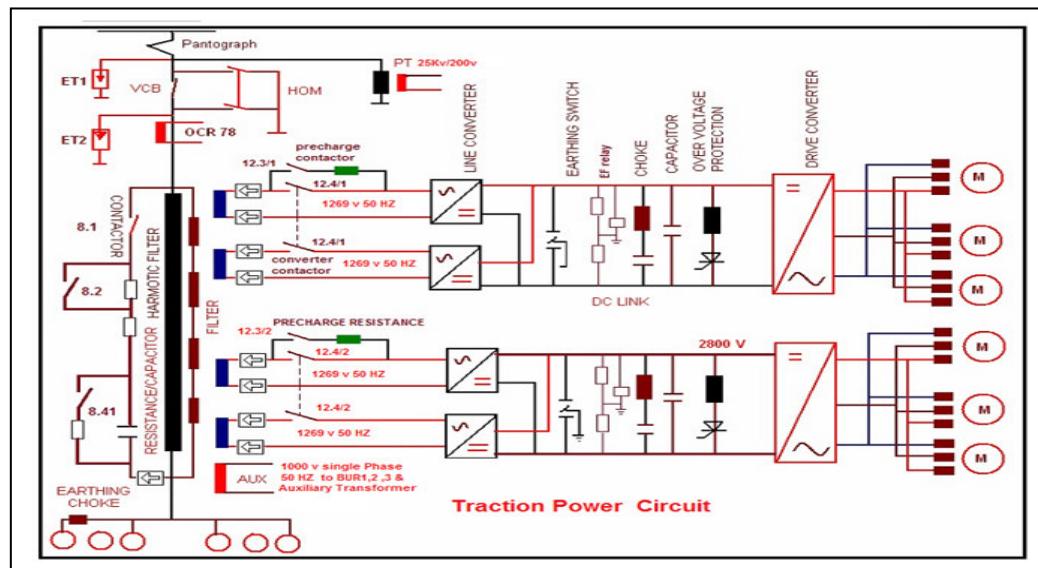
Transformer Oil Temperature Action:

1.	T<47°C	Ventilation OFF
2.	T=50°C (ON) T=47°C (OFF)	Ventilation Level 1 (merged with Level 2)

3.	T=55°C (ON), T=52°C (OFF)	Ventilation Level 2
4.	T=60°C (ON) T=57°C (OFF)	Ventilation Level 3
5.	T<80°C)	TE/BE 100%
6.	80°C < T < 84°C	Linear reduction of the TE/BE from 100% to 0%
7.	T > = 84°C	GTO pulsing inhibited
8.	T > = 84°C longer than 10 sec	VCB OFF

Traction Converter: (SR)

- Traction converter converts single-phase 25 KV AC supply into 3 phase AC, with Variable Voltage (max 2180 V) and frequency (from 65 to 132 Hz) while in traction mode and feeds it to traction motor group.
- There are two traction converters i.e. Traction converter-1 for TM 1-2-3 and Traction converter-2 for TM 4-5-6 (In case of WAP-5 , traction converter-1 for TM 1-2 and Traction converter-2 for TM-3-4)
- During regenerative braking the traction motors work as generators and feeds



generated 3-phase supply to Traction converter. This converter now acts in reverse manner i.e. it converts 3 phase AC supply into single phase AC supply and feeds it to Transformer. Further main transformer steps up this supply and feeds back to OHE. In this way 3 phase loco works as a small powerhouse, which generates supply and share the load by feeding it back to OHE.

- SR is cooled by separate oil cooling unit.
- The traction converter has three main sub parts:
 - 1) Line Converter 2) Intermediate DC link and 3) Drive converter.
- One spy glass is provided on each SR to check the oil level.
- # In IGBT locos SR is cooled by water coolant and side of SR, one gauge is provided with Min. and Max. levels.

SR Oil Temperature:

1.	T<42°C	Ventilation OFF
2.	T=45°C (ON) T=42°C (OFF)	Ventilation Level 1(merged with Level 2)
3.	T=50°C (ON) T=47°C (OFF)	Ventilation Level 2
4.	T=55°C (ON) T=52°C (OFF)	Ventilation Level 3
5.	T<62°C)	TE/BE 100%
6.	64°C<T<66°C	Linear reduction of the TE/BE from 100% to 0%
7.	T> = 66°C	GTO pulsing inhibited
8.	T> = 80°C longer than 10 sec	VCB OFF

Line Converter : (NSR)

The line converter converts the alternating current supplied from the main transformer into direct current (motoring) and forwards this direct current to the intermediate DC-Link. However, it is also able to convert direct current from the intermediate DC-Link into alternating current and to supply this alternating current in turn to the main transformer (braking). Both functions are activated by the traction converter control electronics.

DC Link:

The intermediate DC-Link performs two main tasks. It smoothes the direct current that flows through and, it also performs the storage function, thus covering the peak current demand of the line converter or of the motor. It works as a electrical buffer between ASR and NSR.

Drive Converter- (ASR):

The drive converter converts the direct current from the intermediate DC-Link into three-phase current for the drive motors (motoring). Conversely, it also converts the three-phase current generated by the drive motors into direct current for braking.

Technical Data Of Traction Converter

Coolant oil	: SHELL DIALA DX
Input voltage (RMS)	: 2 x 1,269 Volt
Input current (RMS)	: 2 x 1,142 Amp
Input frequency	: 50Hz
DC-Link circuit nominal voltage(Ud)	: 2,800 Volt
Output voltage (line-line voltage, RMS)	: 2,180 Volt
Output current (per phase, RMS)	: 740 Amp
Output power	: 2,105 kW
Out put frequency	: 65-132 Hz

Traction Motor:

- There are total 6 traction motors provided in WAG-9 / WAP-7 loco.
 - TM 1-2-3 are mounted in bogie-1 and are fed from traction converter -1 where as TM 4-5-6 are mounted in bogie -2 and are fed from traction converter -2. In case of WAP-5 there are 4 traction motors in which, Traction converter-1 feeds to TM-1-2 where as traction converter-2 feeds to TM3-4.
 - Unlike conventional WAG-5/7 individual TM cannot be isolated in this loco only a group isolation is possible.
 - For isolation of TM group one rotating switch No. 154 is provided in SB-1, its normal position is " NORM".
 - In WAP-7 & WAG-9, the traction motor is cooled by TM blower.
 - The power transmission is effected via a spur-wheel gear.
 - Traction motor is suspended on axle, by axle cap at one end and on link at another end.
 - To check the oil in gear case one spy glass is provided on gear case.
 - To monitor the temperature & speed, sensors are provided in the stator assembly.
- # In IGBT locos if any problem arises in TM, particular TM will be isolated automatically. No manual isolation of independent TM.

Technical Data Of Traction Motor: (WAG-9 / WAP-7)

Type	: 6FRA 6068
Kind of motor	: 6 poles/alternating current Asynchronous motor, 3 Ø
Cooling	: Forced air cooling
Power supply	: Current fed converter
Temperature recording	: 2 thermal resistance elements installed in a stator tooth
OUTPUT P (KW)	: Continuous 850; Maximum 850
VOLTAGE U (V)	: Continuous 2180; Maximum 2180
Current Intensity I (A)	: Continuous 270; Maximum 370
Frequency (Hz)	: Continuous 65; Maximum 132

WAP-5

Type	: 6FXA 7059
Kind of motor	: 6 poles/alternating current Asynchronous motor, 3 Ø
Cooling	: Forced air-cooling
Power supply	: Current fed converter
Temperature recording	: 2 thermal resistance elements installed in a stator tooth
OUTPUT P (KW)	: Continuous 850; Maximum 1150
VOLTAGE U (V)	: Continuous 2180; Maximum 2180
Current Intensity I (A)	: Continuous 370; Maximum 540
Frequency (Hz)	: Continuous 65; Maximum 80

AUXILIARY CONVERTERS

General:

- Three auxiliary converters are provided.
- Each Auxiliary converter receives 1Ø AC 1000 volts supply from auxiliary winding kept parallel to main transformer and converts into 3Ø AC 415 Volts.
- This 3Ø AC 415 Volts supply is fed to 12 auxiliaries and one battery charger.
- Auxiliary converter-1 is placed in cubicle called BUR-1 situated in machine room No-1 where as aux converter No. 2 and 3 are placed in cubicle BUR-2, which is situated in machine room No.2.
- The traction motor and oil cooling blowers run only when required. The control electronics adjusts the blower speeds depending on operating temperature, nominal traction values and speed.
- Transformer and traction converter oil pumps work continuously whenever the auxiliary converters are operating.

3 phase, 415 volt Auxiliaries:

Following 3-phase, 415-volt auxiliaries are provided on this loco, which are fed from Auxiliary converter No.1, 2 and 3.

Auxiliary	Location	Function	MCB
Load on Auxiliary Converter No. 1			
Oil Cooling Blower-1 (OCB-1)	Machine Room-1	To cool transformer and SR 1 oil in cooling unit 1 by taking air from roof	59.1/1 In HB 1
Oil Cooling Blower-2 (OCB-2)	Machine Room-2	To cool transformer and SR 2 oil in cooling unit 2 by taking air from roof	59.1/2 In HB 2
Load on Auxiliary Converter No. 2			
TM Blower 1	Machine Room 2	To cool bogie 1 TM group by forced air	53.1/1 In HB 1
TM Blower 2	Machine Room 1	To cool bogie 2 TM group by forced air	53.1/2 In HB 2
Transformer oil pump 1	Under Truck Below Machine room 1	To circulate oil from TFP oil tank to Cooling Unit 1 & back	62.1/1 In HB 1
Transformer oil pump 2	Under Truck Below Machine room 2	To circulate oil from TFP oil tank to Cooling Unit 2 & back	62.1/2 In HB 2
Tr. Converter Oil Pump 1	Machine Room 1 Near SR 1	To circulate oil from SR 1 to Cooling Unit 1 & back	63.1/1 In HB 1
Tr. Converter	Machine Room 2	To circulate oil from SR 2	63.1/2

THREE PHASE LOCO MATERIAL

Oil Pump 2	Near SR 2	to Cooling Unit 2 & back	In HB 2
Load on Auxiliary Converter No. 3			
Main Compressor 1	Under Truck below Machine room-1	To create MR pressure	47.1/1 In HB 1
Main Compressor 2	Under Truck below Machine room 2	To create MR pressure	47.1/2 In HB-2
Scavenging Blower 1	Machine Room 2 Near TMB 1	To clean dust from air filters of TMB 1 & OCB 2	55.1/1 In HB 1
Scavenging Blower 2	Machine Room 1 Near TMB 2	To clean dust from air filters of TMB 2 & OCB 1	55.1/2 In HB 2
Battery Charger	Within Auxiliary Converter Cubicle	To charge battery & feed control circuits	100 in HB2 & 110 In SB 2

NOTE: MCB 100 is relocated on Bur-II in IGBT locos.

In some IGBT locos MRB-2 is getting 3 ph. AC supply from AC-2.

AC equipment also getting supply from AC-2.

In LGD based locos 3Ø Sc. Blowers getting supply from AC-2.

Load Sharing in case of any AC isolated:

In case of failure of any converter another converter shares its load.

Load sharing after isolation of any auxiliary converter.

Aux.Conv-1 isolated	Load on Aux.Conv-2	Oil cooling blower 1, 2, Tr. Motor blower 1, 2 Scavenging blower 1-2
	Load on Aux. Conv.-3	MCP 1, 2, Transformer pump 1, 2, Converter pump 1, 2, Battery Charger
Aux.Conv-2 Isolated	Load on Aux.Conv-1	Oil cooling blower 1, 2,Tr. Motor blower 1, 2 Scavenging blower 1, 2
	Load on Aux. Conv.-3	MCP 1, 2, Transformer pump 1, 2 Converter pump 1, 2, Battery Charger
Aux.Conv-3 Isolated	Load on Aux.Conv-1	Oil cooling blower 1, 2, Tr. Motor blower 1, 2 Scavenging blower 1, 2
	Load on Aux. Conv.-2	MCP 1, 2, Transformer pump 1, 2 Converter pump 1, 2, Battery Charger

NOTE: If any AC is isolated, Blowers works on 37 Hz frequency

Oil pumps and compressors works with 50 hz frequency

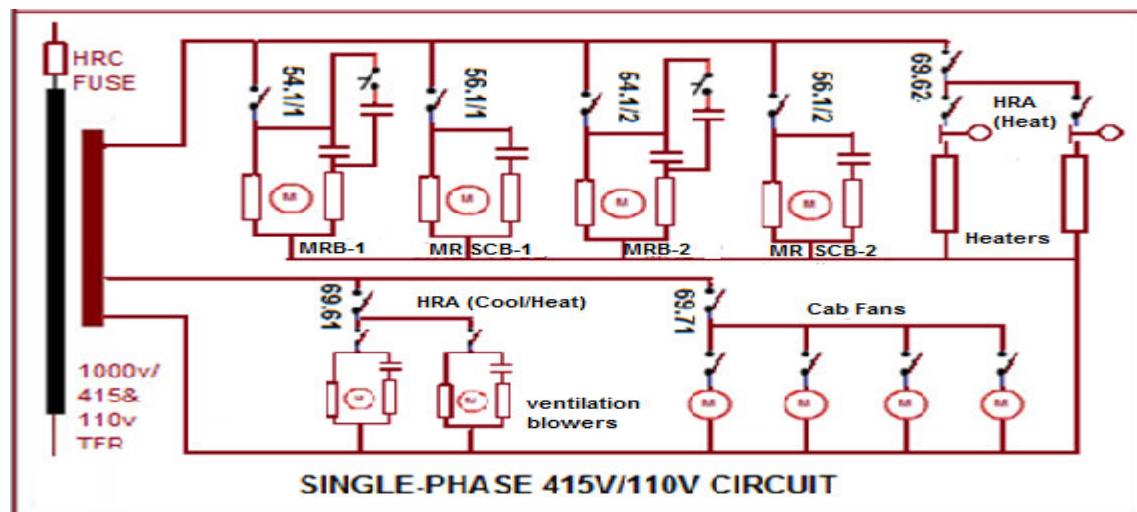
If any Aux.Conv. is isolated, AC will not work.

SINGLE - PHASE 415 V/110 V AUXILIARIES:

The auxiliary transformer is located in cubicle-1 (HB-1) and supplies following systems with 1-phase power.

- This circuit is independent of CE and all these auxiliaries work in Driving as well as cooling mode and start as soon as VCB closed.

Single phase 415 Volts			
Machine Room Blower-1	Machine Room-1	To cool machine room by ducting and limit the temperature of control electronics parts below 70°C	54.1/1 In HB-1
Machine Room Blower-2	Machine Room-2	-do-	54.1/2 In HB-2
Scavenging Blower for Machine room Blower-1	Machine Room-1	To clean dust from air filters of Machine Room Blower-1	56.1/1 In HB-1



Scavenging Blower for Machine room Blower-2	Machine Room-2	To clean dust from air filters of Machine Room Blower-2	56.1/2 In HB-2
Heater Element	In Both cab. Inside Desk	To deliver heat for keeping the cab warm	69.62 In HB-1
Single phase 110 Volts			
Crew Fan: 4 Nos.	2 Nos. in Both cabs	Crew ventilation	69.71 In HB-1
Cab Ventilation Blower- 2 Nos.	One in Both cab Inside Desk	To expel heat of heater element into the cab& cab ventilation	69.61 In HB-1

- In some locos both MRBs are converted as three phase auxiliaries and cooling mode is deactivated.

- **In some locos only MRB-2 converted as three phase auxiliary and works in only driving mode.**
- **MRB-1 works in driving and cooling mode.**

Harmonic Filter:

- Harmonic filter is connected with primary winding of main transformer which consist of contactors, resistances and capacitor and inductive coil.
- This harmonic filter reduces/suppresses the high frequency harmonics to avoid disturbances in signaling.
- Harmonic Resistances are kept on roof and cooled naturally.
- If the harmonic filter get bypassed by the system, the speed of the loco / train will be automatically restricted to maximum 40 KMPH by CE.
- Harmonic filter consists of two EP contactors and one EM contactor. For EP contactors pressure comes from Pn.Panel.
- On Pn.Panel COC is provided and it should be kept open always.
- These EP contactors are monitored by SR1 and SR2 electronics.
- If Harmonic filter is isolated isolate SR1/SR2 and switch OFF CE to bring back harmonic filter into service.

Protective equipment to power circuit:

OCR78: To protect from over current or earth fault in main transformer **Over Current Relay (OCR) 78** is provided in SB-1 cubicle. It is having Mech. Locking.
(In case of OCR is acted, Action to be taken is discussed in T/shooting)

ET1 & ET2 Gapless surge arrestors: These are located on loco roof.

- ET1 protects roof equipment from surge voltage when VCB is opened condition.
- ET2 protects main transformer from surge voltage when VCB is closed condition.

HOM: (LOCO GROUNDING SWITCH)

Location: Underneath of loco roof, middle of Machine room corridor.

Loco should be grounded only before climbing loco roof to attend any trouble on loco roof like removing foreign body, securing damaged pantograph etc.(Grounding procedure is discussed in Loco operating chapter)

Batteries

- In 3Ø locos Ni-Cd Battery is used.
- Total 26 Batteries kept in two boxes and mounted on under frame of loco body.
- Each BA having 3 cells and each cell voltage is 1.4 V.
- Total 26 Batteries Voltage is $26 \times 3 \times 1.4 = 109.2(110)$ v., capacity is 199 A-H
- To show the battery voltage UBA is provided in either cab. Main switch for battery is MCB 112 which is kept in a box provided near BA box No. 2.
- To charge the battery, one battery charger is provided with MCB100 (Input) in HB2 and MCB 110 (output) in SB2.
- For control circuit supply MCB 112.1 is provided in SB2.

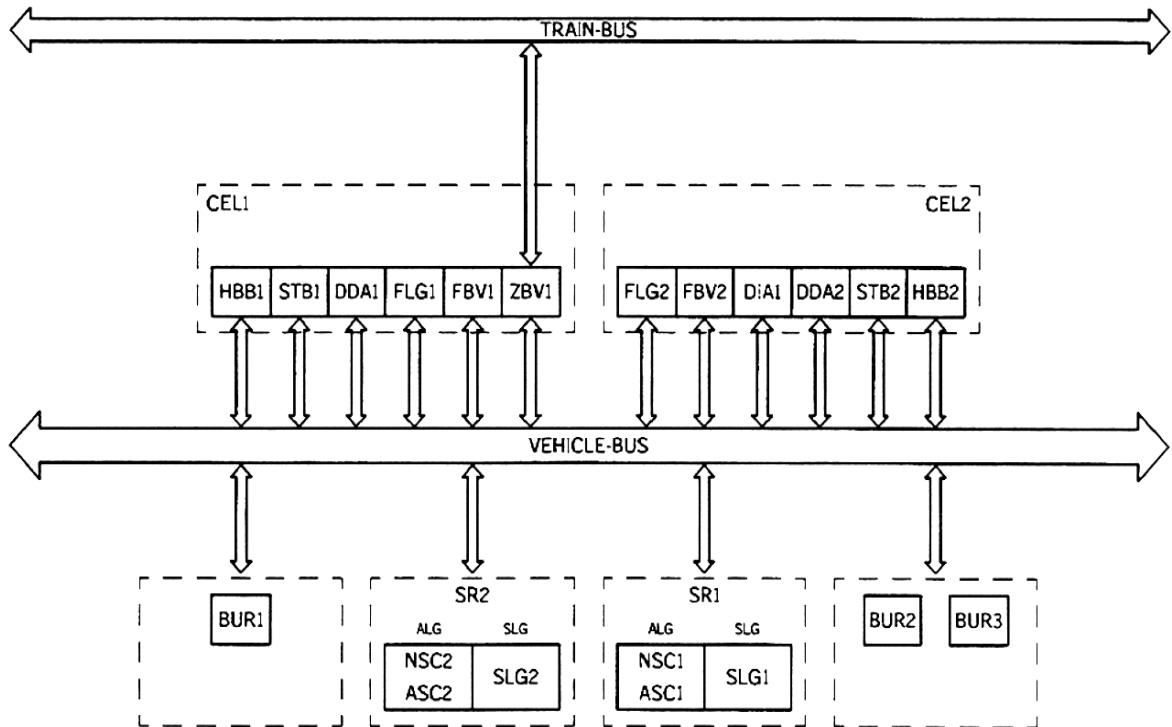


Note:-

- If battery voltage is 92 V for more than 30 seconds, P-2 Fault will appear on the screen.
- If battery voltage is reduced below 86V, P-1 message will appear , if BV drops to 82V loco will shutdown.
- If charging current is reduced by 10 A, P-2 fault will appear on screen.
- If cab is activated and panto is not raised, CE will switch OFF after 10 minutes automatically.
- Loco CE get power supply directly from battery and can supply upto maximum 5 hours.

CONTROL ELECTRONICS-GTO LOCOS

Bus Stations : A control electronics level with at least one computer and a connection to the vehicle bus is defined as a bus station.

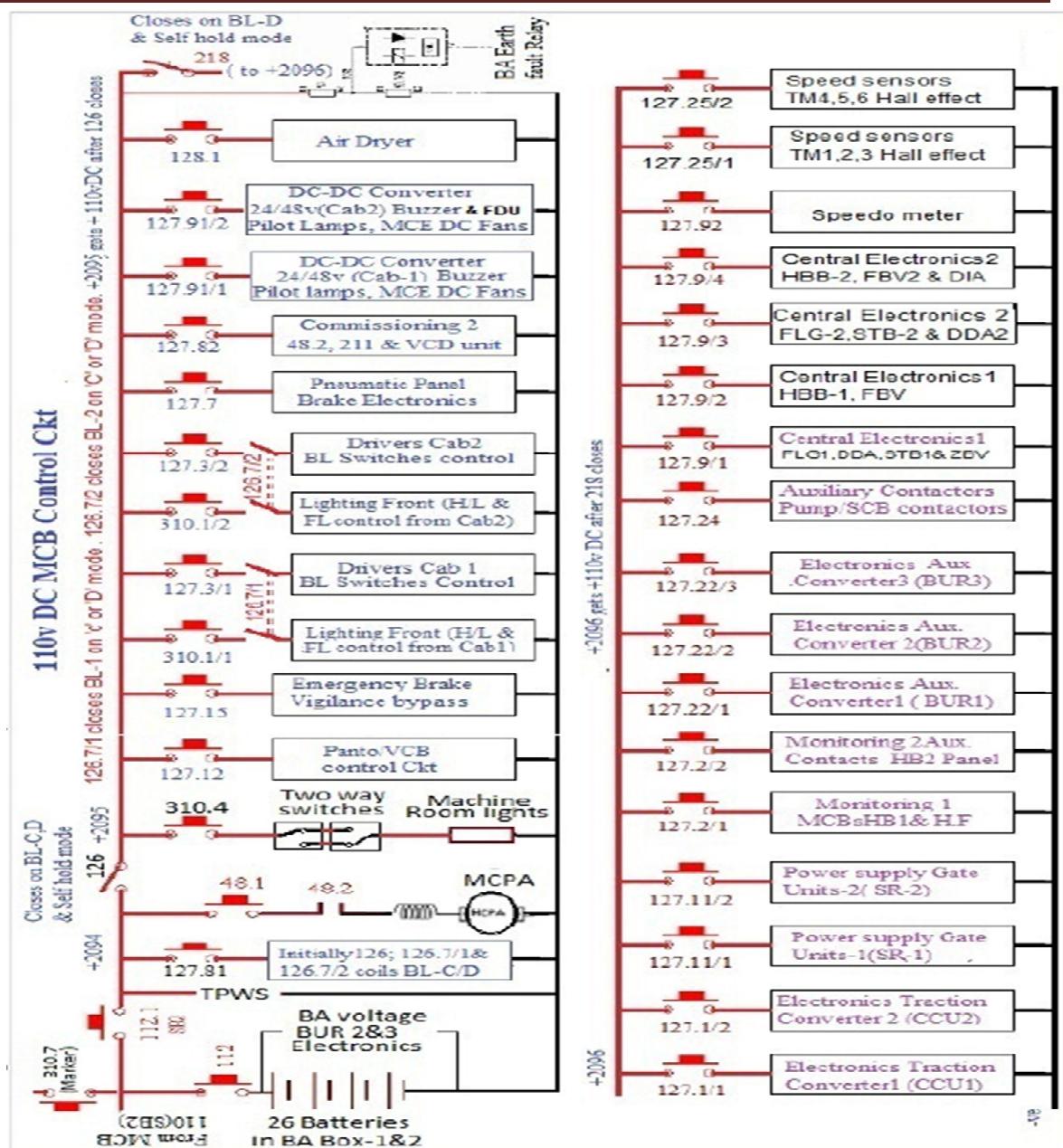


SR	Traction Converter
ALG	Drive Control Unit –controls GTOs in the SR
SLG	Converter Control Unit – converter operation
ASC	Drive Converter Control –Motor side GTOs controls
NSC	Line Converter Control-TFR side GTOs controls
BUR	Auxiliary Converter Control- BUR processor
HBB	Auxiliary Cubicle Control- Cab control processor
STB	Low Voltage Cubicle Control- Cab control processor
FLG	Vehicle Control Unit- Master control of Loco
FBV	Vehicle Bus Administrator-routing signals
ZBV	Train Bus Administrator- MU operation
DIA	Diagnostic Control- Fault generation and fault log
DDA	Display Data Control- cab display control

Third Party Control Electronics

The following third party systems are operated by their own control electronics and independent from the above mentioned bus concept: Example Brake Electronics, VCD, and FDU & SPM electronics.

THREE PHASE LOCO MATERIAL



LOCO OPERATING

Loco Inspection

1. In front Of Cab:

- Ensure that loco is standing on the rail and under the OHE.
- Ensure that both side MRE, BCE, BP, FP hoses are connected properly and their angle COCs are as per requirement. Also ensure that hoses are not hanging.
- Ensure no damages to rail guard and cattle guard.
- Ensure that CBC having no abnormalities and locking pin is available and provided with operating handle.
- Ensure that UIC connector sockets are covered.
- Ensure that both look out glasses are clean.

2. Below Machine Room No. 1 (Cab 1 To Cab 2)

- Ensure that all sand boxes are filled with dry fine sand, and sand pipes are aligned correctly.
- Ensure that additional COC of MRE & BCE are opened behind cattle guard..
- Ensure that Air dryer unit is in service that (D-in open, D- out open & D-off closed).
- Ensure that all suspension dampers; helical springs having no abnormalities like, crack, hanging etc.
- Guide rod is fitted properly and its bolts are tightened.
- All brake rigging; brake block, brake shoe, sleeve rod, assembly hanger arrangement are OK.
- Wheels are not skidded.
- Return current bush are connected properly.
- Parking brakes cylinders are provided with manual releaser hook, if provided.
- Traction link is fitted properly and their all 6+6 bolts are tightened and safety slings provision.
- Oil level in MCP-1 is above min mark, also ensure that CP mounting bolts are tightened and safety sling is slack.
- Bogie brake -1 COC is in open condition.
- Battery box cover is fixed properly.
- Safety chain is intact.
- BP and FP additional COC are in open condition behind cattle guard.

3. Below Machine Room No. 2 (Cab 2 To Cab 1)

- Ensure that all sand boxes are filled with dry fine sand and sand pipes are aligned correctly.
- Ensure that additional COCs of MRE & BCE are opened behind cattle guard.
- Ensure the all suspension dampers, helical springs having no abnormalities like, crack, displacement, hanging etc.
- Guide rods are fitted properly and its bolts are tightened.
- All brake rigging; brake block, brake shoe, sleeve rod, assembly hanger arrangement are OK.

- Wheels are no skidded.
- Return current bush are connected properly.
- Parking brakes cylinders are provided with manual releaser hook, if provided.
- Traction link is fitted properly and their all 6+6 bolts are tightened and safety slings are provided.
- Oil level in MCP-2 is above min mark; also ensure that CP mounting bolts are tightened and safety sling is slack.
- Bogie brake -2 COC is in open condition.
- Battery box cover is fixed properly.
- Safety chains are intact.
- BP and FP additional COC are in open condition behind cattle guard.

4. In Cab

- Cab and look out glasses are clean.
- All switches are normal, ZBAN-OFF, ZTEL-OFF and BLCP-AUTO position.
- Emergency exhaust Cocks are normal.
- Water is filled up in windshield washer unit.
- Spare hoses, wooden wedges are provided in side locker.
- Fixed and handy both fire extinguisher are in good condition and filled with gas.
- Ensure that emergency push button is released.

5. In Machine Room

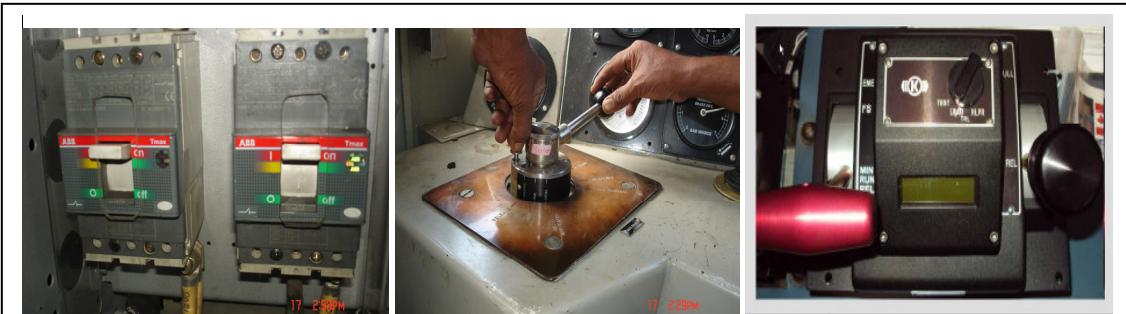
- Control and power Circuit breakers in cubicle SB-1 / SB-2, HB-1 / HB-2 are normal in (UP/ 'ON') position.
- Switches provided in SB-1 are in normal (vertical) position.
- Oil level/water level of Conv-1/2 and transformer-1/2 are above min mark.
- Ensure outer cover of any power equipment is not opened.

6. Pneumatic Panel

- Panto selector switch is in "auto" position.
- COC 70, 74, 136 are in open condition and COC 47 is in close position.
- COC of panto 1, panto 2, VCB and sanders are in open condition.
- Distributor valve is in service.
- IG 38 Key is inserted and kept 'ON'.
- CPA drain Cock is in closed position.
- Parking brake apply/release plungers are not in locked condition.

LOCO ENERGISATION

- Put battery additional circuit breaker No.112.1 to 'ON' position in cubicle SB-2. Also ensure that CHBA circuit breaker No. 110 (SB-2) is at ON position.



MCB 110 & 112.1 in SB-2, Inserting A9 handle in E-70 locos & A9, Mode switch & SA9 in ccb2.0 loco

- Ensure MCB 100 in HB2 or above BUR 2 is ON.
- Go in operating cab with A9 handle in case of E70 brake system and BL key.
- Insert **A-9** handle at '**Neutral**' position and bring to '**RUN**' position by lifting lock. (In **CCB 2.0** brake system **A9** is fixed and keep in '**Full service**' and **Mode switch** in '**LEAD**' position.)
- Insert '**BL**' key at '**OFF**' position and turn it to '**D**' position. Then
 - Light of screen (panel-C) and Memotel will get ON.
 - MCPA will start (if pressure is less).
 - UBA will deviate and shows BA voltage . It should be above 92 V.
 - LSDJ will glow.
- All above indications indicates that Control Electronics is '**ON**'.
- The message "Loco is in configuration, please wait" will appear on the screen and self testing is done for 10 seconds.
- During **self testing**, all pilot lamps will glow and extinguish except LSDJ, Bogies-1 & 2 meter needle will deviate both in BE/ TE mode and come to -0.
- After completion of testing, Node No. **FLG 504** will be displayed on the screen. Now press 'ZPT' in 'UP' mode for raising of pantograph and confirm the touching of panto with contact wire by seeing physically and also U-meter will deviate and indicate the OHE voltage.
- After few seconds Node No. **FLG 550** will display on the screen, now press BLDJ for closing VCB. Now DJ will close and 'LSDJ' will be extinguished.



11. Loco will energize and all the auxiliary motors will start automatically.
12. Ensure that BLCP is at AUTO position.
13. Node No. **FLG 570** will appear on the screen.
14. After building of MR pressure to 6.4 kg/cm², set Reverser to F/R as per requirement. (FLG 590 will show on the screen.)
15. Apply loco brakes. Now release the parking brakes.
16. Ensure BP pressure is 5 kg/cm² and ensure AFI is at Zero.
(In CCB 2.0 brake system keep A9 in full service and Mode switch in 'Lead'. Wait till 'OK to RUN' message in LCD screen on EBV (Provided on A9) and then bring to RUN position. Now BP charges to 5 kg/cm².)
17. Set the screen in 'Simulation Mode'.
18. Now operate throttle in TE direction. **FLG 596** Node display on screen indicates traction converters are ready for traction.
19. Both TE /BE meters will deviate in TE side, and FLG 596 will appear continuously on the screen. TE/BE will be shown in KN in simulation screen.
20. Check the loco brake power (should not move upto 150/100 KN).
21. Now Loco is ready to work.
22. After loco energization and MR pressure is above 5.0 Kg/cm² check sanders, horns and wipers working.
23. Check both side Head light glowing.

Note:

Priority -1 message will appear on the screen: -

- ⊕ If Reverser is put on position F or R when MR pressure is below 6.4 kg/cm²
- ⊕ If throttle is operated without releasing parking brakes.
- ⊕ If throttle is operated without recharging BP to 5 kg/cm².

ZPT & Panto raising:



- It is spring loaded switch provided for Pantograph.
- It is having '0','UP' and 'DN' positions.
- Panto selector switch is provided on Pn.Panel, having 'AUTO', 'I' and 'II'.

- In 'AUTO' position only rear pantograph raises and is monitored by MCE.
- In 'I' position irrespective of cab only panto-1 raises.(Panto-2 isolated)
- In 'II' position irrespective of cab only panto-2 raises.(Panto-1 is isolated)
- I & II positions are not monitored by MCE.
- For panto/VCB control circuit MCB 127.12 provided in SB-1.
- Both pantographs are controlled by IG-38 key provided in Pn.panel.
- Two panto isolation cocks are provided on pn.panel and normally horizontal position.
- In E70 locos IG-38 key normal position is 'Horizontal' and in CCB2.0 locos 'Vertical'.
- To give feed back about panto pressure to MCE in panto pipe line two pressure switches provided in E70 locos as well as CCB2.0 locos.
- **130.1 Aux.Contactor is provided in panto control circuit and is provided in SB2.**
- To raise panto in 'Driving mode' after observing FLG 504 node on display press ZPT down side(UP) and rear panto raises provided PSS on 'AUTO' position.
- Panto can be raised in cooling mode also, but no node appears since display OFF.
- To lower panto operate ZPT upwards (DN) position.

BLDJ & Closing of VCB:

- BLDJ is spring loaded switch.
- BLDJ positions are '0', 'OFF' and 'ON'
- For panto/VCB control circuit MCB 127.12 provided in SB-1
- One VCB isolation cock is provided on Pn.panel normally horizontal position.
- **In VCB control circuit 136.4 aux.contactor is provided in SB-1.**
- VCB can be closed in driving and cooling mode.
- In driving mode, after FLG 550 node press BLDJ towards down side(ON) and release., VCB closes and LSDJ lamp extinguishes.
- In cooling mode no node information but LSDJ lamp extinguishes when VCB closes.
- To open VCB operate BLDJ upwards (OFF).



136.4 contact or in SB-1 panel

BLCP and MCPs starting:

- BLCP is semi spring loaded switch.
- Normal position is 'AUTO' and down side spring loaded 'MAN' and up side 'OFF' position.
- In 'AUTO' position both compressors will work initially from 0-10 kg/cm² and later from 8-10 kg/cm².
- In 'MAN' mode both MCPs work continuously till pressed in 'MAN' position.
- In 'OFF' position both MCPs will OFF.



Checking of Head light, marker light and flasher light:

Whenever loco taken over charge head light, marker lights and flasher light glowing to be checked by crew.



Switching On marker lights:

- Without cab activation also marker lights can be switched ON in any cab.
- Marker lights MCB is 310.7 available in SB-2.
- o put on white marker lights switch ON 'ZLFW'.
- To put on Red marker lights switch ON 'ZLFR'.
- Marker lights gets supply directly from BA and MCB112 should be good condition.

To put ON Head light:

- In both cab BLPR and ZPRD switches provided in Panel 'c'.
- For cab-1 side head light MCB 310.1/1 and contactor 338.1 provided in SB-1 cubicle.
- For cab-2 side head light MCB 310.1/2 and contactor 338.2 provided in SB-2 cubicle.
- BLPR switch is having 'F' 'OFF' and 'R' positions.
- To glow front side Head light put BLPR in "F" position and glows bright in ZPRD switch in 'FULL'. To dim front head light keep ZPRD in 'DIM' position.
- To test rear head light put BLPR switch on 'R' position.

Testing of Flasher light:

- Flasher light control unit is same as conventional loco and kept at ALP side.
- On flasher light two toggle switches are provided.
- One toggle switch is provided with 'AUTO' and 'ON' positions and another provided with 'MAIN' and 'STANDBY'.

- One rotating switch 'BPFL' is provided in Panel 'C' to check the working of Flasher light.
- Before checking Flasher light keep first toggle switch at 'ON' position and operate BPFL. Check the flasher light in 'standby mode' also.
- After checking FL keep first toggle switch on 'AUTO' mode.
- If FL is not working in both modes check fuse provided on FL unit.
- *AFL can not be tested in loco stand still condition.*
- Whenever BP pressure drops on run AFL comes along with ACP message.

Checking of HORNS:

- Above loco roof beside FL two horn hooters are provided facing front and rear.
- In both cabs on LP and ALP side one horn knob is provided with 'LOW' and 'HIGH' tones.
- Below LP's desk two isolation cocks are provided and they should be open condition.
- *After loco energisation check working of horns at LP and ALP side.*
- *Horns works after MR pressure build up more than 5.0 Kg/cm².*

Checking of Sanders:

- *Whenever loco taken over charge sanders working to be checked by loco crew, if not working immediately to be informed to TLC and act accordingly.*



- For sanding PSA pedal switch is provided in both cabs.
- Two isolation cocks are provided on Pn.Panel.
- Before starting a train ensure sanders are working and dry sand available in sand boxes. Keep one spare bag also inside the loco.
- This PSA can be used for VCD ack. also. But do not use since sand will be wasted.
- PSA should operate with a interval of 10-12 sec. since continue sanding is not available in this loco.
- *When sanders EV are energized sand drops in front of wheels of leading axles of both bogies.*
- *Sanders works after MR pressure build up more than 5.0 Kg/cm².*
- If PSA pressed continuously for one min. VCD will go in dead man's mode and penalty brakes will apply.

Checking of Wipers:

- To operate wipers ALP side operating knob provided.
- It is having 'neutral' 'Operate' and 'parking' positions with speed control knob.
- To operate washer press and hold on 'operate'.

Operation of BL Key

BL key is operated in the following modes:

1. DRIVING MODE : Off - D
2. SELF HOLD MODE : D - Off
3. Switching OFF control electronics : D - Off - C - Off
4. COOLING MODE : D - Off - C - Off - C



Operation Of Reverser :

- Reverser has following 3 positions.
- Position 'F' : Forward
- Position 'O' : Neutral
- Position 'R' : Reverse
- Throttle and reverser are interlocked mechanically.
- Reverser to be operated after FLG node 570 information in display and MR pressure should be above 6.4 Kg/cm². If reverser operated below 6.4 Kg/cm² protective action will be taken by MCE and Priority-1 fault message displays.



NOTE:

Whenever BP pressure drops due to train parting or ACP or keep reverser on '0' after stopping the train. After attaching loco and making BP hose pipe through also keep Reverser on 'o'.

Reverser to be operated in train stand still condition only.

Operation of Throttle:

- The TE/BE throttle controls traction and the electric braking effort of the locomotive with an angle transmitter and auxiliary contacts.
- For angular transmitter switch 152 (0&1 positions) provided in SB-1.
- Position '0' : Fine control through out the range by angle transmitter.
- Position '1' : Fine control in steps though auxiliary contacts.
- The % TE/BE will be shown in TE/BE meters on the



- panel A.
- TE/BE handle also works in three steps during failure of Angle Transmitter', ie., 33%, 66% and 100%.

Loco Brake Testing:

- ***While taken over charge and before moving any loco LP should conduct loco brake power test and if it is not as per standard instructions immediately contact TLC.***

Procedure of conducting Loco Brake power Test.

- Apply loco brakes by SA-9.
- Ensure that BC gauge showing 3.5 kg/cm².
- Physically ensure the brake blocks are touching to the wheels and no person/loco is in front .
- Set the screen in simulation mode.
- Release parking brakes/hand brake and keep A 9 on RUN position.
- Ensure MR pressure is above 6.4 kg/cm². Operate reverser to forward.
- Operate throttle gradually towards TE side and ensure loco should not move up to 150 KN in WAG-9 & WAP-7 locos and 100 KN in WAP-5 locos.
- After conducting loco brake power test keep TE/BE handle in 'o' position.

Parking Brakes:

- This is mechanical brake and remained applied indefinite time once applied.
- The parking brakes provided to wheel no. 2,6,7&11 in WAG9 and 1,4,5 & 8 in WAP5.
- Parking brakes can be applied below 5 Kmph but only after stopping the train/loco PB brakes to be applied.
- In WAP 7 locos Parking brakes are removed and hand brake is provided in Machine room 2 towards Cab-1.
- Parking brakes applies with same brake blocks of TBU brakes.
- To apply/release PB in panel 'A' BPPB push button switch and one solenoid valve with application and release plunger is provided on Pn.panel.
- In E70 locos application and release plungers are having locking provision whereas CCB2.0 locos auto latching facility is provided.
- To release PB manually a hook is provided to the PB activator at the above wheels.



Application of parking brakes

During CE ON – Press BPPB. Or Press application plunger in SV.30

- Red illumination glows in BPPB and PB Gauge reads '0' Kg/cm²
- Parking Brakes will apply.

- **When 'BL' key is moved from 'D' to 'OFF',**

- Parking Brake Gauge reads '0'Kg/cm²
- Parking Brakes will apply and BPPB lamp will not glow

- **MR pressure drops below 3.5 Kg/cm² also PB applies.**

Releasing of Parking brake:

- **During CE ON - Press illuminated BPPB. Or Press Releasing plunger in SV.30**

- Red illumination goes off in BPPB and PB Gauge shows 6 Kg/cm²
- Parking Brakes get released.

- Apply SA9 and ensure BC gauge 3.5 Kg/cm²

- **Pull manual release hook at all PB cylinders.**

- Parking Brakes get released and a Releasing sound of locking mechanism is heard.
- Gauge will show '0' Kg/cm² only and BPPB will not extinguish if glowing.

- **To take traction again press illuminated BPPB.**

Driving Mode:

1. This mode is used to drive the loco. To achieve this mode Loco pilot has to Insert BL key in 'OFF' position. Turn it clockwise from 'OFF' to 'D'

2. By doing so, following indications will confirm the driving mode:

- ⊕ LSDJ will glow
- ⊕ UBA will show battery voltage.
- ⊕ Display & Memotel screen will activate.
- ⊕ Control electronics will ON.
- ⊕ Cab will activate.
- ⊕ MCPA start if less pressure.

Driving:

- ⊕ Energise loco as per procedure.
- ⊕ After creating MR pressure above 6.4 kg/cm² and node information No. 570.
- ⊕ Move the reverser into desired position.
- ⊕ Release the parking brake/hand brake if applied.
- ⊕ Put A9 to 'RUN' position & ensure BP 5 kg/cm²
- ⊕ Ensure AFI is on '0'.
- ⊕ Set the TE/BE throttle to desire position.
- ⊕ Release SA9. BC gauge shows 0 Kg/cm².
- ⊕ In order to increase adhesion and to avoid wheel slipping use sanders.

- ⊕ Bogies 1 & 2 meters will show in TE side and loco starts moving.
- ⊕ In simulation mode TE/BE shows in 'KN'

NOTE:

- ⊕ While on run, if bogie meter suddenly not respond, trip VCB and reclose VCB.
- ⊕ While on run, if reduction in traction effort with LSP without any proper reason, isolate bogie-2, work up to convenient place, switch off CE and switch on CE to bring isolated bogie in to service.
- ⊕ While on run, if bogie isolated without any message, at convenient place, switch off CE and switch on CE, to bring isolated bogie in to service.
- ⊕ While on run, after two or three attempts of reclosing of VCB while attending any fault, bogie may get isolated, at convenient place, switch off CE and switch on CE, to bring isolated bogie in to service.

Regenerative braking & Controlling train:

- To use regenerative brake move throttle towards braking side as per requirement and control the train.
- Max. Brake force is 260 KN in WAG-9/WAP-7 & 160 KN in WAP-5. Regenerative Braking is possible up to 0 KMPH.
- Use the Sanders if required while stopping in up gradient.
- Move A9 from 'RUN' to 'Initial Application'. If more brake force is required move the A9 handle to desire position between 'Initial Application' and 'Full Service' & vice versa gradually.
- When train stops, apply SA9. Use pneumatic brakes during shunting.

Note:

- While stopping the train use A9 only.
- While RB in service do not use SA9.
- Whenever VCB tripped during RB or RB is failed loco brakes will apply proportional to RB percentage. More than 90%, max.2.5 Kg/cm² BC pressure went into loco BCs.
- In E70 locos only loco brakes will apply so immediately press PVEF to avoid wheel skidding and control the train with A9 if required.
- In CCB2.0 locos along with loco brakes emergency brakes will apply if loco BC pressure exceeds 2.25 Kg/cm²

Automatic Vigilance Control System:

- ⊕ VCD is meant for keeping the Loco crew alert.
- ⊕ It is a safety device. VCD comes into service when the speed of train is more than 1.5 KMPH.



- ⊕ LP only has to ack VCD for every 60 seconds interval by anyone of the following ways.
 - ⊕ Press VCD "Foot switch".
 - ⊕ Press VCD ack/BPVR switch.
 - ⊕ Operate throttle in TE/BE with difference of more than 3%.
 - ⊕ Operate 'Sanders'.
- ⊕ If anyone of the above exercises is done, the Loco crew is considered alert and the 60 seconds cycle get reset.
- ⊕ If none of the above activities are done once within 60 sec, In E 70 locos, buzzer will sound and 'LSVW' will glow for next 8 sec ie., from 61 to 68 sec.
- ⊕ Within these 8 sec. VCD should be acknowledged. If not acknowledged, VCD will apply penalty brakes ie.
 - TE/BE will come to '0'.
 - BP pressure will drop to 2.5 to 3.0 kg/cm² and P1 Message F10 03 P1 will be displayed on the screen.
 - LSVW glowing and buzzer sound continues.

Dead Man's Mode:

If VCD 'Foot switch' or VCD Ack. button remain pressed for more than 60 sec. then the system will go automatically in "Dead Mans" mode, buzzer will sound & LSVW will glow. If not released within next 8 sec. VCD penalty brakes will be applied.

(In CCB2.0 locos, after 60 sec, next 8 sec 'LSVW' blinks and next 8 sec. buzzer sound also comes. If LP not acknowledged within 60+8+8 sec.; penalty brakes will apply. BP pressure drops to '0' along with loco brakes application, max.3.8 Kg/cm². "**Train- line Emergency – Keep Handle in EMER**". Message displays on EBV and F 10 03 P1 message displays in DDU.)

Resetting Of VCD Penalty Brakes:

- ⊕ After stopping the train, keep throttle to '0' and reverser on '0'.
- ⊕ Apply Direct brake max. Keep A9 on Full Service/Emergency to avoid MR pressure dropping.
- ⊕ Wait for 120 sec. in E70 locos.(In case of CCB 2.0 locos wait for 32 sec.)
- ⊕ Press "BPVR" to reset VCD, LSVW will extinguish and buzzer sound stops.
- ⊕ Press and release VCD "Foot switch".
- ⊕ Press 'BPFA' for acknowledging fault message.
- ⊕ Release auto brakes.
- ⊕ Resume normal traction after charging MR and BP pressure.
- ⊕ Inform to TLC and write remark in loco log book.

Isolation Of VCD:

- ⊕ If Loco pilot is acknowledging VCD correctly as per procedure, but still VCD penalty is applying, it is assumed that VCD is malfunctioning.

- + After stopping the train, to isolate VCD, keep 237.1 on '0' position without 'switching OFF' MCE. Message F11 05 P2 displays. Ack. the fault message. Inform to TLC and write remark in loco log book.
- + To normalize VCD, stop the train. Normalize 237.1. F 10 03 P1 message displays. BP pressure drops to '0'. Ack. the fault. BP pressure again charges to 5.0 Kg/cm²

Constant Speed Controller:

- + This system enables the train to maintain a constant speed automatically and can be activated at any speed above 5 KMPH by pressing push button 'BPCS'.
- + The control electronics controls the constant speed by giving tractive or braking effort to the TM as per requirement irrespective of position of throttle i.e. TE/BE

CSC is activated only when

- + Speed is more than 5 KMPH
- + Throttle in either TE or BE side ie., not in '0' position.
- + Train Br. and loco Br. are not applied
- + BPCS is pressed once, green lamp will glow.

CSC can be cancelled in following conditions.

- + Pressing illuminated 'BPCS'.
- + Moving of throttle by 3%.
- + Drop in 'BP' by 0.25 kg/cm² and above.
- + BC pressure more than 0.6 kg/cm².
- + By doing any one of above actions CSC will be cancelled and lamp in BPCS will extinguish.

Note:

- + BPCS switch should not be pressed for more than 5 Sec. It shall give switch struck up message and became non functional.
- + In C-DAC VCU locos due to malfunctioning of soft ware BPCS is not cancelling as per procedure.
 - o If Constant speed not cancelling immediately open VCB and control the train if required.
 - o After stopping the train switch OFF MCE and switch On & Try.
 - o Still BPCS lamp not extinguishing try from rear cab.

Most of CDAC VCU locos BPCS is deactivated.

- + To minimize oscillation, the CSC should be set during a slow acceleration phase.
- + CSC will maintain the speed only up to max TE / BE.
- + Speed may vary+/- in undulated area, according to TE/BE handle angle. So to maintain constant speed of set speed the TE/BE handle to be kept nearer to '0' position after setting the required speed.
- + While working full loaded trains better to avoid CSC. LP has to implement best driving technics in undulated area.

- ⊕ If CSC is used in undulated area, the loco will trigger for TE to BE and BE to TE very frequently with heavy amplitude, which is not good as far as driving technique is concerned.
- ⊕ While nullifying CSC ensure that needle position of TE/BE meter and throttle are not just opposite. If so, first bring the throttle to '0'.

Banking Mode:

When it is required to use loco as a banker i.e use of TE / BE without charging BP, at that time loco should operate in banking mode.

Procedure:

- ⊕ Attach the banker loco in rear of the formation.
- ⊕ Ensure CBC is locked properly.
- ⊕ Keep SA9 on max.; throttle on '0' and reverser on '0'.
- ⊕ Couple the BP and FP hose pipes, but their Angle COC should not be opened till loco set up in 'Banking Mode'.
- ⊕ Trip the VCB and keep the switch "ZBAN" to "ON" position (Panel A). In E70 locos, Close 70 & 136 COCs provided on pn. panel.
- ⊕ BP pressure drops to '0' and F10 04 P1 message displays. Ack. the message.
- ⊕ (In CCB2.0 locos keep mode switch in 'HLPR' mode after keeping A9 in 'FS' and close 136 cock on Pn.panel. then switch ON ZBAN. BP pressure drops only after keeping Mode switch on 'HLPR'.)
- ⊕ Close VCB.
- ⊕ Now open the FP and BP Angle COCs , FP and BP pressure will rush from the leading loco into FP & BP pipe of banker loco and both gauges shows the pressures. (FP: 5.8/5.7 and BP 4.8/4.7 kg/cm²)
- ⊕ Auto brake will not work in banker loco except in emergency position.
- ⊕ When train stops SA9 can be applied.



Note: In case of CCB 2.0 locos, if traction is not coming, keep A9 in 'FS' and try.

Self Hold Mode:

- ⊕ This mode is used while changing the cab.
- ⊕ Stop the train/loco. Apply SA9 and ensure BC is showing 3.5 Kg/cm².
- ⊕ Keep throttle on '0' and reverser on '0'.
- ⊕ Open DJ , lower the pantograph.
- ⊕ Rotate 'BL-key' from 'D' to 'OFF': Now control electronics will remain 'ON' for 10 minutes.
- ⊕ PB applies automatically if provided. (gauge shows '0' and BPPB shall not glow)

- Screen will display the message as "Self hold mode active. After 10mins MCE will switch OFF".

Switching Off - Control Electronics:

Control electronics to be switched OFF in following occasions:

- To make loco dead.
- Before grounding loco.
- During troubleshooting.
- To bring back the isolated sub system into service.
- Before resetting circuit breakers in SB-1/2 panel except 48.1, 127.91/1, 127.91/2, 310.7, 310.1/1, 310.1/2, 310.4, 128.1 & 129.1
- Before going to cooling mode.

Procedure of switching OFF CE:

- Stop the loco/train and secure the loco/train.
- Keep A9 in emergency. Open the VCB and lower the pantograph.
- Operate BL-key from 'D' to 'Off' (wait for 2 sec.)
- LSDJ, and UBA goes off.
- Operate BL-key from 'Off' to 'C' and wait until display screen, Memotel SPM LEDs, goes OFF.
- It indicates that CE is 'OFF' and now rotate BL key from 'C' to 'OFF'.

Note :

- CE gets automatically 'off' after 10 minutes if BL-key is rotate from 'D' to 'OFF' (as explained in self hold mode)
- C.E. will get 'off' automatically after 10 minutes in driving mode also, if panto is remained in lowered position for more than 10 minutes.

Modified procedure of CE OFF:

- Stop the train and secure the train.
- Open BLDJ and lower the panto.
- Press VCU reset button in SB-1 or in 'D' panel for 3-5 sec.
- Now display will OFF and reboot again. (BP pressure will not drop, only CE will switch OFF)
- Now close VCB as per procedure.

NOTE: On run also VCU reset button can be used, Follow the instructions displayed in cab.

Cooling Mode:

1. Whenever temperature of control electronics increases above 70° C then lamp LSCE glows on Panel 'A'.
2. Clear the block section and stop the train.
3. Inform TLC/SCOR regarding cooling.
4. Open VCB and lower the pantograph.

5. Switch off CE as per procedure.
6. Move 'BL' key from 'C' to OFF.
7. Again move 'BL key' from 'Off' to 'C' and ensure that UBA shows battery voltage and LSDJ glows, Screen is Off - no node information and Memotel SPM LEDs will not glow (Note: CE is OFF).
8. Now raise the panto, close the VCB- LSDJ will extinguish and loco will energize in cooling mode.
9. Machine room blowers & their scavenging blowers will start automatically to cool the machine room.
10. Ensure working of machine room blowers.
11. When the machine room temperature goes below 70⁰ C then LSCE will extinguish.
12. Now Open the VCB, lower the pantograph.
13. Put BL from 'C' to 'Off' and 'off' to 'D' and energize loco & resume traction.

NOTE:

- ⊕ During Cooling Mode observe UBA meter frequently. If battery voltage drops to 92V, stop cooling mode and try to energise the loco in driving mode to charge the batteries (CHBA will not work in cooling mode).
- ⊕ If LSCE lamp does not extinguish after 10-15 mins, keep BL key in Driving Mode and try. If 'Driving Mode' possible, ignore LSCE and work further.

Latest instructions:

- *Do not go for cooling mode immediately. Clear the block section.*
- *If LSCE not extinguished within 10-15 min, again change to Driving mode and press 218 contactor till FLG 504 Node comes.*
- *Then energise the loco in driving mode*
- *Ignore LSCE. Work further.*
- ***In some locos cooling mode is inactive.***
- ***Machine room blowers converted as 3Ø aux and works in driving mode only.***

Failure Mode Operation

- ⊕ This mode allows the locomotive to operate even if the angle transmitter of the throttle is failed.
- ⊕ Whenever throttle not responding; the following steps are initiated with a time delay of 2 sec.
 - ⊕ Traction is set to 0 by the MCE.
 - ⊕ A priority 2-fault message (F 17 03 P1/F 18 03 P1) is displayed.
 - ⊕ The Loco pilot should bring the TE/BE throttle to '0'.
 - ⊕ No need to stop the train.
 - ⊕ Now move the rotary switch "152-Failure Mode Operation" in (SB1) from '0' to '1' position. This deactivates the angle transmitter.
 - ⊕ Now acknowledge the fault message.

- ⊕ Now the TE/BE handle will respond in three position only i.e., 33%, 66% and 100%.
- ⊕ While driving loaded goods train be cautious.
- ⊕ Inform to TLC after clearing block section

Modified procedure of bogie isolation:

A) If the loco is running.

- ⊕ Bring the throttle to '0' position.
- ⊕ Open the VCB. Ensure Node No. 550.
- ⊕ Keep switch No. 154 in required position.
- ⊕ Required bogie will be isolated after 10 seconds.



B) If the loco is stand still.

- ⊕ Bring the throttle to '0' position. Ensure Node No. 590.
- ⊕ Keep switch No. 154 in required position.
- ⊕ Required bogie will be isolated after 10 seconds.
- ⊕ Press 'ENTER' button after isolation message comes. LSFI glows continuously.

NOTE: If wrong operation done switch OFF MCE, Normalise 154 switch and keep 154 on required position and switch ON MCE.

Emergency Stop Push Button

- ⊕ One red colored push button is provided on panel 'A' in such a place that LP as well as ALP can operate it.
- ⊕ In normal condition it's button remain projected out. In case of an emergency if LP/ALP press this button, button will go inside and remain pressed and following actions initiated.
 1. VCB will open.
 2. TE/BE comes to '0'.
 3. Pantograph will lower.
 4. BP drops to 0 and Train & Loco brakes will apply.
 5. LSFI blinks & BPFA glow with message (F10 08 P1).
 6. "Emergency shutdown on the loco" appears on screen and train will stop with emergency brakes.



ESPB Resetting:

- ⊕ Bring TE/BE throttle to '0'. Keep A9 in emergency position.
- ⊕ Press "emergency stop push button" slightly and rotate it clockwise as per arrow indication on it, the button will come out from pressed condition.
- ⊕ Press BPFA and acknowledge the fault and node information will appear.

- ⊕ Energise the loco and work the train as per procedure.

Procedure of Cab Changing: Single Loco

1. Stop the train/loco.
2. Apply direct brake and ensure loco BC gauge is showing 3.5 kg/cm^2 .
3. Build up maximum MR pressure by pressing BLCP in 'MAN' position.
4. Open 'VCB' and ensure LSDJ is glowing.
5. Lower the pantograph. Physically ensure it.
6. Move automatic brake (A-9) handle to Emergency and ensure BP dropped.
7. Remove the automatic brake (A-9) handle from 'Neutral' position in E-70 locos.
8. **(In CCB2.0 locos, Keep A9 in 'FS' and Mode switch on 'TRL')**
9. Operate BL key from 'D' to 'OFF' and extract it.
 - a. CE will remain ON for 10mins. (In display 'self hold mode active' message appears.)
 - b. Parking brakes will apply if provided.
10. **Keep SA9 in applied position only.**
11. Close the doors and window shutters.
12. Go to the other cab.
13. Apply direct brake SA9.
14. Insert the automatic brake (A-9) handle and keep in 'Run' position.
15. **(In CCB2.0 locos Keep A9 on 'FS' and Mode switch on 'LEAD'. Bring A9 handle to RUN position after observing 'OK to RUN' message on EBV)**
16. Operate BL key from 'OFF' to 'D'.
17. Raise pantograph and close VCB as per procedure.
18. Ensure BC gauge is showing 3.5 kgs/cm^2 . Release SA9 handle partially and apply
 - . Ensure BC pressure dropping and again raising to max.
19. **Now go to rear cab and release SA9.**
20. Conduct loco brake power test as per procedure.

INCHING MODE

- ⊕ For making engine on train, INCHING MODE feature is provided in the three phase loco.(Active in WAG9 loco only)
- ⊕ In Inch mode loco will move at a speed of max. 1.5 kmph in E70 locos and 2.0 Kmhp in CCB2.0 locos.
- ⊕ Procedure for using inching mode:
 1. Keep Throttle in '0'
 2. Keep Automatic train brake, parking brake in release and Direct brake in applied position.
 3. Press menu, opt for "3. Process information"
 4. Opt for "3. Motor temp. / Soft ware / Inchng"
 5. Opt for "Inching mode" The following message will appear on the screen



INCHING MODE ACTIVE : 0

ACTUAL SPEED : 0.00 KMPH

SET SPEED : 0.8 KMPH

MODIFY SET SPEED BY UP AND DOWN KEYS

6. Now use curser up and curser down keys to modify the set speed. (Min: 0.5 kmph & Max: 1.5 kmph)(In CCB 2.0 max.speed is 2.0 Kmph)
7. Close ZTEL and release loco brakes. Loco will start moving maximum with set speed.
8. To stop the loco apply direct brake and after completing of loco coupling and CBC locking test , open ZTEL.

Note:

- Throttle need not be operated for inching mode.
- While moving the loco with 1.5/2.0 kmph, if ZTEL is opened due to any reason, set speed will come back to preset ie., 0.8 kmph speed.
- VCD need not acknowledge during inching mode in E70 locos.

HOTEL LOAD

HOTEL LOAD MEANS

In coaching trains passengers needs

such as

- Coach lighting
- Fans
- Mobile and laptop charger,
- Air conditioning equipment,
- Water raising pumps,
- Pantry loads such as bottle coolers, water boiler, refrigerators
- Other equipment such as battery charger for emergency light etc.

These loads are collectively described as Hotel Load.

- In WAP 5 and modified WAP 7 locos hotel load facility provided to give power supply to coaches.
- Two separate hotel load windings of 622.5 KVA each, at nominal voltage of 960 V 1Ø, kept parallel to main transformer winding.
- This 960 V 1Ø supply is fed to the Hotel load converter, which gives 750 V, 3Ø, 50 Hz supply as output, for feeding the hotel load of the train.
- Nowadays most of the trains hotel load supply is given from above locos.
- Two converters are provided in machine room 1& 2.
- Both side in front of cab two hotel load couplers and two UIC sockets are provided.
- While checking ensure covers for these.
- MCB 129.1 provided in SB2 cubicle.



- In Panel A spring loaded switch BLHO provided.
- In Panel A signalling lamp 'LSHO' is provided.

DUTIES OF CREW:

- Before coupling hotel load couplers Power car manning staff (C&W) will give memo to LP to lower pantograph.
- After receiving memo build up max. pressure by pressing BLCP.
- Open VCB and lower panto.
- Trip Hotel load MCB 129.1.
- The Hotel load couplers shall be coupled by power car manning staff, only after ensuring that both pantos are lowered condition.
- After coupling LP shall be informed by power car manning staff that couplers have been fixed and locked and Hotel load can be switched "ON".

(In case of any trouble in coupling, the train shall work with power car without trying further.)

- Loco Pilot shall switch on MCB 129.1.
- Raise the panto, close VCB and switch ON BLHO switch and ensure that LSHO lamp is glowing.

ON RUN:

In case of loco /OHE failure,

- LP shall inform to Guard, in turn Guard shall inform to power car manning staff.
- Then they switch over to DG set.
- LP shall inform TLC at suitable place.
- AT N/S no need to open BLHO. (Hotel Load Converter will get switch off automatically due to tripping of VCB)

HOG can not be switched 'ON' in the following condition

- MR pressure below 6.4 kg/cm². If LP tried to switch ON HOG, a fault "F10 02P1" message will be displayed even MPJ on "0".
- Transformer oil Pressure not OK (F01 02 P2)
- STB1 fails -HOG cannot be switched on from both cabs.
- STB2 fails -HOG cannot be switched on from cab2.

At Destination:

- Before dis-connecting the Hotel load couplers LP/Shunter shall switch OFF the BLHO, Trip 129.1 MCB.
- Open VCB & lower panto.
- Power car manning staff shall disconnect the Hotel load couplers from Locomotive.
- LP/Shunter to ensure that Hotel load couplers are disconnected before raising Panto & detaching the locomotive.

HOTEL LOAD FAULTS:

F 05 03 P1

- Earth Fault In Hotel Load Circuit. Hotel load will be isolated
- LSDJ & BPFA will glow, LSF1 will start blinking

F 05 04 P1

- Over current in Hotel load circuit. Try to close the VCB again
- LSDJ & BPFA will glow, LSF1 will start blinking
- Acknowledge fault by pressing BPFA. Press BLDJ to close VCB.
- Hotel Load is isolated

F 05 01 P2

- Hotel Load Contactor Stuck OFF, Hotel load not available.
- BPFA will glow. Acknowledge fault by pressing BPFA.

F 05 02 P2

- Hotel Load Contactor Stuck ON, For un/coupling hotel load trip VCB
- BPFA will glow. Acknowledge fault by pressing BPFA.
In case of any above fault encountered on run, isolate Hotel load and inform to Guard.
- Make a remark in loco log book.
- Inform to TLC.

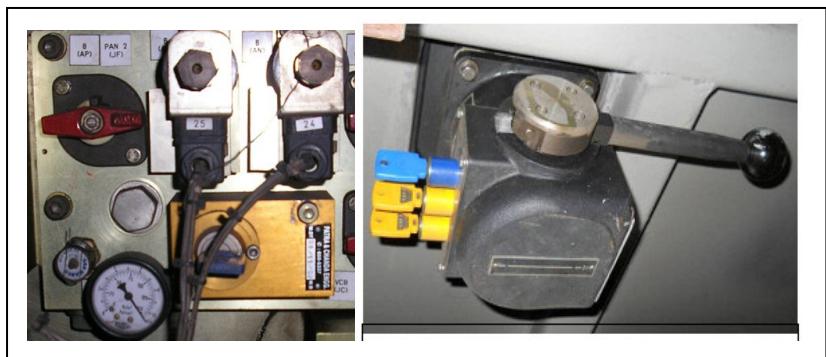
Active functions with deactivated Loco pilot's cab:

While the cab deactivated, the following functions remain operative.

1. MEMOTEL (SPM) functions
2. U Meter
3. RS on ALP side
4. Cab and desk lighting
5. Windshield wipers
6. Fault display screen
7. Cab venting and heating
8. Crew fans
9. Hand lamp socket.
10. GAUGES.
11. Marker lights switches.

Grounding

procedure: For LP it is required to ground the loco to climb on loco roof only.



1. Stop the train at convenient place and secure the train.
2. Open VCB and lower pantograph.
3. Switch OFF CE as per procedure. Put OFF MCB 112.1.
4. Rotate IG-38 in anti clockwise direction and extract the key.
5. Insert the key in empty socket of HOM box and rotate in clock wise direction.
6. Operate HOM handle by 180 degrees by taking it out from latch.
7. Rotate yellow KABA key in clock wise direction and extract the key and keep in personal custody.
8. Loco roof to be attended only after power block taken by TRD staff and OHE is grounded both side of loco.

Protective measures by control electronics:

Initiation of protective measure in dangerous situation are controlled by Control Electronics. MCE monitors a range of values such as voltage, current, temperature, pressure and other signals.

- 1. Catenary voltage out of range:** When catenary voltage drops down below 17.5 KV and raise above 30.5 KV VCB will open automatically.
- 2. Temperature protection:** When temp of Transformer exceeds beyond 84 degree C, for more than 10 sec, VCB will trip.
- 3. Primary Over Current Protection (QLM):** Reason for over current.
 1. Disturbance in measurement of primary current.
 2. Fault in converter.
 3. Short circuit in transformer winding
 4. Insufficient cooling of transformer oil due to pump/blower failed.

Fire Detecting Unit

- Fire detection unit is provided in SB2.
- There are two smoke detectors provided to detect the smoke in machine room.
- Each machine room is equipped with one detector.

When one detector detects the smoke –

- Buzzer will sound
- Priority-2 message will appear on screen.

When both detectors detect the smoke

- Priority-1 message will appear on the screen.
- Tractive/Braking effort becomes '0'
Buzzer will sound.

Action to be taken by Crew:

- Inspect Machine room. Found smoke or fire, use small fire extinguisher.



THREE PHASE LOCO MATERIAL

- ⊕ It is big fire, use big fire extinguisher provided in cab ALP side (back cubicle)
- ⊕ To operate big F/E, open the cock and release the gas by rotating adjusting knob, gas will expel and extinguish the fire at appropriate places in machine room.
- ⊕ After extinguishing of fire, reset the FDU by pressing the white knob provided on it.
- ⊕ To acknowledge the fault press BPFA. Resume normal traction.

Note:- In case of defect in FDU, P-2 fault message will appear on the screen. After inspecting the machine room, reset the white knob on the FDU. Acknowledge the fault and keep watch on machine room. Inform to TLC and make a remark.

If 127.91/2 tripped FDU will not work(Cab-2 pilot lamps also will not work)

Alarm Chain Pulling:

- ⊕ When airflow increases without initiation of Loco pilot or CE i.e. in case of ACP/Guards brake applied/RS applied/ heavy leakage in train etc.

Following indications appear.

- ⊕ Air Flow Indicator needle will deviate.
- ⊕ LSAF will glow.
- ⊕ Buzzer will sound.
- ⊕ BPFA will illuminate with F 10 02 P2 message.
- ⊕ Auto flasher light will start flashing.

To reset,

Attend the ACP.

- ⊕ To ack fault message press BPFA.

FAULT DIAGNOSIS

MODIFIED DISPLAYS:



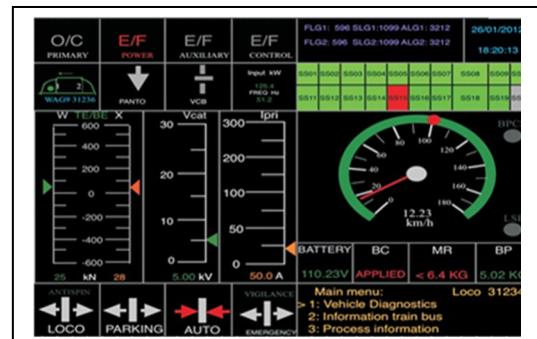
Advanced Rail Controls-II Display

O/C PRIMARY – Over current primary, indication glow with F 01 08 P1 and relay OCR -78 (SB1) acts.

E/F POWER – Earth fault power circuit, indication glow with F 02 01 P2 or F 03 01 P2.

E/F AUXILIARY – Earth fault auxiliary circuit, indication glow with F 01 03 P2.

E/F CONTROL – Earth fault in BA circuit, indication glow with F 09 05 P2.



BHEL MAKE DISPLAY

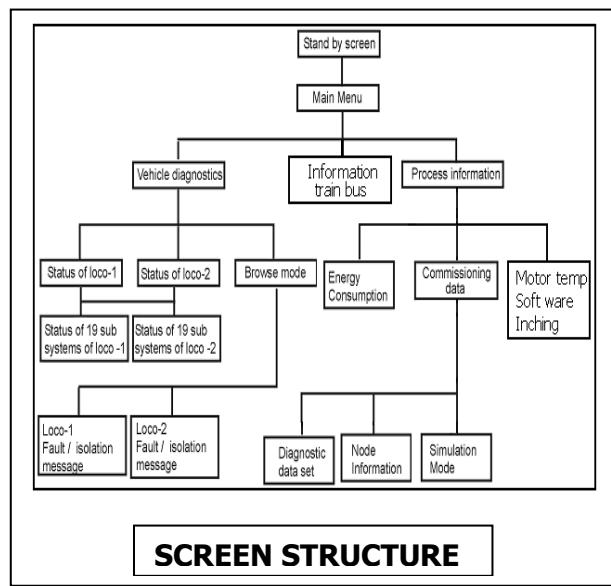
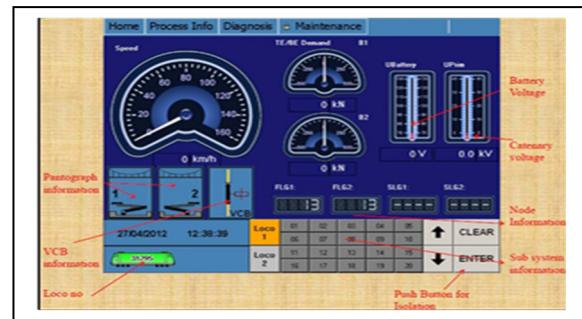
Loco status checking:

No fault: Loco pic displays in **Green** colour and all sub systems displays **Green** colour.

P2 fault: Loco photo displays in **Red** colour and faulty sub system displays **brown** colour.

P1 fault: Loco pic displays in **Red** colour and faulty sub system displays **red** colour.

SS isolation: Loco pic displays **Red** colour and isolated sub system displays **Black** colour.



Faults with Priority-1:

- ⊕ The action to be taken is entirely clear.
- ⊕ The action to be taken must be initiated immediately.

- ⊕ A protective action is initiated (VCB opens or pantograph lowers or TE/BE comes to '0' or BP drops or all the above).
- ⊕ BPFA will glow
- ⊕ LSFI will flicker.
- ⊕ Priority 1 message will display on the screen.

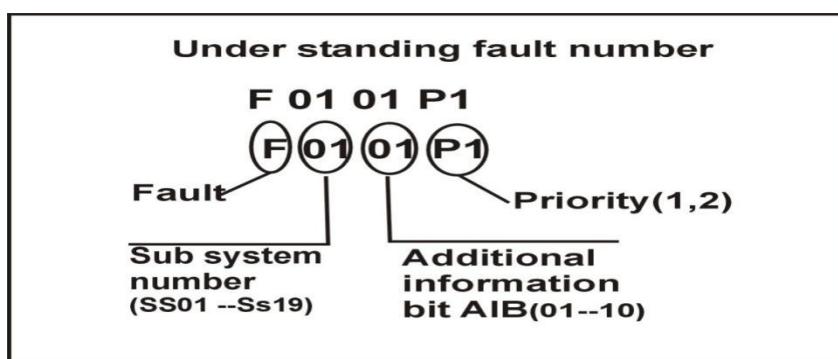
If any subsystem is isolated LSFI lamp glows continuously.

Faults with Priority-2:

- ⊕ The action to be taken is not entirely clear.
- ⊕ The action to be taken does not initiate immediately.
- ⊕ The faults can be remedied manually by Loco pilot.
- ⊕ BPFA only will glow.
- ⊕ Priority 2 message will appear on screen.

Note:

- ⊕ A fault message with priority-2 remains on the screen until it is overwritten by a fault message with priority-1 or by subsequent fault with priority-2.
- ⊕ Before acknowledging fault message note down the fault number with time of occurrence.



- ⊕ Note down the fault number and press BPFA.
- ⊕ The illuminated lamps will extinguish and message disappears.
- ⊕ According to message action to be taken.

STATUS CODE

FIRST DIGIT

0- No sub system isolated
9- at least one sub system isolated

SECOND DIGIT

0- no fault WITH priority -1 OR 2
1- at least one Priority-1 fault
2- at least one Priority-2 fault

0 0 No fault and no sub system isolated

0 1 No sub system isolated, at least one Priority-1 fault

0 2 No sub system isolated , at least one Priority-2 fault

9 0 At least one sub system isolated , no fault

9 1 At least one sub system isolated , at least one Priority-1 fault

9 2 At least one sub system isolated , at least one Priority-2 fault

List of Subsystems

Subsystems	Equipment & controlling
SS01 Main power-	Panto, P.T, VCB, Transformer & CEL
SS02 Traction Bogie 1	SR1, TM 1, 2 & 3.
SS03 Traction Bogie 2	SR2, TM 4, 5 & 6
SS04 Harmonic filter	8.1, 8.2 & Harmonic
SS05 Hotel load	Hotel Contactor
SS06 Aux Converter 1	BUR-1
SS07 Aux Converter 2	BUR-2
SS08 Aux Converter 3	BUR-3
SS09 Battery System	BA
SS10 Brake System	MR, BP, Loco Brakes
SS11 AUXILIARIES HB1	MCBS IN HB-1 PANEL, 160 & 237.1
SS12 AUXILIARIES HB2	MCBS IN HB-2 PANEL
SS13 CAB 1	STB1, HBB1 & REVERSER
SS14 CAB 2	STB2, HBB2 & REVERSER
SS15 FIRE DETECTION	FDU
SS16 SPEEDOMETER	SPM & EXCESS SPEED
SS17 PROCESSOR FLG1	CAB-1 ANGLE TRANSMITTER AND BOGIE METERS, LOCO CONTROL & MU OPERATION
SS18 PROCESSOR FLG2	CAB-2 ANGLE TRANSMITTER, BOGIE METERS & R.B
SS19 TRAIN BUS	MU OPERATION

OPERATING INSTRUCTIONS FOR FIXED 22.5 KG CO2 F/ES

- Stop the train, open VCB, lower panto and secure the train.
- Rotate the valve of fixed F/E after ensuring both the corridor doors are closed and nobody is inside the machine room.
- Check the operating pressure by observing the needle in the gauge provided
- Now, remove the latch (lock) (if provided) and open the cut out cock.
- CO2 gas will enter and spreads in the machine room.
- If the fire is not controlled with one fixed F/E, use the other in the same way.
- If the fire is uncontrollable, give information to TLC/ section controller/DY SS to arrange fire brigade and observe G & SR.



QUICK EXAMINATION DURING SHORT STOPPAGE

- Drain out moisture from MR and AR reservoirs.
- Check the temperature of axle boxes.
- Check the condition of helical springs, dampers, guide rods, traction links with safety slings, torque arm bolts, sand pipes, brake rigging, speedometer gear case fittings.
- Check for any oil leakage from TFP tank, gear cases and condition of air bellows for any leakage.
- Check the proper working of MCPs, its bed bolts and safety slings are intact.
- Condition of battery boxes covers.
- Check the cattle guards, rail guards & buffers for any abnormality.
- Ensure front coupling is secured in the hook and rear CBC coupling is tight and safety pin is intact.
- In case of exp./pass. Trains ensure U clamp is intact in case of T/S coupling.

STABLING OF LOCO:

Before moving the loco ensure that stabling line is provided with OHE and in case of hand brake provided locos ensure hand brake is in working condition.

- Bring throttle to '0' and Stop the loco.
- Apply SA9 and ensure BC gauge is showing 3.5 Kg/cm².
- Keep reverser on '0'.
- Place four wooden wedges.
- Apply hand brake in WAP7 & WAG9 (if PB not available).
- Open VCB and lower the pantograph.
- Remove A9 handle in E-70 locos & switch off CE as per procedure.
- (in Knorr CCB2.0 locos keep A9 in 'FS' and lock it.)
- Switch off cab lights & corridor lights if glowing.
- Switch off the MCB 112.1 in SB2 panel.
- Close the doors and shutters on both sides.
- Hand over BL key & A9 handle and log book to authorized person.
- **Enter in 'stable load register' at DY/SS.**

Hauling 3-Phase loco as a dead loco.

3Ø locos in dead condition can be hauled both by conventional and 3Ø locos.

Making loco dead and precautions to be taken:

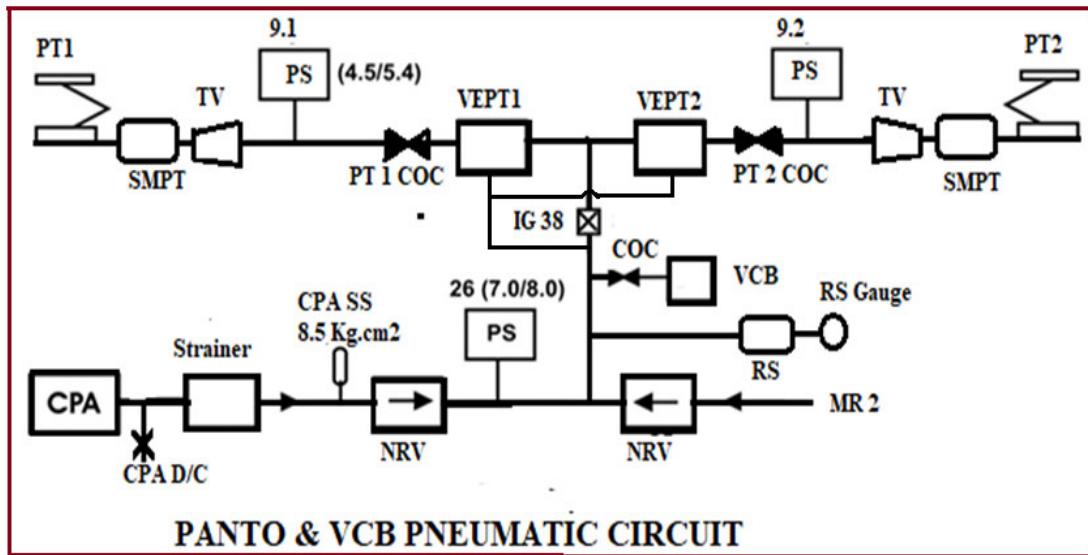
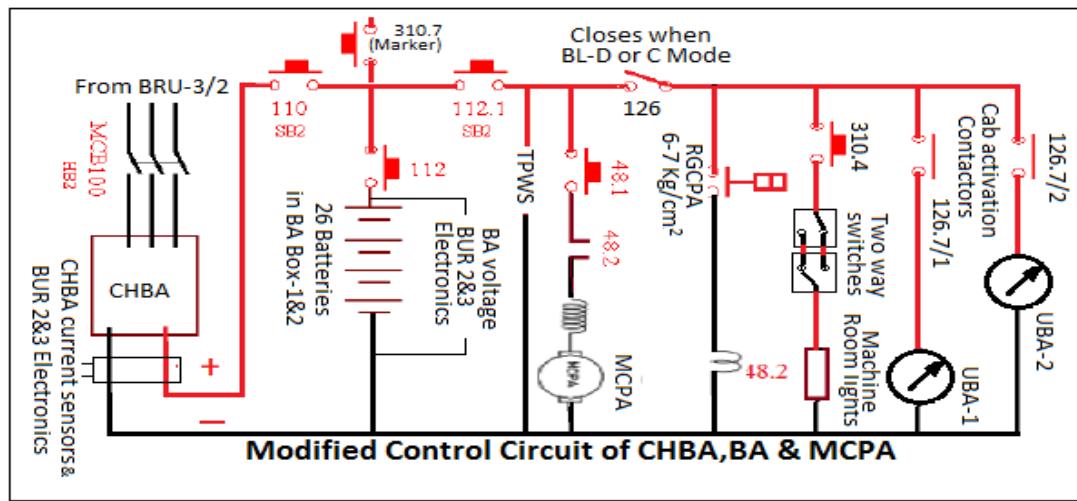
- Stop the loco and apply SA9.
- Open VCB and lower pantograph.

- Keep A9 in '**Neutral**' position and extract the handle and keep in safe custody in case of E70 locos. (In CCB2.0 locos keep A9 handle in 'FS' and lock it. Keep Mode switch in 'TRL')
 - Switch off the control electronics.
 - Switch off MCB 112.1 in SB2 panel.
 - Couple the dead loco with live conventional or 3Ø loco.
 - Release SA9 and ensure rear cab SA9 also released condition in dead loco.
 - Drain out the MR and AR pressures.
 - In Pn.Panel close 70,74 and 136 COC and open 47 COC. (In CCB2.0 locos 70 cock is not provided)
 - Connect both BP and FP hose pipes and open both side angle COCs.
 - The aux. reservoir on dead locomotive will be charged from BP pressure of working loco.
 - If parking brakes are provided apply and lock with SV30/23 plunger.
 - Release PB manually. (This procedure is safe to avoid brake binding and condensation of moisture in the parking brake cylinder)
 - Apply A9 in the working locomotive and check that loco brakes on both the locomotives are getting applied. (In E70 locos max. loco BC pressure during proportional braking is 2.5 kg/cm² and in CCB2.0 loco in dead condition max. BC pressure is 3.8 Kg/cm²)
 - Release A9 in the working loco and check that loco brakes are released on both the locomotives. In dead loco it takes about 1 minute to release.
-
- *As a final check, run the coupled locos for about 500 meters and feel for any abnormal rise in temperature of wheels of dead loco and also check same at subsequent stop during journey.*

Detaching dead loco:

- After reaching the destination, before detaching the working loco, In dead loco;
- Unlock the application plunger of PBSV. 30/23.(If applied)
- Press the release button of PBSV 30/22. This will charge parking brake accelerator with 5 kg/cm².
- Again apply parking brakes on dead locomotive with application plunger of PBSV 30/23. Then detach the dead loco.
■ **If parking brakes not available, apply hand brake then detach the dead loco.**

PNEUMATIC SYSTEM



PR pressure building up:

- ✚ As soon as BL is turned to either 'D' or 'C' mode Contactor 126 closes and feed DC supply to all control circuits.
- ✚ If Panto Reservoir pressure less than 7 Kg/cm², 48.2 contactor closes and its interlock closes in the MCPA circuit.
- ✚ MCPA starts functioning provided MCB 48.1 on 'ON' condition and stops as soon as pressure reaches to 8 Kg/cm².
- ✚ The auxiliary pressure goes to volume Reservoir (RS) via air strainer and NRV 24 and will be blocked at NRV 25 connected to MR2 pipe line.
- ✚ The auxiliary pressure further goes to VCB unit and both the PT EP valves as pilot pressure.
- ✚ When LP operated ZPT to 'UP' (Down position) contactor 130.1 closes and rear PT EP valve energises, provided PSS at 'AUTO' and both PT cocks are 'OPEN', and allows RS pressure to rear SMPT and rear panto raises.

- ⊕ There are two pressure switches of pantographs 130.4/1 (in E-70 locos PS 9.1/In CCB2.0 locos PAN1-PS)) is for monitoring the air pressure for pantograph 1. Similarly 130.4/2 (in E-70 locos PS 9.2/In CCB2.0 locos PAN2-PS) is for pantograph 2. (raising 5.4 Kg/cm² & Lowering 4.5 Kg/cm²)
- ⊕ Throttle valve is provided for gradual raising and lowering of pantograph.
- ⊕ Cut in and cut out of MCPA depends on pressure switch setting, i.e. PS-26 in E-70 locos/PANS-PS in CCB2.0 locos (172.4) and pressure switch No.9 feeds back to loco software if pick up pressure is reached.
- ⊕ NRV 25 will not allow RS pressure to MR circuit. It allows only MR 2 pressure to DJ & both pantos after VCB is closed and MR pressure build up.

In CCB2.0 locos

- ⊕ Panto 1&2 isolation cocks are provided before EP valves.
- ⊕ PR gauge connected after IG-38 key.
- ⊕ IG 38key normal position is 'vertical'.
- ⊕ SS1 blows at 8.7 Kg/cm².
- ⊕ Pans PS (172.4) setting is 7.0 to 8.0 Kg/cm²
- ⊕ To monitor panto pressure 'PAN1&2 PS' are provided.
- ⊕ ULV connected to RS circuit also.
- ⊕ One more safety valve connected to RS circuit and blows at 10.7 Kg/cm²

MR pressure- Description

- ⊕ There are two main compressors provided and mounted under slung loco body.
- ⊕ These are three stage reciprocating compressors.
- ⊕ MCBs are 47.1/1 and 47.1/2 provided in HB1 and HB2 respectively.
- ⊕ MCPs are getting supply from AC3. In case of AC3 failed AC2 supply will be given automatically.
- ⊕ There is a CP independent safety valve in each of the compressor legs to protect the system in the event of a check valve blockage and there is an unloader valve also in each leg.
- ⊕ The unloader is operated from an electro-pneumatic valve EP26(E-70 loco) mounted on the brake frame.
- ⊕ This auto drain valve is operated from the same signal line that operates the unloader valves.
- ⊕ Two 450 liters capacity Main Reservoirs vertically mounted in machine rooms. One AR 240 liters also provided in machine room.(In WAP5 three main reservoirs are provided)

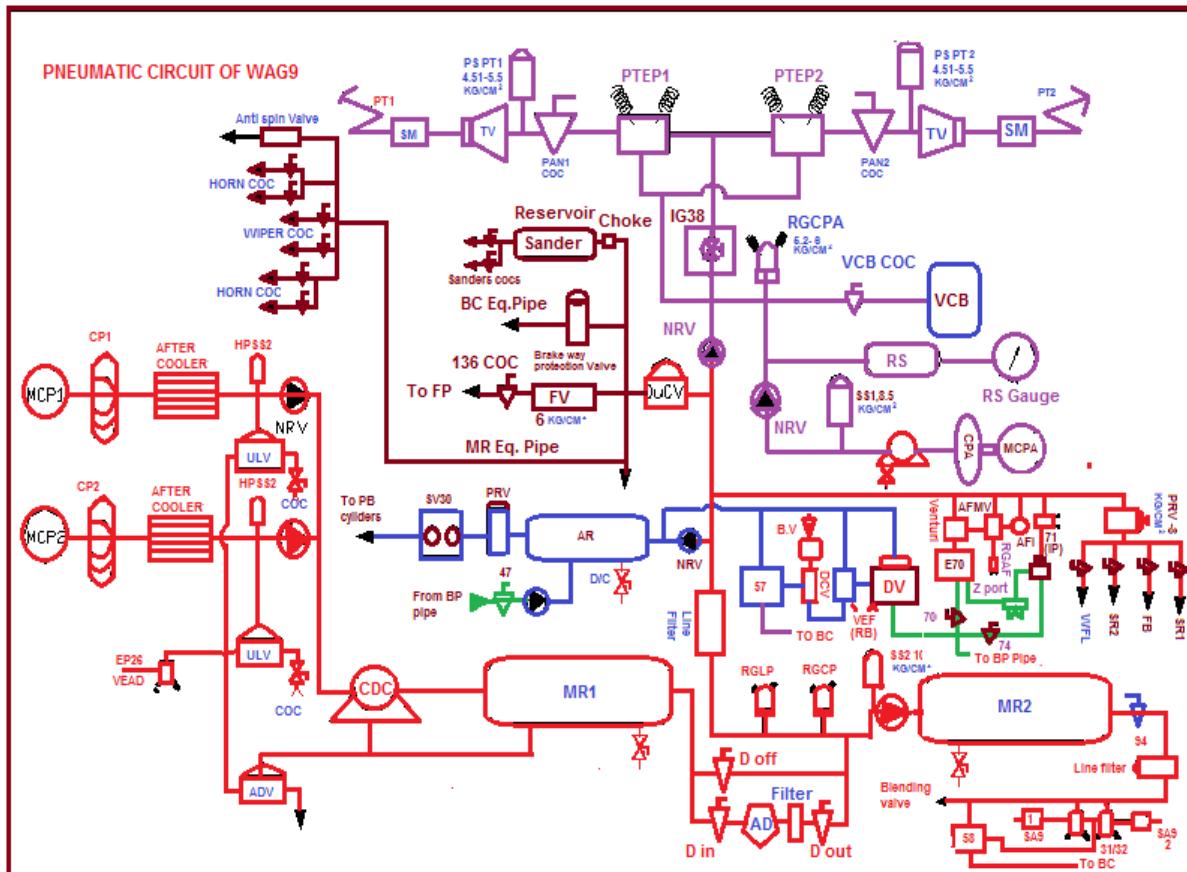
 Ha
 ving
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fitted with a manual drain cock and an auto drain valve .

- ✚ Twin tower air dryer is provided between two MRs.
- ✚ MR Safety valve is provided at MR1 and blows when MR pressure reaches 10.5 kg/cm²
- ✚ Two compressor governors are provided near AR.
- ✚ PS 36(172.3) being for operation of both compressors between 8 kg/cm² and 10 kg/cm².
- ✚ The low main reservoir PS37 (269.4) is also in this part of the circuit and is used to interlock with traction in the event of the main reservoir pressure falling below its set point. (5.6 Kg/cm²)

E-70 Loco Pn. circuit:



MR 1 Pressure usage :

- MR equalising pipe
- Horns
- Wipers
- Sanders
- BP Charging
- Air flow meter
- Feed pipe
- SA9 control pressure
- Auxiliary reservoir
- Parking brakes
- VCB and both pantos and RS.
- SA9 pilot pressure.
- BC equalizing

MR2 pressure utilisation:

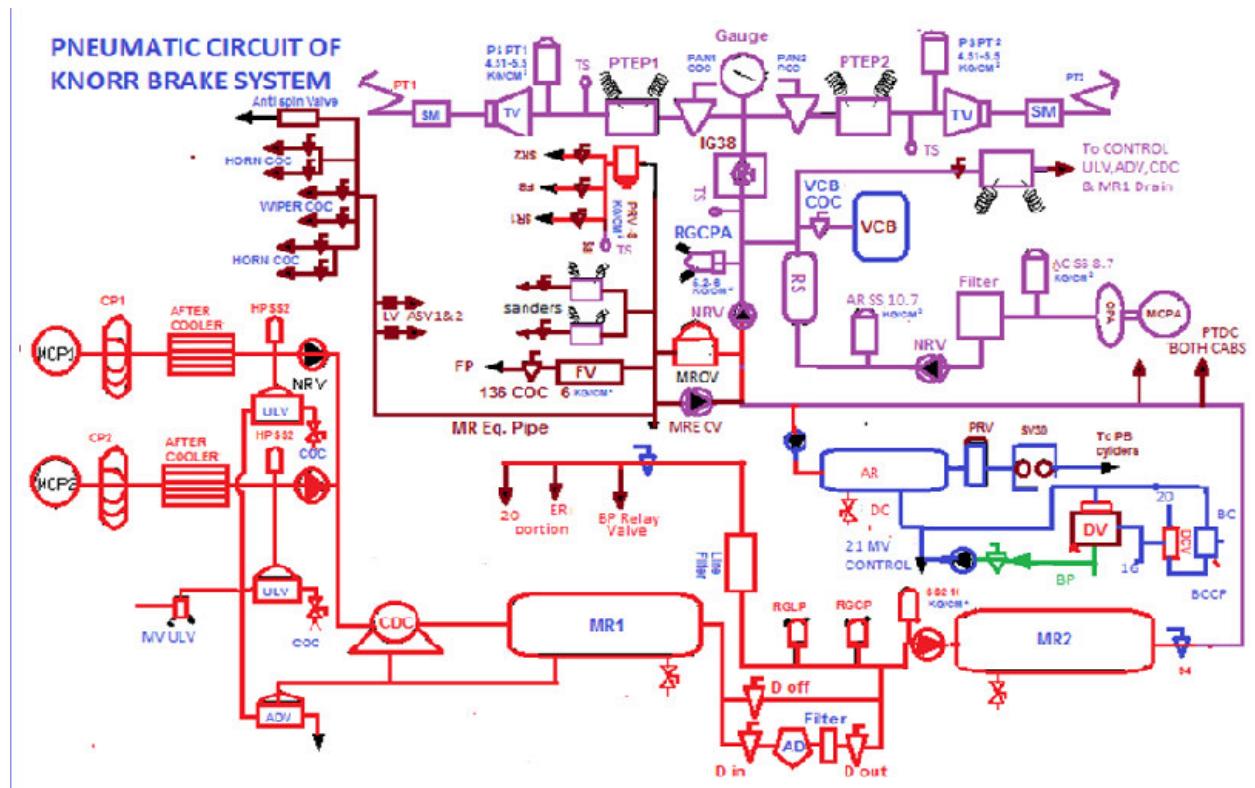
- Blending circuit
- SA9 circuit .

AUX RESERVOIR pressure:

- ⊕ This tank is charged by the air of MR-1 Tank. This tank is a buffer for auto brake circuit (C3W brakes).
- ⊕ AR pressure is used for releasing parking brakes also.
- ⊕ In dead movement, this tank is charged by the BP pressure of lead loco via cock 47 and check valve 48 (located on C3W manifold).
- ⊕ In dead loco, AR pressure is used for conjunction braking and PB releasing also.

In CCB2.0 Locos MR2 feed all equipment (Pressure from MR1 goes to MR2 and as pilot pressure for brake relay valve)

CCB2.0 Loco, Pn circuit:



Brake System:

There are 5 types of brakes available on this loco.

1. Automatic Train Brake (Pn)
2. Direct Brake (Pn)
3. Parking Brake (Spring Loaded)
4. Anti Spin Brake.(Pn) (Not in service)
5. Regeneration Brakes.(Elect)

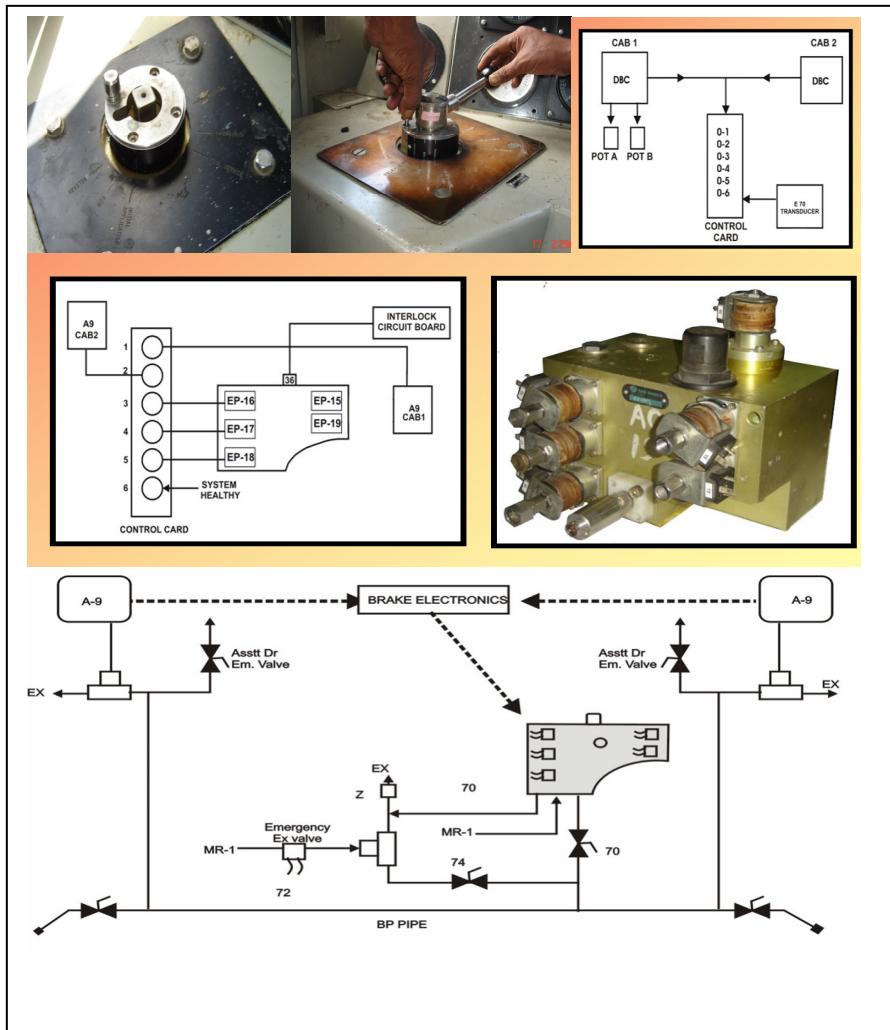
Note: All the brake system functions are monitored by brake electronics and if there is any wrong configuration, the brake electronics do protective action along with P-1 message on screen. One circuit breaker is also provided in SB-2 for this brake electronics. In case of failure of brake electronics, crew should check this MCB 127.7.

Supporting brakes:

ESPB (emergency stop push button), Blending valve & ALP Emergency.

Automatic Train Brake (A-9)- E70 Brake system:

- ⊕ A9 handle is removable.
- ⊕ One locking device also provided.
- ⊕ To take out move A9 handle to emergency then lift the locking device and rotate to 'Neutral' and remove.
- ⊕ Two potential meters are provided in A9 unit.
- ⊕ By operation of A9 handle at desired position, it gives different voltage by potential meter to control card of brake electronics for application and releasing of brakes by dropping and charging of brake pipe.



- ⊕ One air connection is connected to emergency exhaust valve and vents on emergency application by A9.
- ⊕ Both potential meters are operated at a time, but if one fails then A9 will initiate full brakes as a emergency to avoid line failure.
- ⊕ This valve has following 6 positions.

Handle position Pressure (kg/cm²)

➤ Release	: 5.4 ± 0.05
➤ Running	: 5 ± 0.05
➤ Initial Application	: 4.60 ± 0.05 Variable
➤ Full Service	: 3.35 ± 0.10
➤ Emergency	: 0
➤ Neutral	: 0

Note:

- The handle of A-9 can be removed and inserted in neutral position and can be locked by locking device.
- If the electronic brake control system fails, a priority-1 message (F10 01 P1) display on the screen and an emergency brake is triggered.

E-70, LOCO Brake cylinder gets supply from following:

1. From SA-9 through 58 D2 relay valve (3.5 kg/cm^2)
2. During proportional braking, through 57 D2 relay valve (Max. 2.5 kg/cm^2)
3. From Anti spin device (Wheel slip) (0.6 kg/cm^2 to 1.0 kg/cm^2) – Not in service
4. From blending valve (DBR cut off) : in proportion to RB.

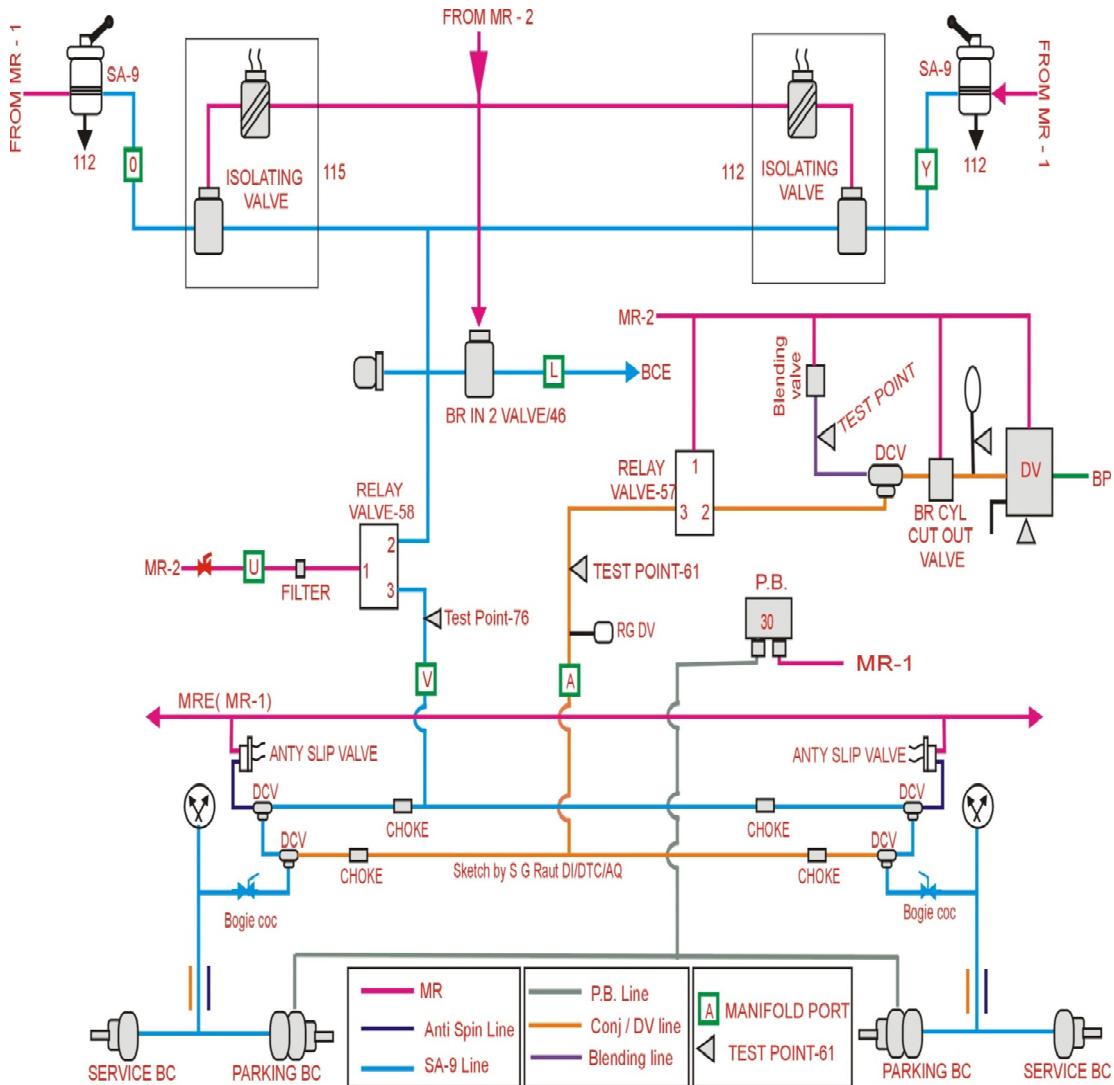
To separate these different pressure paths different DCVs are provided in the path.

Brakes through Blending Valve:

- If train is running in regenerative (DBR) mode and suddenly regenerative braking gets cut off due to internal fault or VCB tripping, to compensate regenerative braking, blending valve sends the MR pressure in the brake cylinder in proportion.
- This pressure activates the relay valve (57), further this relay valve allows MR pressure into BC (See figure of loco brake system).
- If RB is more than 90% at the time of RB cut OFF , max 2.5 Kg/cm^2 pressure enters in loco brakes in E70 & CCB2.0 locos.
- In CCB2.0 locos if BC pressure exceeds 2.25 Kg/cm^2 train brakes also applies.
- To avoid loco wheel skidding press PVEF.

Proportional loco brakes: Whenever BP pressure drops below its pre-determined value (i.e. 5 kg/cm^2), distributor valve gets activated and allows MR pressure to activate relay valve (57), further this relay valve allows MR pressure to rush in brake cylinder (2.5 kg/cm^2). When BP restores, DV gets balanced and releases the loco brakes accordingly.

LOCO BRAKES CIRCUIT IN E-70:



Emergency Braking Operation

Emergency brakes will apply through brake electronics when:

1. Response from the Vigilance module
2. Permitted maximum speed being exceeded (10% MORE)
3. Moving of the automatic train brake handle to position EMERGENCY
4. Actuation of the emergency brake Cock on ALP side
5. Actuation of the emergency stop push button on the panel A
6. Failure of the electronic brake control system.

Note:

- The emergency stop button is only active in the activated Loco pilot's cab.
- Emergency braking is actuated directly in all cases and is not controlled by the MCE.
- However, the MCE responds to emergency braking by reducing tractive effort to 0.
- If an emergency braking operation is triggered in multiple operation, it is transferred to the slave locomotive also.

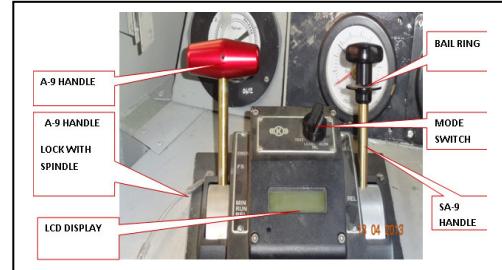
KNORR'S CCB-2.0 BRAKE SYSTEM ON 3-PHASE LOCO

Some of 3-phase Locos provided with KNORR CCB-2.0 brake system, with minor modifications in equipment and working system with existing knorr-brake system.
#Existing knorr brake(1.5) system is removed in all locos.

Equipment provided in CAB:

Auto brake (A-9):

- A9 is not removable.
- Automatic train brake handle can be locked or unlocked in FS (full service) position by a locking spindle provided in both cabs.
- Non driving cab auto train brake handle is to be kept in FS and locked condition where as in working cab to be kept in run position.
- While clearing loco as dead both cab handles are to be kept on FS and locked condition.
- This handle has 5 positions.
- **REL (release):** in this position BP pressure is over charged to 5.5 kg/cm² for preset time, for quick charging of BP.
- **RUN:** this is the normal position on which BP is charged to 5.0 kg/cm². In this position BP is overcharged by 0.2 kg/cm² for preset time.
- **Minimum reduction:** BP pressure drops to 4.5 kg/cm².
- **FS (full service):** BP pressure drops to 3.0 kg/cm². The handle can be locked or unlocked in this position.
- **Emergency:** BP drops to 0 kg/cm² on this position.



Direct brake (SA-9) : It has two positions, apply and release. One spring loaded clip called "bail off ring" is provided below the handle for quick release of proportional brake in loco.

MODE SWITCH: One rotating switch called mode switch is provided in each cab on EBV. To operate this switch just press downward and rotate to required position. This switch has following 4 positions.

- **HLPR:** While working as banker this switch to be kept on 'HLPR'.
- **TRL (TRAIL):** In non working cab (SU/MU), this switch should be kept on 'TRL' position.
- **LEAD:** In working cab (SU / MU), this switch should be kept on 'LEAD' position, then only BP will charge.
- **TEST:** In this position BP leakage / brake continuity tests to be conducted. When this switch is kept on 'TEST' position , Loco brakes also get applied.

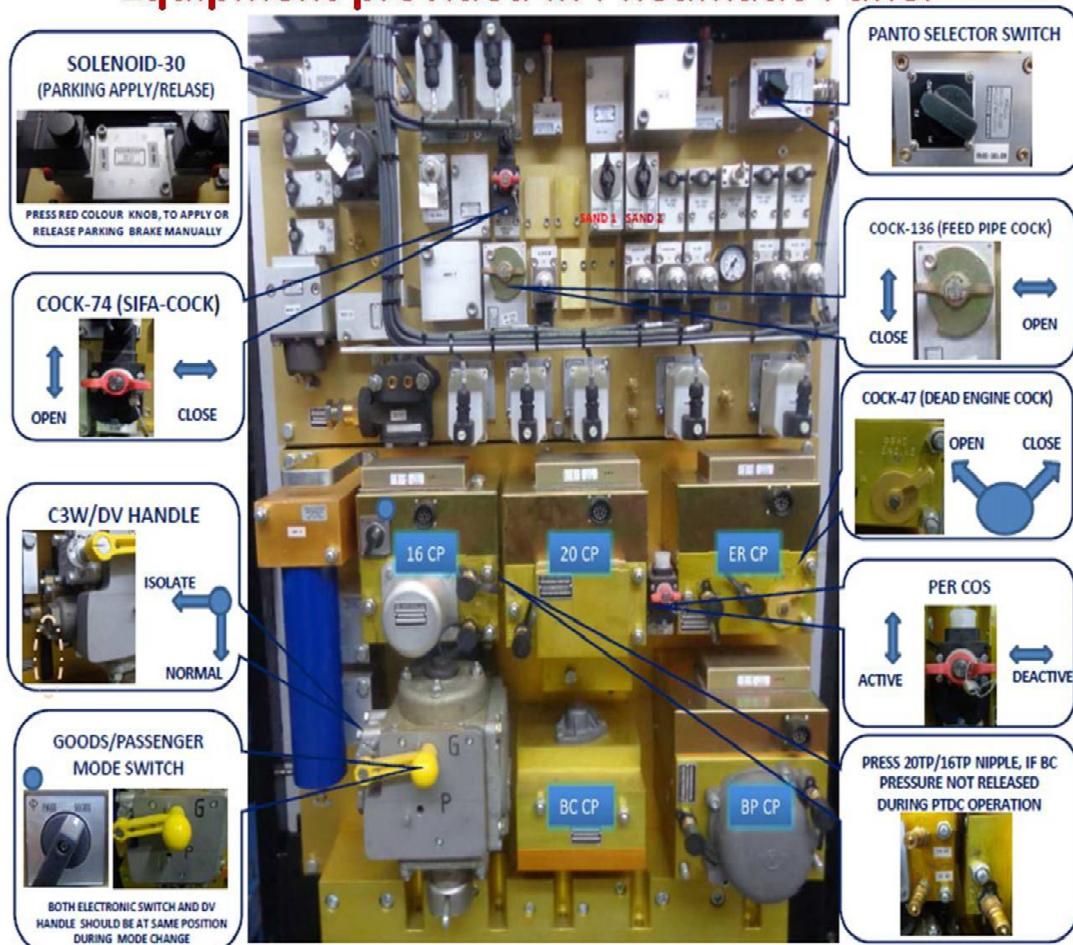
NOTE: Before operating 'Mode' switch keep A9 in "FS".

LCD DISPLAY : On EBV small LCD display provided. It will show messages like

1. **"Okay to Run"**: Till this message comes A9 to be kept on FULL service. Afterwards to be kept on 'RUN' and BP charges to 5 kg/cm².
2. **"Safety Penalty-Keep Handle in FS"** :To recover this penalty brake, move A9 handle to **FS** and keep 10 sec and then 'OK to RUN' message comes then only A9 to be bring back to RUN.
3. **"Train-line Emergency-Keep Handle in EMER"** : To recover Emergency penalty, A9 handle should be moved to Emergency and keep 10 sec and then OK to RUN message comes then only A9 to be bring back to RUN.

PARTS IN PNEUMATIC PANEL :

Equipment provided in Pneumatic Panel



1. **SOLONOID VALVE FOR PARKING BRAKE:** Same as E70 (Self latch)
2. **COCK NO 74 :** working position open (vertical) , while moving dead loco - Close (horizontal).
3. **C3W/DV HANDLE:** Normal position vertical, Isolation Position horizontal.
4. **PANTO SELECTOR SWITCH:** with 3 positions AUTO, I, II positions.

5. COC-136 (FEED PIPE COC): Normal position open (horizontal), while moving dead loco close (vertical).
6. COC- 47 :(Dead engine cock) Normal 45^0 , provided on ERCP. While moving this loco as dead rotate to 135^0 i.e. open position.
7. PER-COS: Normal position horizontal, while moving loco in PTDC mode rotate to vertical. Provided between ERCP and 20CP.
8. 20TP & 16 TP POINTS: If loco brakes not releases, remove the safety caps, press and release these test points.
9. SANDER 1&2 COCs: Normal position working (vertical), sanders to be isolated keep in horizontal position.
10. UNLOADER-COC: Normal position open (horizontal) , in case of PR pressure is not building up close this COC (to vertical) and try.
11. VCB COC: Normal position open (horizontal) for closing of VCB , for VCB isolation close (vertical).
12. IG-38 key : Normal position open (vertical) for raising of pantos , for grounding keep it in horizontal.
13. PAN-1 COC: Normal position open (horizontal), in case of panto-1 isolation close this COC (vertical).
14. PAN-2 COC: Normal position open (horizontal), in case of panto-2 isolation close this COC (vertical).
15. SR-1, SR-2 COCs: Normal position open, for closing electro pneumatic contactor of SR-1 & SR-2 (in GTO locos). In IGBT locos these are closed.
16. FB COC: Normal position is horizontal(open), for closing electro pneumatic contactor of harmonic filter.

NOTE: 70 COC is not provided.

AUTO/A9 OPERATION:

- To charge the BP, energize the Loco as normal 3 phase loco, Keep Auto/A9 handle in FS, wait to see the message on LCD display of EBV as "Okay to Run". Move the Auto handle to RUN from FS position, BP will charge to 5 kg/cm^2 and BC will reduce to zero.
- To overcharge the BP to 5.50 Kg/cm^2 , Keep Auto/A9 handle in REL (Release) position for 3 seconds. Once BP starts overcharging, leave Auto/A9 handle. BP will charge to $5.50 +/- 0.1 \text{ Kg/cm}^2$.
- Quick release of proportional brake in loco either can be performed by lifting Bail-ring provided on Direct Brake/SA9 handle or by pressing PVEF Foot Switch.

RECOVERY OF PENALTY SERVICE BRAKE:

Penalty service brake would result into dropping of BP to 3 Kg/cm^2 & crew message will appear as "**Safety Penalty – Keep Handle in FS**". To recover this penalty brake, move Auto/A9 handle to FS and then back to RUN (Follow message on LCD of Brake Controller). BP would charge to 5.0 Kg/cm^2 .

RECOVERY OF PENALTY EMERGENCY BRAKE:

Emergency penalty brake can also get applied by over speed relay or Emergency stop button and also at the time of connection of Load with Locomotive & crew message will appear as "**Train-line Emergency – Keep Handle in EMER**". To recover Emergency penalty, Auto/A9 handle should be moved to EMER and then back to FS and then to RUN. (Follow crew message on Display of Brake Controller). Then BP will charge to 5.0 Kg/cm².

RECOVERY OF VIGILANCE PENALTY BRAKE:

Vigilance penalty would result into **dropping BP to '0' kg/cm²** and application of full BC pressure & crew message will appear as "**Train-line Emergency – Keep Handle in EMER**".

To recover vigilance penalty, bring throttle handle (TE/BE) to '0', wait for 32 seconds. After that, move Auto/A9 handle to EMER and press BPVR on driver's desk. To charge "BP" move Auto/A9 handle to RUN. BP will charge to 5.0 Kg/cm². Acknowledge the fault by pressing BPFA. Resume normal operation.

PARKING BRAKES : Parking brakes can be applied or released in three ways as done in E70 brake system.

PTDC MODE (PN.TIME DEPENDENT CONTROL)

This feature has been provided in case of brake electrons failure in CCB 2.0 system.

- By keeping the brake system in PTDC mode, loco / train can move at a restricted speed of Max. 10 Km/h to clear the block section. (If any speed restriction is stencilled in cab, follow same)
- In both cabs PTDC handle is provided.
- It is having three positions; Neutral, Release and Apply.
- On Pn.Panel '**PERCOS**' (Pn. Equalising reservoir cut out switch) is provided.

PROCEDURE:

- After stopping the train keep throttle to '0'. Reverser on '0'.
- Open VCB and trip the MCB 127.7 (in SB 2).
- On Pn. panel rotate PER-COS from horizontal to vertical position.



- ⊕ Acknowledge the fault one time. (the message of “Brake electronics failed” will not come again)
- ⊕ Now close VCB as per procedure.
- ⊕ Keep PTDC on **RELEASE** position and ensure that BP is 5.0 kg/cm². After charging BP pressure keep PTDC handle on ‘**Neutral**’ position.
- ⊕ If BC pressure is not reducing to zero then give brief pulls to QRV provided at bottom of DV. Ensure BC reduces to zero. (Note: If Loco Brake remains applied, press 20 TP & 16TP on Pn. Panel)
- ⊕ Release parking brake by pressing illuminated BPPB (if provided) & take traction.
- ⊕ To apply brakes operate PTDC handle (give brief pulls) to **application** position . For releasing pull release side.
- ⊕ **Along with train brakes loco brakes also applies.**
- ⊕ Clear the block section with 10 KMPH (Through CE gets only 10 Km/h)
- ⊕ **@ While working in PTDC mode ensure rear cab PTDC handle is in neutral position for proper BP charging.**

IGBT based SRs and BURs Locomotives:

The Electrical equipment for loco consists of Two water cooled Traction Converters with 3 independent Motor Side inverters, (Medha, BHEL, Bombardier, ABB & CGL makes)

BUR-1 with 1*130 kVA inverter. BUR-2 with 2*130 kVA inverter and 11 kW battery charger & Two Vehicle control units.

Advantages of IGBT Locos:

- ⊕ In case of any problem in a TM, particular TM will be isolated automatically.
- ⊕ 3.40% reduction in weight and compact in size compared to GTO equipment will facilitate to install additional equipment like hotel load converter in the locomotive.
- ⊕ Power loss reduction by approx. 50% in comparison with GTO loco equipment. Water cooled system thus safer vis-à-vis oil cooled system.
- ⊕ Less harmonics because of high switching frequency.

NOTE:

- ⊕ SR1 and SR2 cut out cocks are in closed condition on pn.panel since converter contactors are Electromagnetic/ Motorized Contactors.
- ⊕ Can isolate one SR by using 154 as like in GTO based SR provided Locos but in case of any problem in TM, particular TM will be isolated by the system.
- ⊕ Due to space consistent the message for isolation of TM will be display in F04 & F05 subsystem fault messages.

Cooling system:

- ⊕ The water cooling system is a closed loop system with water /glycol mixture as a cooling medium in BHEL and ABB makes. In Bombardier make the coolant mixture is water and Antifrogen N .
- ⊕ The cooling system comprises a pump, heat-exchanger and a expansion tank.
- ⊕ The Cooling pump is located inside the SR in ABB and Bombardier makes.
- ⊕ Ensure 3 way COC in proper position if provided for SR.
- ⊕ The level of the water can be viewed from sight glasses on the side wall of the expansion tank, between min-max mark.
- ⊕ If water level decrease below Sensor level concern SR will isolate with fault message numbers as F0206P₁/ F0306P₁.

IGBT Based General Description of Auxiliary Converter:

- ⊕ Three-phase IGBT-based inverter, 130kVA, cos (ϕ)=0.8, 415V/50Hz.
- ⊕ The control Electronics supply is taken from the 110V DC battery.
- ⊕ The energy conservation feature through multi level ventilation/cooling is adopted.
- ⊕ The speed is controlled in three steps (17Hz, 33Hz and 50Hz) for the traction motor blowers, oil cooler blowers depending on the temperature of the traction motors / cooling oil sensed by the temperature sensors in traction motor stator winding and oil cooling circuit.
- ⊕ Aux Converter-3 operates at a fixed frequency of 50Hz. It enables soft starting of the compressor motors by varying the voltage and frequency from zero at start to full value.

Control Electronics:

- Controlled by TCN based network.
- The advancement in the processor speed which has paved the way for less number of PCB cards (only 3 major cards compared to 17 in MICAS) with better performance at the higher temperatures.
- Isolation of cab due to card failure will not take place.
- The card names and comparison between MICAS-S2 and TCN based network is given below.

EQUALISING PROCESSORS:

S.No.	MICAS	BHEL-TCN	MEDHA	BTIL-TCMS
1	FLG1	ICP1	MCC1	CCUO
2	FLG2	ICP2	MCC2	CCUO1
3	BUR 1/2/3	ACI 1/2/3	ACC 1/2/3	BUR 1/2/3
4	SLG 1/2	VIU 1/2	LIC 1/2	SPIF
5	NSC 1/2	DCU 1/4	LIC 3/4	DCUL
6	ASC1	DCU 2&3	TIC 1/2/3	DCUM
7	ASC 2	DCU 5&6	TIC 4/5/6	DCUM
8	STB1	RBU1	Not available	Not available

			Controlled by MCC1/2	Controlled by CCUO
9	STB2	RBU3	Not available Controlled by MCC1/2	Not available Controlled by CCUO
10	HBB1	RBU2	..do..	..do..
11	HBB2	RBU4	..do..	..do..
12	DDA 1/2	DDU ½	DMC 1/2	HMI 1/2

MCC: Main control card: Vehicle operation includes both cab controls

LIC: Line inverter computer control/ Line converter control: SR1/2

TIC: Traction Inverter computer control: TM 1-6

ACC: Auxiliary converter computer: Bur 1,2 &3

DMC: Data management computer for both cabs display units

CCUO: Central control cubical operation

SPIF: Standard propulsion Inter phase

DCUL (Line side) converter operation & interphase to VCU

In **C-DAC TCN;** FLG-1= FLG1+STB1; HBB1=HBB1+DDA1;

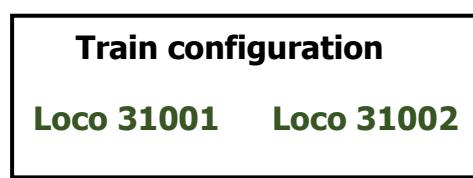
FLG-2= FLG2+STB2; HBB2=HBB2+DDA2;

3Ø LOCO-Multiple Unit Operation

Preparation and energisation:

- ⊕ Maximum two locomotives are permitted.
- ⊕ Generally MU locos formed in shed only.
- ⊕ Leading loco called as 'master locomotive' and the rear loco is called as 'slave locomotive'.
- ⊕ Couple both locomotives mechanically, pneumatically.
- ⊕ Both locomotive must be deactivated and connect the UIC cable.
- ⊕ Secure both locos by keeping wooden wedges.
- ⊕ Go to slave loco and switch ON CE. When FLG504 node information appears move the key from 'D' to 'OFF' and remove the key in self hold mode.
- ⊕ Now come to master loco and switch ON CE as per procedure within 10 min.
- ⊕ The control electronics starts to configure the train bus.
- ⊕ After the configuration procedure, screen on the display shows the both locos Numbers.

Example:



- ⊕ Insert **A9 in E70 brake system** and keep in Run position in master loco.
- ⊕ In case of **CCB2.0 Knorr brake system** in master loco

- A9 in FS in leading cab. In trailing cab and both cabs of slave loco keep in FS and lock the handle.
 - Mode switch should be 'LEAD' in master loco leading cab and in trailing cab and both cabs of slave loco in 'TRAIL' position.
 - As per Node information (both locos Node information should be equal) energise the loco.
 - Before moving locos remove wooden wedges and apply SA9. Ensure BC gauge is showing 3.5 Kg/cm² and BP is 5 Kg/cm². (In CCB2.0 locos bring A9 handle to RUN position after showing 'OK to RUN' in EBV display)
 - Ensure loco brakes are working with proportional braking.
 - Conduct loco brake power test.
- NOTE:**
- If configuration proves impossible, (or if no locomotive is available) locomotive number 00000 appears.

E 70 Brake system Pn. COC position:

MODE		ISOLATING COCK POSITION			
		47 DEAD ENGINE	74 (EMERGENCY/VIG)	136 (BRAKE FEED PIPE)	70 (E70 BRAKE PIPE)
MULTIPLE UNIT	LEAD (LIVE)	CLOSED (OUT)	OPEN (VERTICAL)	OPEN (HORIZONTAL)	OPEN (VERTICAL)
	TRAIL (LIVE)	CLOSED (OUT)	OPEN (VERTICAL)	CLOSED (VERTICAL)	OPEN (VERTICAL)
	TRAIL (DEAD)	CLOSED (OUT)	CLOSED (HORIZONTAL)	CLOSED (VERTICAL)	CLOSED (HORIZONTAL)

Knorr CCB 2.0 Brake system Pn.COC position:

MODE		ISOLATING COCK POSITION			
		47 DEAD ENGINE	74 (EMERGENCY/VIG)	136 (BRAKE FEED PIPE)	PER COS
MULTIPLE UNIT	LEAD (LIVE)	CLOSED (OUT)	OPEN (VERTICAL)	OPEN (HORIZONTAL)	CLOSED (HORIZONTAL)
	TRAIL (LIVE)	CLOSED (OUT)	CLOSED (HORIZONTAL)	CLOSED (VERTICAL)	CLOSED (HORIZONTAL)
	TRAIL (DEAD)	CLOSED (OUT)	CLOSED (HORIZONTAL)	CLOSED (VERTICAL)	CLOSED (HORIZONTAL)

Other observations/instructions:

- When **ZPT pressed to 'UP'** most distant pantos (Leading loco leading side and in trailing loco rear side) will raise if PSS switch is on 'AUTO' position.
- When **BLDJ pressed to 'ON'** VCB closes without delay in master loco and with 0.5 sec delay in slave loco. When switched OFF no delay in opening of VCB.

- ⊕ There is a **limitation on the regenerative brake** (50%) on the slave locomotive. This limitation reduces forces on the loco buffers (prevention of derailing).
- ⊕ The **constant speed** control of the slave locomotive is inactive. The train bus transmits the selected tractive/braking effort from the master locomotive to the slave locomotive.
- ⊕ Both locos **main compressors** will work as per master loco BLCP position.
- ⊕ If more than one Loco pilot's cab is activated in both locomotive, one is shutdown and a corresponding message appears on the displays in both locomotives.
- ⊕ In case of **smoke/fire** on the slave locomotive initiates an audio signal on the master locomotive. In addition, the VCB on the slave locomotive is switched off and a **priority 1 fault message** appears on the displays of both locomotives.
- ⊕ If the **electrical brake** on one of two locomotives fails, the electrical brake on the other locomotive remains functional.
- ⊕ All **emergency braking commands** from the master loco transmits to slave loco.
- ⊕ At **neutral sections** open and close VCB as single loco.
- ⊕ **Cab changing** is also same as single loco.
- ⊕ Closing of VCB & raising pantograph not possible of Slave loco separately like conventional Loco operation.
- ⊕ Fault message of both loco will appear on master loco display unit.
- ⊕ **If FLG1 Failed, MU Operation not possible.**
- ⊕ **If FLG2 failed, Regenerative braking not possible.**
- ⊕ During **Angle Transmitter failed**, 152 switch to be operated in master loco only.
- ⊕ **Glowing of LSF1** in leading loco indicates at least one Sub-system is isolated in any locos. So, through Vehicle diagnosis, Find out how many subsystems are isolated in which locos.
- ⊕ If **harmonic filter fails** on master or on slave loco traction or braking effort is inhibited on the corresponding loco
- ⊕ If **trailing loco panto is lowered** on run with any fault/fatal error fault (F 01 10 P1) clear the block section within 10 min. Otherwise trailing loco MCE will OFF and BP drops in leading loco.
- ⊕ If **trailing loco VCB open** but panto not lowered, if load permitted clear the block section within 10 min.
- ⊕ If leading loco VCB opens with any fault message, LSDJ lamp will glow and node is showing 715, Press BPFA and note node information and act accordingly.
- ⊕ In trailing loco VCB trips, LSDJ does not glow but node 715 will appear in leading loco with fault message, acknowledge by pressing BPFA and note down the fault no. and act accordingly.

TRAILING MODE

- Trailing mode means operating 'slave loco' from Master loco even though no tractive effort available in 'Master loco' (both bogies are electrically isolated)
- The LP's cab of the master locomotive still controls the slave locomotive.
- Conditions for trailing mode are
 - Slave Loco present,
 - Master loco is in node 504,
 - Main Power isolated,
 - Cab1 is not isolated,
 - Cab2 is not isolated,
 - Brakes are available, and
 - Train bus is working.

Procedure of making trailing mode:

- Stop the loco. Switch OFF MCE as per procedure.
- Keep 154 on I+II.
- Again switch 'ON' MCE.(First trailing loco then leading loco). Leading loco node information shows only 504, Slave loco node information changes.
- Energise the trailing loco from master loco.
- **In master loco pantograph lowered and LSDJ remains glows.**
- Fault message **F 01 03 P1** (Low pressure /faulty panto) displays, ack. the fault.
- Release Parking brakes, keep reverser in required direction.
- Move throttle and release direct brakes.

Note: All equipment on the master locomotive are supplied by the battery and are functional for a maximum of 1-2 hours or clear block section, if battery is fully charged.

Uncoupling Procedure:

- Generally uncoupling is not permitted en-route.
- Stop the locos and apply SA9.
- Switch OFF MCE in both locomotives as per procedure.
- Remove the UIC cable and uncouple the locomotives pneumatically and mechanically.
- Secure the both locos by keeping wooden wedges.
- If parking brakes available apply PB otherwise apply hand brakes in both locos, if made stabled.

TRAIL DEAD PROCEDURE

- ➡ Switch "OFF" MCE of both locos.
- ➡ Put OFF MCB 112.1 in SB-2 panel of slave loco.
- ➡ Close isolating cocks E-70, 74 & 136 . (In case of CCB2.0 close 74 & 136)
- ➡ Release SA9 of both cabs, (In case of CCB 2.0 keep A9 in 'FS' and insert spindle & Mode switch on 'Trail' in both cabs.)

- Close BC and MR Equalizing COC. Open cock 47 (Dead engine cock), if moving as 'Towed Dead'.
- Manually release the parking brake. (Ensure loco brakes are released in slave loco).
- Now switch "ON" MCE of leading loco and energise the loco.

TROUBLE SHOOTING

Failure of processors in modified locos

Failure of HBB1:

- Cab-1 will not isolate
- Auxiliary motor MCB in HB1 and earth fault relay 415/110 V and its HRC fuses will not monitor.
- Isolate Hotel load.

Failure of HBB2:

- Cab-2 will not isolate
- RB, Sanders and PT1 will not work. 47.1/2 will not be monitored
- Pressure switches BC1&2; BP, train parting, Low pressure-MR will not be monitored.
- Parking brakes will apply and release through SV30.
- Isolate VCD.

Failure of STB1:

- Cab-1 will not isolate
- Hotel load, Air dryer and switches 152, 154 and 160 will not function.
- 47.1/1 will not be monitored

Failure of STB2:

- Cab-2 will not isolate
- The following equipment will not monitor
Auxiliary MCB in HB2, over speed, BUR earth fault relay fire detection alarm in master loco when fire arises in slave loco. VCD Buzzor

Failure of FLG1: The following equipment will not work

- Cab-1 Angle transmitter
- TE/BE meters in cab-1
- Multiple operation

Failure of FLG2: The following equipment will not work

- Cab-2 Angle transmitter
- TE/BE meters in cab-2
- Regenerative brake will not work.

MR Pressure not maintaining: (See t/shooting for F10 02 P1 message)

- ➡ Ensure BLCP in 'AUTO' position
- ➡ Ensure MCPs are working. If **MCPs not working** check their MCBs 47.1/1 & 47.1/2 in HB1 & HB2.
- ➡ If tripped open VCB and reset. If repeatedly tripping switch OFF CE and isolate BUR 3 (127.22/3 to be kept OFF in SB2).

➡ MCPs are working but MR pressure not maintaining:

- Continuous using of sanders leads to MR pressure dropping. Ensure no sanders valve is energised. If continue sanders are working close sanders cocks on Pn.panel.

- Ensure no air leakage from AFI gauge glass.
- Ensure no air leakage from Un loader valves. If found close the ULV COCs above BA Box 2. In CCB2.0 locos close ULV cock on pn.panel also.
- Ensure no air leakage in the system.
- Ensure all drain cocks are closed.
- ⊕ Ensure no VCD action. If VCD acted keep A9 handle in FS to avoid MR pressure dropping.
- ⊕ Isolate FP and try in twin pipe brake system.
- ⊕ May be due to defective Air dryer. Isolate air dryer and try.

NOTE:

- ⊕ Other than A9 operation if BP pressure drops keep A9 in emergency to avoid MR pressure dropping.
- ⊕ Before switching of CE, Keep A-9 to emergency, to avoid MR dropping.

BP pressure is not charging in E70 brake system:

- ⊕ Ensure MR pressure is between 8 to 10 Kg/cm²
- ⊕ Ensure A9 is on RUN position. Press to 'REL' position and try.
- ⊕ Ensure ZBAN is 'OFF' position in working cab.
- ⊕ Ensure brake electronics MCB127.7 in ON position.(If tripped F10 01 P1message comes)
- ⊕ Ensure 70 and 74 COC are open (Horizontal) position. (If 70 COC is closed wrong configuration message comes)
- ⊕ Ensure in both cabs RS is closed .
- ⊕ Ensure both side BP Angle COC are closed in case of Light engine. In case of train formation side to be opened.
- ⊕ Ensure both side Addl BP COC is opened.
- ⊕ Ensure no air leakage in train formation. If found arrest.
- ⊕ If it is happened after cab changing ensure rear cab A9 handle removed properly.
- ⊕ Still unsuccessful switch OFF CE and Switch ON CE & Try.

BP PRESSURE IS NOT CHARGING IN CCB2.0 BRAKE SYSTEM:

- ⊕ Ensure MR pressure 8 to 10 kg/cm².
- ⊕ Ensure both side BP angle COCs in closed position.
- ⊕ Ensure both side additional BP cocks open.
- ⊕ Ensure lead cab A-9 in FS position, rear cab A-9 in FS and locked by pin.
- ⊕ Ensure both side RS COCs closed position.
- ⊕ Ensure MODE switch in leading cab LEAD position, in trailing cab in TRAIL position.
- ⊕ Ensure Z-BAN switch in off position in working cab.
- ⊕ Ensure both side PTDC handles in neutral position.

- Initially to charge the BP, energize the Loco as normal 3 phase loco, Keep Auto/A9 handle in FS, wait to see the message on LCD display of EBV as "Okay to Run". Move the Auto handle to RUN from FS position, BP would charge to 5 kg/cm² and BC would reduce to zero if SA9 released.
- Ensure there is no VCD action or emergency brake application.
- For messages "Safety Penalty–Keep Handle in FS" or "Train-line Emergency– Keep Handle in EMER". Keep A9 handle in FS or Emergency for 10 sec or 'OK to RUN' message comes and then bring A9 handle to RUN position to charge BP 5 Kg/cm².
- Still BP is not charging switch OFF & ON CE and try.
- Still BP is not changing contact TLC.

PROCEDURE OF RESETTING MCBS:

- Switching OFF CE is required to reset MCBS in SB 1 & 2 except
 - ❖ 48.1; 127.91/1; 127.91/2; 310.1/1; 310.1/2; 310.4, 310.7, 128.1 & 129.1 (For these only trip VCB)
- To reset MCB s in HB1 & HB2; trip VCB.

ABB make MCB:

NORMAL position:

- Operating handle upwards.
- Below the handle screw grove is vertical.
- Beside the screw red indication displays.

TRIPPED position:

- Handle comes to downwards
- Below the handle Screw turned to horizontal
- Red indicator turns to green



RESETTING procedure:

- First turn the screw to vertical if changed to horizontal.
- Lift the handle upwards
- Green indication turns to Red.

ABB-MS132 type:

- **Normal position;** Knob vertical('1' position)
- **Tripped position:** knob rotates 45° left.('TRIP' position)
- **OFF position:** Rotate the knob to 90° left.('0' position)
- **To Reset,** Rotate the knob first to '0' and then rotate clock wise to '1' position.



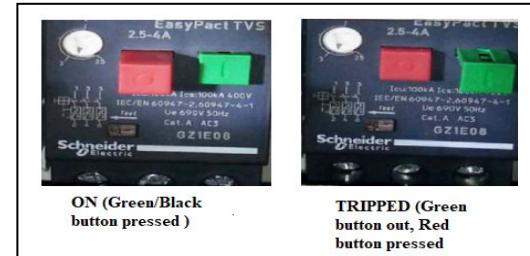
Schneider make MCB:

- **Normal position;** Operating Knob upward
- **Tripped position:** knob comes to middle position
- **OFF position:** operating knob fully downward.
- **To Reset,** first press the operating knob to OFF and then lift to Normal position.



Schneider make MCB with Red & Green buttons:

- **Normal position;** Green/Black button pressed condition. Red button projected.
- **Tripped position:** Red button pressed and Green button projected
- **To Reset,** Press Green/Black button.



M G Make MCB:

- **Normal position;** Operating Knob upward.
- **Tripped position:** knob comes to middle position.
- **OFF position:** operating knob fully downward.
- **To Reset,** first press the operating knob to OFF and then lift to Normal position.



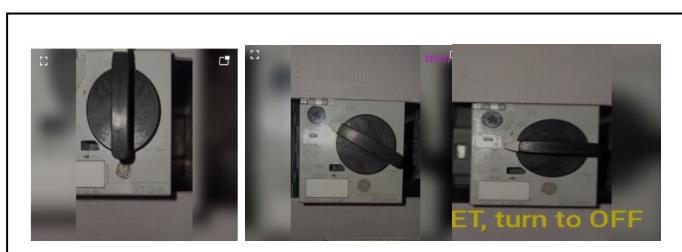
LT (SUPERNova) MAKE MCB:

- **ON position:** Knob pressed towards '1' position.
- **Tripped position:** Knob comes to middle position and moves freely.
- **OFF position:** Press the knob towards '0' position.
- **To Reset;** first press towards '0' and then press towards '1' position.



GE Make Rotary type MCB:

- **Normal position:** Knob vertical
- **Tripped position:** knob rotates 45° left.
- **OFF position:** Rotate the knob to 90° left.(9'o clock position)

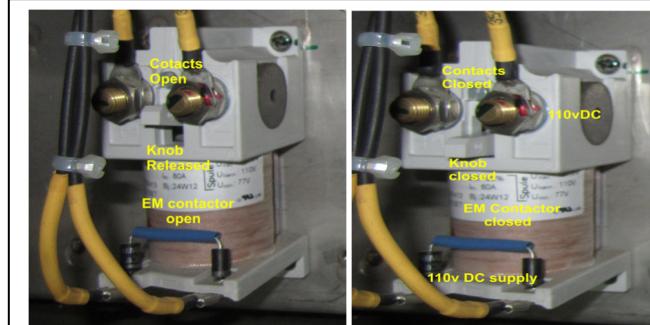


- **To Reset,** Rotate the knob first to 9'0 clock position and then rotate to 12'o clock position.

Operating EM Contactors (Used in 110 V DC circuits)

To operate 48.2, 338.1/338.2, 126 & 218 Contactors press and hold the contactor knob

- If MCPA not working though pressure is less press and hold the knob of **48.2 contactor**.
- Cab-1 head light is not working wedge **338.1 contactor**.
- **Cab-2 head light** is not working wedge **338.2 contactor**.
- If **CE is not getting ON** wedge **126 and 218 contactors**. (126 contactor closes either D or C mode)



EM Contactor-OPEN

EM Contactor - Close

Speed Troubles

1 Kmph Problem:

Fault message: DEMANDED SPEED CAN NOT BE ACHIEVED (F 01 07 P2)

Effect: Speed not increasing more than 1 KMPH and Loco moving with heavy jerk above 50 % of TE; LSP glows for few sec.at the time of jerk. BPFA glows.

T/Shooting: Check DDS message

- Isolate Bogie1/2 by 154-I for ASC1 0052/0053/0054 or for ASC 2 0052/0053/0054 by 154-II for as the case may be.
- Work with one Bogie in service if load permits.
 - ASC1:0052 Error Tacho Generator 1 - TM-1,
 - ASC1:0053 Error Tacho Generator 2 - TM-2,
 - ASC1:0054 Error Tacho Generator 3 - TM-3
 - ASC2:0052 Error Tacho Generator 1 - TM-4
 - ASC2:0053 Error Tacho Generator 2 - TM-5,
 - ASC2:0054 Error Tacho Generator 3 - TM-6
- If unsuccessful, ask for relief / banker Loco.

In IGBT locos independent TM will isolate and message will be displayed in SS04/SS05

If the DDS message is 'Warning Loco creeping'.

- Apply sanders & try to overcome the creeping problem.
- Operate Throttle gradually and pick up speed more than 11 KMPH. The logic will reset after 11kmph.
- If train stalls or unable to start in up gradient, secure the train & bring throttle '0' wait for 2 minutes.
- Ensure there is no brake binding on formation, oil/ grease or wet rails & both converters are in service.
- Operate Throttle gradually duly pressing PSA and try.

10 Kmhp Problem:

Fault message: TRACTION NOT ALLOWED WITH APPLIED BRAKE - F10 09
P1 (Loco brake is applied)

This fault messages is generated when BC pressure is more than 0.65 Kg/cm², throttle is at TE side or BE side and speed is over 10 kmph or Alarm Chain pulling (BP drop more than 0.6 kg/cm²) with the above conditions .

Action to be taken:

- Bring TE/BE handle to '0' position.
- Ensure B P pressure is 5 Kg/cm².
- Ensure rear Cab SA9 in release.
- If Loco brakes are applied, release loco brakes by pulling QRV at DV.
- Lift Bail ring & try in CCB2.0 brake system.
- Still loco brakes are not releasing, Press 20 TP and 16 TP nipples on pn. panel in CCB2.0 loco.
- Gently tap pressure switches No. 269.6/1 & 269.6/2 located on side wall near AR.
- Still un successful switch OFF and ON MCE & try.
- Press 'BPFA' for acknowledging fault message and resume traction.
- Inform to TLC and Record in Log book.

Loco brakes released and still getting same message

- Switch OFF & ON MCE.
- Unsuccessful, Contact TLC and disconnect cables at 269.6/1 and 269.6/2 and secure.

15 Kmhp Problem

If the speed is not increasing more than 15 kmph

- Keep throttle on '0'.
- Stop the train/Loco and apply SA9.

- Bring Reverser to 0. Observe 570 node.
- Go to SB1 cubicle and ensure 160 switch on '1'. If not keep on '1' position.
- Now loco/train can work in normal speed.

40 Kmph Problem: This problem comes during '**Harmonic filter isolation**'.

Harmonic filter will isolate if **HARMONIC FILTER CURRENT TOO HIGH (F 04 01 P1)** or **HARMONIC FILTER CONTACTOR (S) STUCK OFF /ON (F 04 02 P1)** trouble exists.

If harmonic filter isolated due to **F 04 02 P1** problem, **check 127.2/1 in SB1**, if tripped, reset it once after switching OFF & ON MCE.(While checking loco ensure FB Cock on Pn.panel is open. i.e. Horizontal position.)

How to work further:

- Resume Traction and clear the block section with 40 kmph.
- After clearing the block section, inform to TLC and switch OFF & ON MCE.
- If Harmonic filter comes in service, resume normal traction with normal speed.
- **If Harmonic filter not comes in service-**
 - For **full loaded trains** work with 40 kmph duly informing to TLC.
 - For **light loads** keep 154 on '1' and switch OFF & ON MCE and work with normal speed.
 - If harmonic filter not come in service switch OFF MCE, normalise bogie I and isolate Bogie II, & switch ON MCE and work with normal speed, with one bogie in service.

OTHER FAULTS:

LOW PRESSURE PANTO/ FAULTY PANTO (F 01 03 P1)

Effect: LSDJ & BPFA will glow, LSFI will start blinking; Panto will not raise (will lower if raised condition)

Action to betaken:

- Stop the train. Keep throttle on '0' and reverse on '0'.
- Acknowledge the fault by pressing BPFA.
- Ensure FLG-504 and press "ZPT" to 'DN'.

If panto is not raising,

- Check the Panto reservoir pressure (more than 7 Kg/cm²) in the gauge provided on pneumatic panel.

If pressure is low,

- Ensure that MCPA is working & its D/C (Parallel to pipe) is closed.

- In case of **CCB-2 Locos** - Press "PANS-TP" (test Point) on Pn.panel to drain out the moisture & try. Close ULV / CP1&2 ULV cocks and try. Open after energising the loco.
 - If **MCPA not working**, Check the MCB 48.1 "ON" (in SB2).If tripped reset the same.
 - Check the contactor 48.2, if it is not closed, tap the pressure switch 26 (PS 172.4) in E70 ("PANS-PS" in CCB2).
 - **Press 48.2 contactor** knob down and hold till pressure reaches 7.0 Kg/cm²
If pressure is available,
 - Operate IG-38 key two times (Horizontal in E70 and vertical in CCB2) and ensure Pan 1 & 2 cocks are in horizontal position .
 - **Press 130.1 aux. contactor** in SB-2 & try.
 - Change the position of panto selector Switch (85) on pn. panel and try to raise other pantograph.
If both Pantos are not raising Switch OFF & ON MCE and try.
If Panto is raising and message appears ,
 - Gently tap the pressure switch no.9.1 or 9.2 (130.4/1 & 130.4/2 available in E70 panel) & 'PAN1 PS & PAN2 PS' in CCB2 panel.
 - Switch OFF & ON MCE & Try.
 - Try by changing the cab.
 - Inform to TLC & Record in Log book.
- NOTE:** If VCB closes and then trips with the above message, may be due to Pressure dropping through VCB after closing VCB.
- **If the above pressure switch is not picking up within 35 sec causes to disable VCB or if VCB closes it will open after 2 seconds.**

CATENARY VOLTAGE OUT OF LIMIT (F 01 04 P1)

Effect: VCB trips (Range: OHE voltage 17.5 kV to 30.0 kV); LSDJ & BPFA glows, LSFI flickers

T/Shooting:

- Bring throttle to '0' position.
- If BP pressure drops suddenly switch on flasher light if AFL not comes and act as per G&SR .
- Acknowledge the fault by BPFA.

If 'U' meter is not deviating then either no tension or PT fuse blown off. Lower Panto once and raise the panto.

- When panto touches OHE, a minor spark indicates Tension is available. Stop the train and conform with TLC/TPC .

If there is no OHE wait for catenary voltage to raise above17.5 KV but less than 29 KV.

- Ensure OHE voltage in Simulation Screen, If it is above 29 KV inform to TPC/TLC to reduce.
- After OHE voltage gets restored, reclose the VCB and resume traction.

If OHE is available and 'U' meter not deviating,

- Lower Panto and replace PT fuse in SB1 panel.

If U meter deviates & F 01 04 P1 message displays

- Check DDS message.
- If DDS message is SLG1-0020 isolate SR-1 by opening MCB 127.1/1 in SB1 & keep 154 switch -1 or if the message is SLG2-0020 isolate SR-2 by opening MCB 127.1/2 in SB2 and keep 154 switch -II position and try.
- If the message from both SLG1 0020 & SLG2 0020 it may be OHE problem.

If OHE supply is normal, Switch OFF & ON MCE and try.

- Try by changing panto & Cab.

If unsuccessful, Contact TLC & Record in Log book.

PRIMARY OVER CURRENT (F 01 08 P1)

Effect: VCB trips, LSDJ & BPFA will glow, LSFI will start blinking.

T/Shooting:

- Bring throttle to '0' position and press BPFA.
- Don't close VCB until you check OCR 78 & oil points in the Machine Room.
- Try to clear the block section by Coasting & bring the loco / train to stop.
- Check the OCR 78 & Check the oil levels in oil expansion tanks of transformer and SRs
 - for sign of overheating
 - any abnormal raise
 - colour change (black)
 - oil splash through vent pipe of transformer and Machine room.
 - Check smoke/smell/fire from VCB unit, SRs and in machine room
 - Check for oil leakage any at TFP oil tank or oil splash surrounding tank.
 - **If any abnormality is noticed shut down the Loco,** use fire extinguishers if required and ask relief Loco.
 - **If no abnormality is noticed** reset OCR 78.
 - Close VCB and work onwards.
 - If not successful after making one attempt then VCB will be inhibited.
 - Ask for relief Loco without losing time and make a remark in Log book.

EARTH FAULT AUX. WINDING CIRCUIT (F 01 03 P2)

Effect: No effect, Normal operation can continue.

How to work further:

1. Check visually machine room for smoke / burning smell of Auxiliaries. If found, trip MCB of that Aux.
2. Inform to TLC and record in the Log book.
3. If fault repeats, trouble shoot as per additional instruction given as follows.

Auxiliary converter -1 isolated followed by Auxiliary converter-

2: Earth fault in OCB-1/OCB-2

Auxiliary converter -2 isolated followed by Auxiliary converter-

1: Earth fault in TMB-1/TMB-2

Auxiliary converter -2 isolated followed by Auxiliary converter-

3: Earth fault in SR Pump-1/SR pump-2/TFP pump-1/TFP pump-2.

Auxiliary converter -3 isolated followed by Auxiliary converter-

2: Earth fault in MCP-1/MCP -2

Auxiliary converter -3 isolated followed by Auxiliary converter-

1: Earth fault in Sc.Blower-1/Sc. Blower -2

NOTE: In LGD base locos 3Ø Sc.Blowers load is shifted to AC_2.

Auxiliary converter -1 isolated followed by Auxiliary converter-

2:

Reason: Earth fault in OCB-1/OCB-2

T/Shooting:

- Check OCB1&2 MCBs.
- If MCB No. 59.1/1 or 59.1/2 trips due to faulty motor of OCB.
- Do not reset MCB.
- Isolate the concerned Bogie by Bogie cut out switch No.154
- Half TE/BE will be available. Continue traction with one bogie if load permits, otherwise ask for assisting loco.

If there is no tripping of MCB No. 59.1/1 or 59.1/2, follow the procedure.

- Isolate OCB-1 by tripping MCB no. 59.1/1 located in HB-1.
- Close VCB.
- Check for following message.
 - F 06 01 P1- Disturbance in processor BUR-1
 - F 06 02 P1- Fault in Auxiliary converter -1
 - F 01 03 P2- Earth fault Auxiliary winding circuit.

If there is no message, then faulty OCB has been isolated.

- Isolate Bogie -1 by operating Bogie cut out switch No. 154.
- Half TE/BE will be available. Continue traction with one bogie if load permits, otherwise ask for assisting loco.

If above messages are displayed, then

- Normalise 59.1/1 in HB-1 panel.
- Isolate OCB-2 by tripping MCB 59.1/2 located in HB-2.
- Then isolate bogie -2 by Bogie cut out switch 154.
- Close VCB as per procedure.
- Half TE/BE will be available. Continue traction with one bogie if load permits, otherwise ask for assisting loco.

NOTE:

- Trouble shoot for other auxiliary converters also as per above procedure.
- For TMB1/2 isolation, isolate bogie also
- For SR pump1/2 isolation, isolate bogie also.
- For TFP pump1/2 isolation, work further 70% of reduced tractive effort.
- For Sc.Blowers isolation inform to TLC and make a remark in loco logbook.

DISTURBANCE IN CONVERTER -1 (F 02 01 P1)

Effect: VCB trips, LSFI starts blinking & BPFA glows.

Action to be taken:

- Bring Throttle to '0'. Acknowledge the fault message through BPFA
- Press BLDJ to close VCB.
- If the message repeats bogie-1 may or may not get isolated automatically.
- Check DDS messages.

In case of NSC1: Error PS hardware followed , NSC1: Error PS hardware CGP – close DJ and work onwards

In case of ASC1: Error PS hardware followed by either ASC1: Error PS Fault storage CGP or ASC1: Error PS Fault storage GBC, NSC1: Error PS hardware followed NSC1: Error PS Fault storage GBC.

- For the above messages or if Bogie I is isolated, place 154 on 'I' after opening VCB if train is running. Close VCB and try to work on words with one bogie or clear section if possible.
- **If bogie-1 isolation message comes,** press 'Enter' button.(LSFI glows continuously)
- Check MCB (127.1/1) in SB-1. If tripped, reset it once after switching OFF MCE and try.
- **If not tripped also,** try by switching OFF & ON MCE.
- Still bogie isolation message repeats, clear the section with half TE/BE.

- If both bogies are required - For other than above messages, normalise 154 and Switch 'OFF' MCE for 5 minutes and switch 'ON' & try.
- If unsuccessful, inform Background messages to TLC and act as per instructions. Record in the loco log book.
- For the following background messages sometimes bogie will be get isolated.
- Bogie needs to be isolated through its MCB 127.1/1 for following messages.(In IGBT locos trip 127.11/1 also)
 - ASC1:0078 Error MVB,
 - NSC1:0078 Error MVB,
 - Life sign missing from SLG-1,
 - ASC1:0085: Error calibration,
 - NSC1:0085: Error Calibration,
 - Primary voltage below Minimum,
 - SLG1: 0077 Protective turn off ALG extn.
 - ASC1:0042: Error BS/MUB over load.
 - SLG1:0042-Disturbance MUB test.

NOTE: For disturbance in traction converter-2 also trouble shoot as above procedure.

FAULT IN BRAKE ELECTRONICS (F10 01 P1)

EFFECT: LSF1 Flickers & BPFA Will glow, TE/BE comes to '0', Emergency brake applied, No traction allowed

Action to be taken:

- Bring Throttle to '0'. Keep A9 in 'Emergency' and apply SA9.
- Check MCB 127.7 in SB2. If tripped, reset once.
- Acknowledge through BPFA.
- Release parking Brake through SV30 release plunger, avoid the operation of sanders and work on wards.
- If MCB not tripped, switch off & on MCE & try.
- If unsuccessful try from rear cab.
- If the same message repeats, ask for **relief loco in case of E-70 locos** and write remark in loco Log book.

In case of Knorr's Bresme Brake system (CCB2.0)

- If rear cab A9 in Emergency bring it to FS & lock it and mode switch in trail position.
- If unsuccessful clear section with PTDC mode.

LOW PRESSURE MAIN RESERVOIR (F 10 02 P1)

EFFECT: LSFI Flickers & BPFA will glow, TE/BE comes to '0'

- No traction allowed till pressure reaches 6.4 kg/cm²

Action to be taken:

- Bring Throttle to '0', Stop the train and secure the train.
- Keep MPJ on '0'. Press BPFA
- Press BLCP to MAN position & try.
- Check the working of **MCPs, if not working,**
- Check the MCBs 47.1/1 & 47.1/2 . If tripped reset the MCB after opening VCB and try.
- If MCBs are normal, isolate BUR3 (open 127.22/3 in SB2 panel) and try.
- If unsuccessful, Switch OFF MCE, normalise 127.22/3 and switch on MCE. & try.

If compressors are working and MR pressure is not building up.

- If BP pressure drops and causes drop in MR pressure , isolate VCD/SPM & try.
- Close TPWS COCs in TPWS locos (both cabs below SA9) .
- Ensure ALP Emergency cock closed in both cabs.
- FP pressure drops, close 136 COC and try.
- Any Air Leakage in the front side, close corresponding Addl.cock behind cattle guard & work on wards .
- For any other Air leakages, attend the same
- Ensure no air leakage at AFI meter.
- If Air leaks through Un-loader valves at BA Box2, close COCs and try. (In case of CCB2.0 locos close ULV cock on Pn.Panel also). After MR charging, normalize the cocks.
- Try from rear cab. If success, clear section.
- If there is no leakage from Auto drain valve & un- loader valves. Bypass Air dryer. If MR charges, Normalize Air dryer once & try.

MR pressure is available and message F 10 02 P1 displays

- Contact TLC and short both the cables of 269.4.
- If not successful trip 127.9/4 in SB2 .
- Isolate VCD and release PB manually and change to Cab-1 if driving from cab-2.
- In cab redundancy locos still driving is possible from same cab.
- Work the MCPs in 'MAN' mode. If ECPSW is provided change the position (MCPs will work in 'AUTO' mode.)
- Make a remark in loco logbook.

WORKING WRONG CONFIGURATION BRAKE SYSTEM (F 10 04 P1)

Generally this message generates if 70 cock is closed or ZBAN is switched ON/Kept Mode switch on HLPR position.

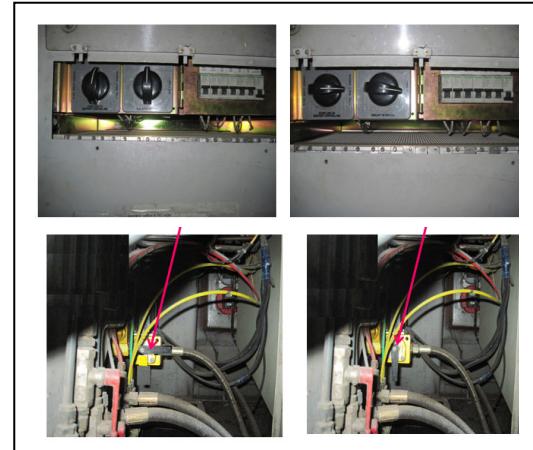
Action to be taken:

- Check E70 COC & ZBAN & Mode switch also.
- E70 cock is normal, operate once/twice and keep horizontal.
- Reg. E70: It may be improper sensing of 70 COC by HBB2 from both cabs
- **If Cab redundancy locos;** Trip 127.9/4; Isolate VCD and release PB manually & Drive from same cab. Inform to TLC.
- Reg. ZBAN; Driving from Cab-1, It may be due to improper sensing of ZBAN 'ON' position by HBB1 processor.
- **If Cab redundancy not available -** trip 127.9/2 in SB2 and work from Cab-1.
- Driving from Cab-2, It may be due to improper sensing of ZBAN 'ON' position by HBB2 processor.
- **In Cab redundant locos -** Trip 127.9/4; Isolate VCD and release PB manually and work from Cab-2
- Inform to TLC & Make a remark in loco log book.

NOTE: For all other faults go through TSD. Any fault message appears on screen first note down fault No., Message with time and trouble shoot as per TSD.

ADDITIONAL INSTRUCTIONS

- Corridor lights will be switched off automatically after 10 Min of loco shut down to avoid battery discharge, if corridor lights are required, BL key to be kept in "C" mode.
- If loco is unmanned and OHE is failed for short time, it leads to battery discharge through continuous working of MCPA. Do not unman the loco.
- In TPWS provided loco, while working in non TPWS area, ensure Battery control switch in 'OFF' position, TPWS Isolation switch in 'ON' position on TPWS unit. (Operating knobs are horizontal in isolation position)
- Pneumatic isolation COCs in closed condition in both Cabs, provided under the driver brake controller (A-9). (one window is provided for opening and closing of this COC).



- ❖ If loco brakes not releasing, close and open 94 COC and try in E 70 brake system.
- ❖ If loco brakes not releasing in KNORR-CCB2.0 brake locos, press gently test points 16 and 20 on brake manifold of pneumatic panel



- ❖ In case BL key giving trouble, try by pulling the key up slightly.
- ❖ C-DAC VCU modified locos, in case of messages like F1301P1, F1302P1, F1401P1, F1402P1, cab will not isolate and can work from same cab with precautions.
- ❖ In case of CPs working continuously, trip DJ and isolate CPs one by one using MCBs 47.1/1 and 47.1/2. At convenient location MCB shall be reset duly tripping DJ.
- ❖ In WAP7 locos, Bogie-II isolated on run and further DJ not holding with F 01 04 P1 (OHE voltage out of range), trip MCB 127.1/2 in SB2 panel to close the DJ.
- ❖ If CE is not getting OFF, open 112.1 breaker in SB-2
- ❖ If CE is not getting on, CE can be switched on by pressing 126 and 218 contactor knobs in SB1 panel at a time.
- ❖ If MCPA not getting on, MCPA can be started by pressing 48.2 contactor knob in SB2 panel.
- ❖ If both Head Lights are not working from cab-1 check MCB 310.1/1(SB-1), from cab-2 check 310.1/2 (SB-2) and ensure not in tripped condition.
- ❖ If Head Light is not getting on, H/L can ON by wedging 338.1 or 338.2 contactors knob in SB1 & SB2 panel respectively.



after opening door.

- ❖ If VCB is not closed, it can be closed by pressing 136.4 contactor knob in SB1 panel.

- ❖ In IGBT locos, in case of problem F0201P1, isolate bogie1 duly tripping MCBs 127.1/1 & 127.11/1 respectively. In case of problem F0301P1, isolate bogie2 duly tripping MCBs 127.1/2 & 127.11/2. and ack. the fault by pressing PFA.
- ❖ In case of FLG-1 detecting all processors life sign missing and main power getting off, then trip MCB 127.9/1 (central electrons-1) in SB-1 Panel.
- ❖ In case "equipment temp high" message there is no need to isolate bogie. Drive cautiously with reduced tractive to enable system to restore TE/BE.
- ❖ **In ECPSW (Emergency compressor switch) provided locos, keep this switch from '0' to '1', available in SB-1, to start CPs automatically in case of 127.9/4 tripped or HBB-2 processor failed.**
- ❖ In modified locos MCE reset button provided in SB-1 panel/Panel'D', to bring back isolated Sub-system into service, trip VCB, Lower panto, press push button for 3-5 sec (Follow shed instructions).
- ❖ In some of LGD locos MRB2 is converted as 3Ø auxillary and supply is given from AC2 , MRB-1 works with single phase supply. In driving mode both will work, in cooling mode only MRB-1 will work.
- ❖ FDU will not work if MCB no.127.91/2 is off.
- ❖ Any fault message should not be acknowledge without read and note down.
- ❖ MCB 127.7 in SB2, to be checked first during brake electrons failure.
- ❖ Timely action to P₂ message, avoid failure of loco with P₁ message.
- ❖ Isolate SR-1 and SR-2, by 127.1/1 or 127.1/2, in case of faults like F0104P₁, F0107P₁, and F0107P₂.
- ❖ If regenerative brake fail on run, press PVEF and apply A-9 .for application of brakes and to avoid wheel skidding.
- ❖ In case fault message with F020101 P1, F0301P1, if need CE off, switch on CE after 5 minutes only.
- ❖ If any repeated tripping of MCB in HB-1 or HB-2 try by isolating concern auxiliary converter.

CO-CO FLEXI COIL BOGIE (WAP 7 / WAG 9 LOCOS):

1. This loco is provided with CO-CO flexi coil Mark-I bogie.
2. This bogie has two stages of suspensions. Primary & secondary suspension
3. Primary suspension (Axe box to bogie frame).
 - On each wheel set, one pair of helical springs are provided and called as primary springs
 - The springs provided in middle wheel set are provided with inner spring.
 - On these primary springs bogie frame is mounted.
 - Between end axle box and bogie frame vertical dampers are provided and called as primary suspension vertical dampers.

in WAG9H in primary suspension outer and inner helical springs are provided at all axle boxes.

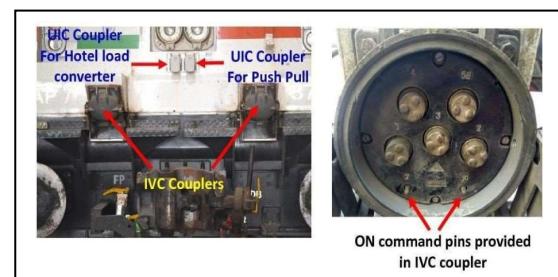
 - For all axle boxes wheel set guide rods are provided. One end connected to Axe box and another end connected to bogie frame.
 - Middle axles are provided with safety link.
4. Secondary suspension: Bogie frame to loco body.
 - Near middle axle one pair of helical springs are provided in each side of bogie and called as secondary springs.
 - On these secondary springs loco body is mounted
 - Between bogie frame and loco body two 'Yaw dampers' 2 Nos. are provided one in each side of bogie. Yaw (longitudinal) dampers control the loco body pitch rate.
 - Near middle axle, between bogie frame and loco body two horizontal dampers are provided one in each side of bogie.
 - Near middle axle box and loco body vertical damper one in each side is provided and called as secondary suspension vertical dampers.
5. Wheel set Guide rods control the fore and aft movement between the axles and the bogie frame
6. Between two side beams of bogie frame, four cross beams are provided and called as 'Transoms'.
7. Middle transoms are used for holding the traction motors. The transom towards the centre of the loco is provided with 'Traction link'. The traction link connected between the bogie transom and loco under frame, transmits the tractive forces to the loco body and braking force is transmitted vice versa.
8. The traction motors are suspended in the bogie frame and on the individual axles. The motors transmit their energy to the driving axles through a gearbox mounted on the driving axle.
9. Two lateral buffers are provided to limit the lateral movement.
10. Safety chain is provided between bogie frame and loco body and provided at centre axle.

THREE PHASE LOCO MATERIAL

11.12 No.TBU brakes and 4 No. parking brakes are provided.in WAP7 conventional BCs and hand brake is provided. In some WAG 9 locos also conventional BCs and hand brake is provided.

OPERATION OF WAP7 LOCOMOTIVES IN PUSH PULL MODE

- In push-pull operation two locomotives are operated in MU mode with the rake in-between the front and rear locomotives.
- The communication between front and rear locomotives is established through wired media laid on the coaches.
- For this purpose 22 core cables laid throughout the rake.
- At present only 18 core cables are used and 4 cables are kept as spare for future extension.
- Out of total 18 core
 - 3 wires for MU operation,
 - 8 wires for BL key duplication,
 - 7 wires for LED indication signal and fault acknowledge.
- In Push Pull mode one loco is in front of rake called Master loco and another loco is in rear of rake called slave loco.
- The modification for push pull operation involves provision of **additional BL switch**, **additional BPFA** and **additional LSDJ** on 'A' panel in each cab of both master and slave loco.(In some locos these are provided on pane 'D').
- ZTEL switch provided on 'A' panel is renamed as **ZNN switch** and is used for negotiating of **neutral section**.
- WAP-7 locos are provided with four couplers on each cab front side.
- IV Couplers- 2 Nos. for power connection of Hotel load. 'ON' command pins of hotel load converter are also provided in IV Coupler only.
- LP side IV Coupler (Male) for HLC-B.
- ALP side IV Coupler (Male) for HLC-A.
- UIC couplers – 2 Nos.
- LP side coupler(Female) for Push Pull operation
- ALP side coupler(Female) for Hotel load converter
- On rake side each power car is having male sockets at both sides (LH & RH) for Push Pull operation. Both these sockets are connected in parallel.
- For Push Pull operation one flexible jumper having male& female couplers at either end is required. One end of flexible jumper (male) is inserted in LP side female socket on loco cab and another end of jumper (female) is inserted in either of the two male sockets provided on power car for push pull operation.
- Similar jumper is to be provided between rear power car and slave loco. Here it is pointed out that both jumpers (one used between master loco and front



power car and another used between slave loco and rear power car) appears to be similar.

- Even though both jumpers are 18 pin, internal wire connection is different. One jumper is called **straight jumper** and another jumper is called **cross jumper**. In push pull operation one straight and one cross jumper is must.
- Location wise if straight jumper is provided between master loco and front power car then cross jumper has to be provided between slave loco and rear power car and vice-versa.

SET-UP FOR PUSH PULL OPERATION:

- Master and slave locos should be attached with the rake in front and rear.
- Ensure flexible jumpers **ONE STRAIGHT AND ONE CROSS JUMPER** for push pull operation are connected.
- **Hotel Load Converters:** In Push pull operation, Hotel load converters of master loco only will be in service. Therefore, IVC coupler & UIC coupler of Hotel load of master loco only, to be provided with jumpers from front power car.
- **Note: No IVC & UIC jumper of hotel load converter to be connected between slave loco & rear power car.**
- Connect BP and FP pipe of both locos with BP & FP pipe with train rake and open angle cocks.

Cock and switch position of master and slave loco:

S.No.	Name of cock/ Switch	Master loco	Slave loco
1	Panto selector switch (85)	Auto mode	Auto mode
2	Feed pipe charging cock (136)	Open	Close
3	BP charging cock (70)	Open	Open
4	Emergency exhaust cock (74)	Open	Open
5	Dead movement cock (47)	Close	Close
6	Kaba key (IG 38)	Open	Open

70cock is not provided in CCB2.0 locos

Note: If Panto selector switch (85) is in Auto mode for both master & slave locos, then front panto of master loco & rear panto of slave loco will rise in Push pull similar to MU operation.

- However, it is preferable to rise rear panto of master loco by using panto selector switch (85).
- Connect BP and FP pipe of both locos with BP & FP pipe with train rake and open angle cocks.

CAB ACTIVATION

Activating Slave Loco from Master Loco:

- ⊕ Insert BL key in additional BL switch provided on 'A/D' panel and move it from 'OFF' to 'D' mode.
- ⊕ Now additional LSDJ glows which indicates Slave loco is activated.
- ⊕ After around 35-40 seconds slave loco will be on 504 node and additional BPFA provided on 'A/D' panel in master loco will glow. (This indicates VCU boot up process completed in slave loco)
- ⊕ Move additional BL key from 'D' to 'OFF' and take it out.
- ⊕ Now 612 node will display for slave loco in DDU. Now slave loco is in 'Self-hold' mode.



Activating master Loco:

Insert BL key in 'A' panel and move from 'OFF' to 'D' and wait for 35-40 seconds. DDU will display 504 node for both master and slave loco in Node information screen.

LOCO ENERGISATION

Now energize the both locomotive pair of push pull combination from master loco as is done normally for single WAP-7 loco.

Push pull combination of locos can be checked from train configuration screen.

ZNN switch:

Normal position is OFF.

Operate ZNN Switch to 'ON' position during Neutral Section negotiation, only.

INSTRUCTIONS FOR NEUTRAL SECTION :

- ⊕ At 250 m board bring throttle to '0' and switch 'ON' ZNN.
- ⊕ At DJ open board, switch 'OFF' BLDJ and ensure LSDJ lamp is glowing.
- ⊕ At DJ close board, switch on BLDJ and ensure extinguishing of LSDJ.
- ⊕ Additional BLDJ provided on 'A/D' panel of master loco will remain in extinguished condition continuously.
- ⊕ The logic used for negotiating of neutral section in push pull operation is as follows.
- ⊕ When DJ open command is given while front loco passing the neutral section, DJ gets opened in front loco only and the rear loco DJ will open after travelling the pre-defined distance which was set at 330 meters (Considering minimum rake length)
- ⊕ After closing VCB of master loco, VCB of slave loco closes after 750 meters. (Considering maximum rake length)

Note: Opening and closing of VCB in slave loco can be checked from Node information screen in DDU of Master loco.

↳ In Push Pull operation fault messages will be popped up on DDU of master loco with LSFI glowing but along with loco No.

↳ From loco no. crew has to understand whether fault is in master loco or slave loco and take corrective action as per TSD.

In case of communication failure between master and slave loco, message of "**COMMUNICATION DISTURBANCE**" is displayed in DDU of master loco and following action takes place automatically.

- VCB tripping in master loco.
- VCB tripping and lowering of Pantograph in slave loco.
- Master loco can be worked normally by closing VCB.
- After communication failure and tripping of VCB and lowering of Pantograph in slave loco, it remains in **self-hold mode for 100 min.** only.
- During this 100 min. period, at any convenient Stop, following procedure is to be followed.
- Ensure ZNN (ZTEL) Switch in Off Condition.
- Re-configure master and slave loco combination.
- If not Succeeded, slave loco is to be made dead as per TSD after observing the procedure of Towed Dead Mode operation.
- Drive from Master Loco in independent mode.

ISSUES IN PUSH PULL SCHEME:

- Addl. LSDJ lamp is not glowing as the 24 volts supply is not getting extended in the rear locomotive through 126.7 contactor interlock since both the CABs are inactive in rear locomotive. Additional loop has been given to enable Addl. LSDJ lamp to glow in front locomotive. Enabling this loop through software/control wiring may be required.
- Additional BPFA is serving the purpose of indicating the MCE is on in the rear loco (lamp glows) after which the BL key to be removed. However, it is not indicating any other condition after key removal.
- **Working of single compressor in each loco:** In case of failure of rear locomotive and due to modification of CP logic, then only single CP works as the 7.5 kg detecting RGCP has been permanently disabled as per RDSO scheme. It is difficult to haul LHB loads with single CP as air requirement is more due to CDTs and air spring.

WAG12 B LOCOMOTIVE (M/S ALSTOM MAKE)

TECHNICAL DATA OF WAG12B LOCOMOTIVE

Description	Specification
Type of vehicle	Freight locomotive
Horsepower	12000 Hp
No. of Sections	2 (Section-1, Section-2) (Section-A, Section-B)
Axial arrangement	BO-BO
Number of axles	8
Rail gauge	1,676 mm
Mass of locomotive	180 t for 22.5 Tonne/axle 200 t for 25 Tonne/axle
Length	38,400 mm
Width	3,058 mm
Height	4,150 mm
Wheelbase	2,600 mm
Diameter of Wheel	1,250 mm (New Wheel) 1,207 mm (Half Worn) 1,164 mm (Fully Worn)
Maximum speed	100 km/h (upgradable to 120 km/h)
Continuous speed	60 km/h
Gearbox ratio	110/23
OHE Voltage	Nominal: 22.5 kV, 50 Hz, single phase AC Maximum: 31 kV Minimum: 17 kV
Traction power in continuous rating mode	9,000 kW
Maximum starting tractive effort at 22.5 t/axle load	705 kN
Maximum starting tractive effort at 25 t/axle load	785 kN
Tractive effort at maximum operating speed 120 km/h	270 kN
Maximum tractive effort	115.149 kN/motor
Maximum braking effort	79.315 kN/motor
Low voltage supply	110 V DC
Auxiliaries voltage supply	415 V, 3-phase AC
Convertor	DC Link voltage: 1800 V DC \pm 3% Permanent O/P current DC Side: 1535 A Permanent I/P current AC side: 2000 A Rms

THREE PHASE LOCO MATERIAL

Inverter	DC Link voltage: 1800 VDC± 3% Permanent O/P current AC side: 850 A rms Permanent I/P current DC side: 1200 A
Multiple unit operation	2 Locomotives
Suitability for remote multiple unit operation	2 Locomotives
Cattle Guard	196 mm above rail level
Stone Deflector	40 mm above rail level
Side Buffer	968 mm above rail level