

भारत सरकार
रेल मंत्रालय
(रेलवे बोर्ड)

भारतीय रेल
ए सी कर्षण नियमावली
अनुरक्षण एंव परिचालन
जिल्द - 3
विधुत चल स्टाक

नवंबर, 2022

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
RAILWAY BOARD

INDIAN RAILWAYS
MANUAL OF AC TRACTION
MAINTENANCE AND OPERATION
VOLUME III
ELECTRIC ROLLING STOCK

NOVEMBER, 2022

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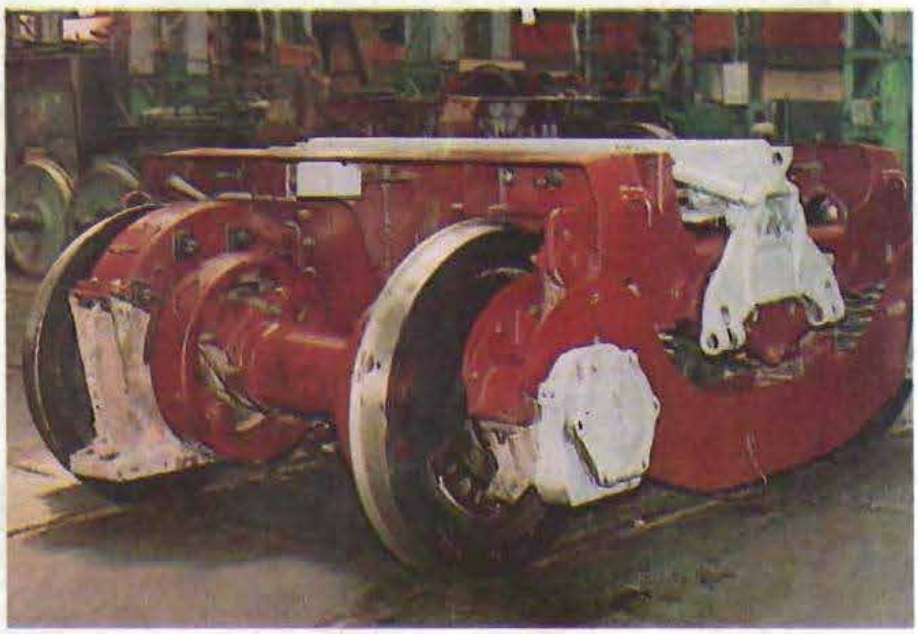
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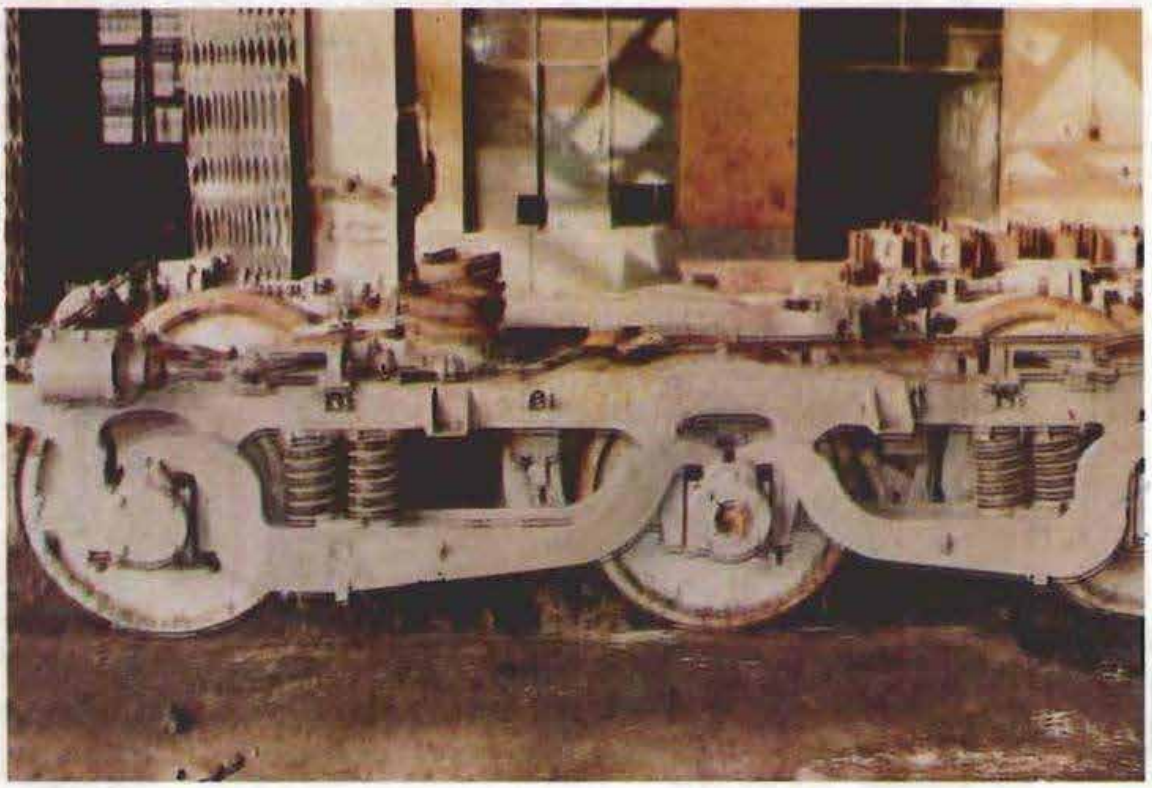
30100 Evolution of Electric Rolling Stock



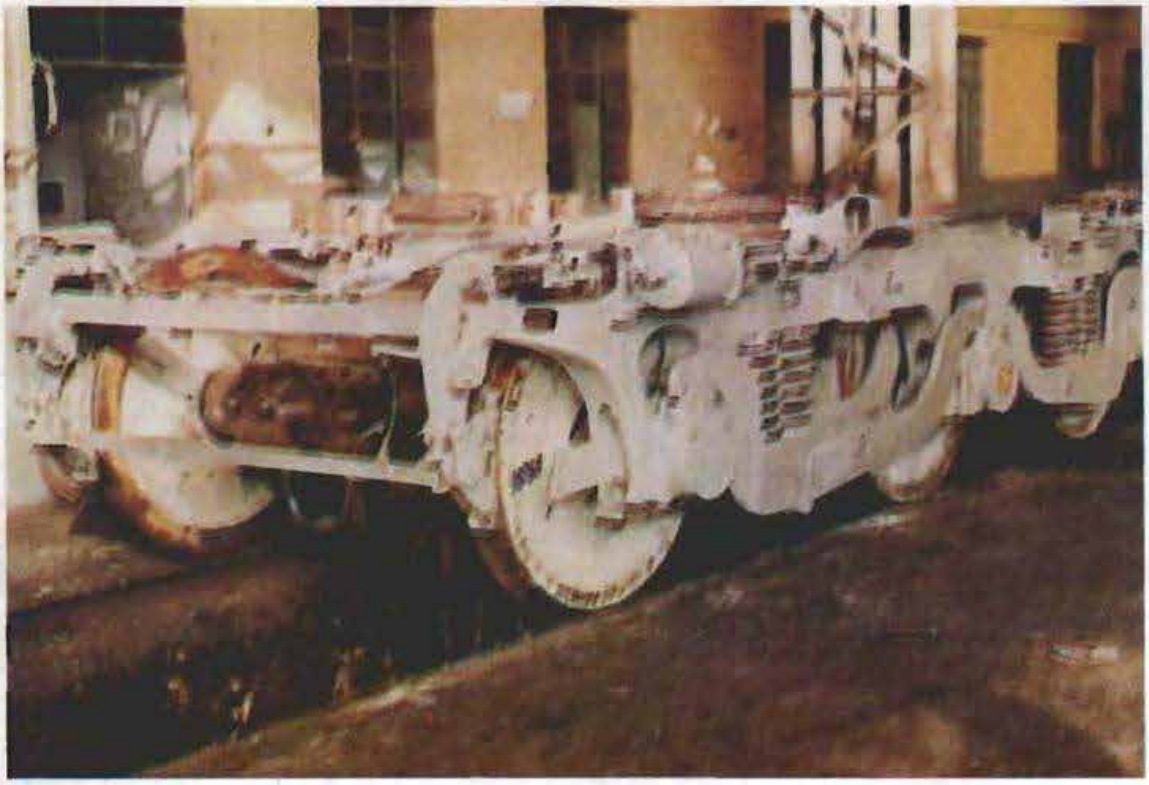
A - Bogie for WAG1 Loco-Athermos axle
WAG1 लोको - एथरमोस एक्सल के लिए बोगी



B - Motorised Monomotor Bogie for WAG1 Loco
मोटरयुक्त - मोनोमोटर बोगी WAG1 लोको के लिए बोगी



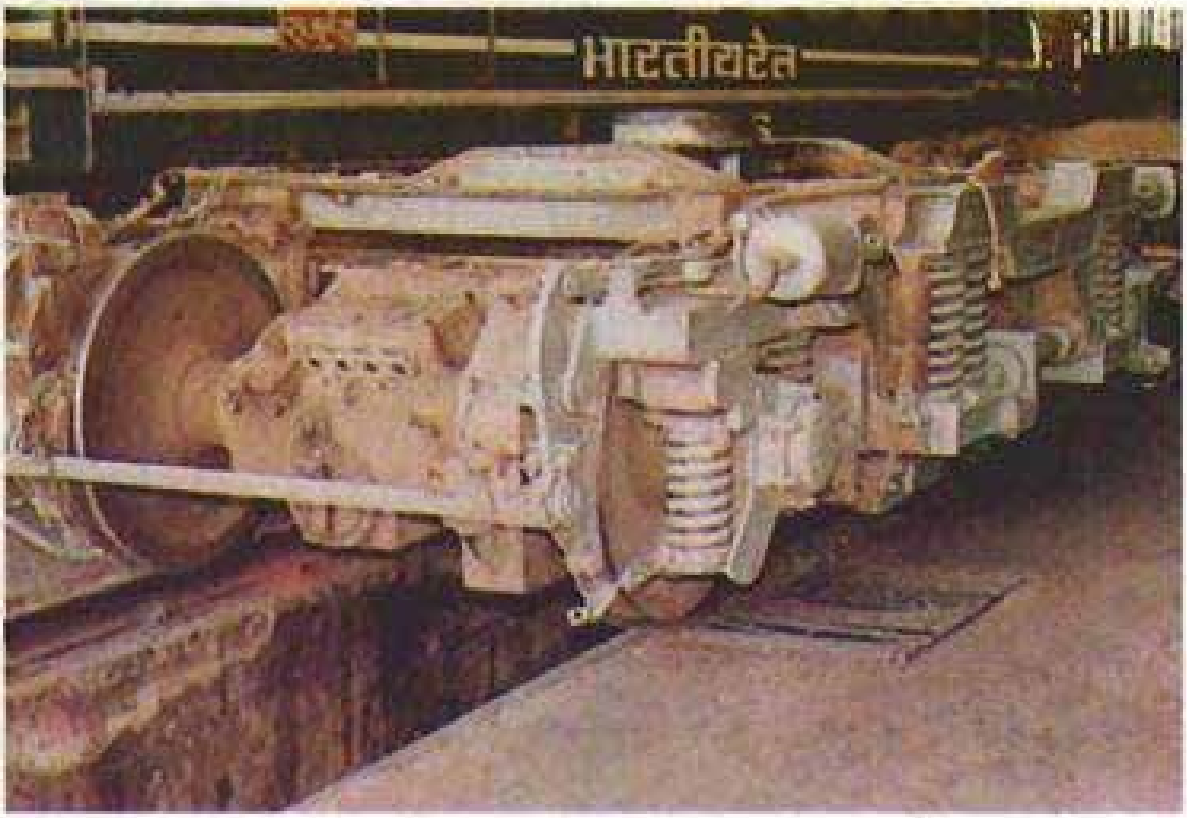
Motorised Bogie WAG5
मोटरयुक्त बोगी WAG5



Motorised Bogie WAG5 (side view)
मोटरयुक्त बोगी WAG5 (पार्श्व दृश्य)



Motorised Bogie WAP1
मोटरयुक्त बोगी WAP1



Motorised Bogie WAP3 Fabricated (side view)
मोटरयुक्त बोगी WAP3 विरचित (पार्श्व दृश्य)



Motorised Bogie WAP3 (Fabricated)
मोटरयुक्त बोगी WAP3 (विरचित)

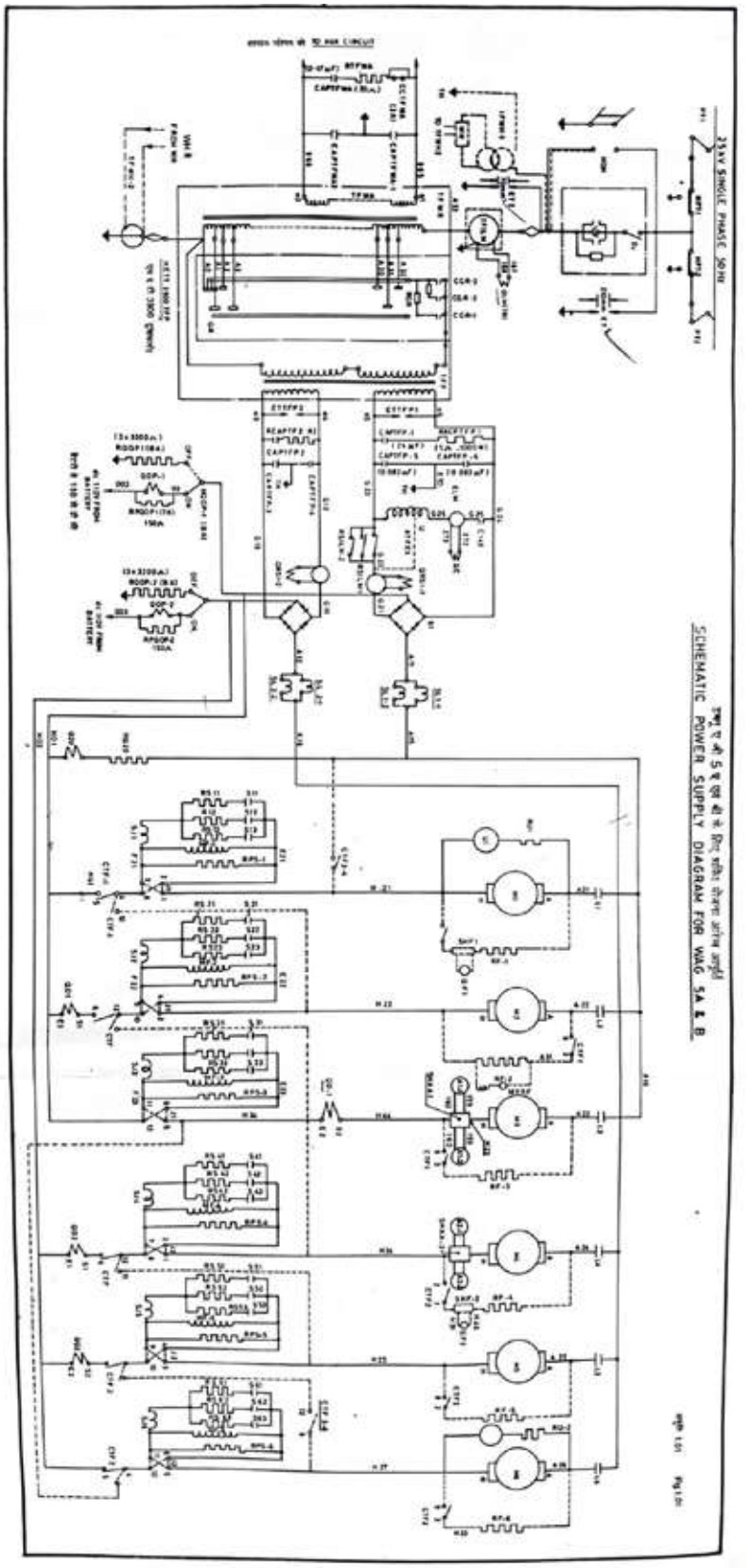
1.0 Electrical Concept

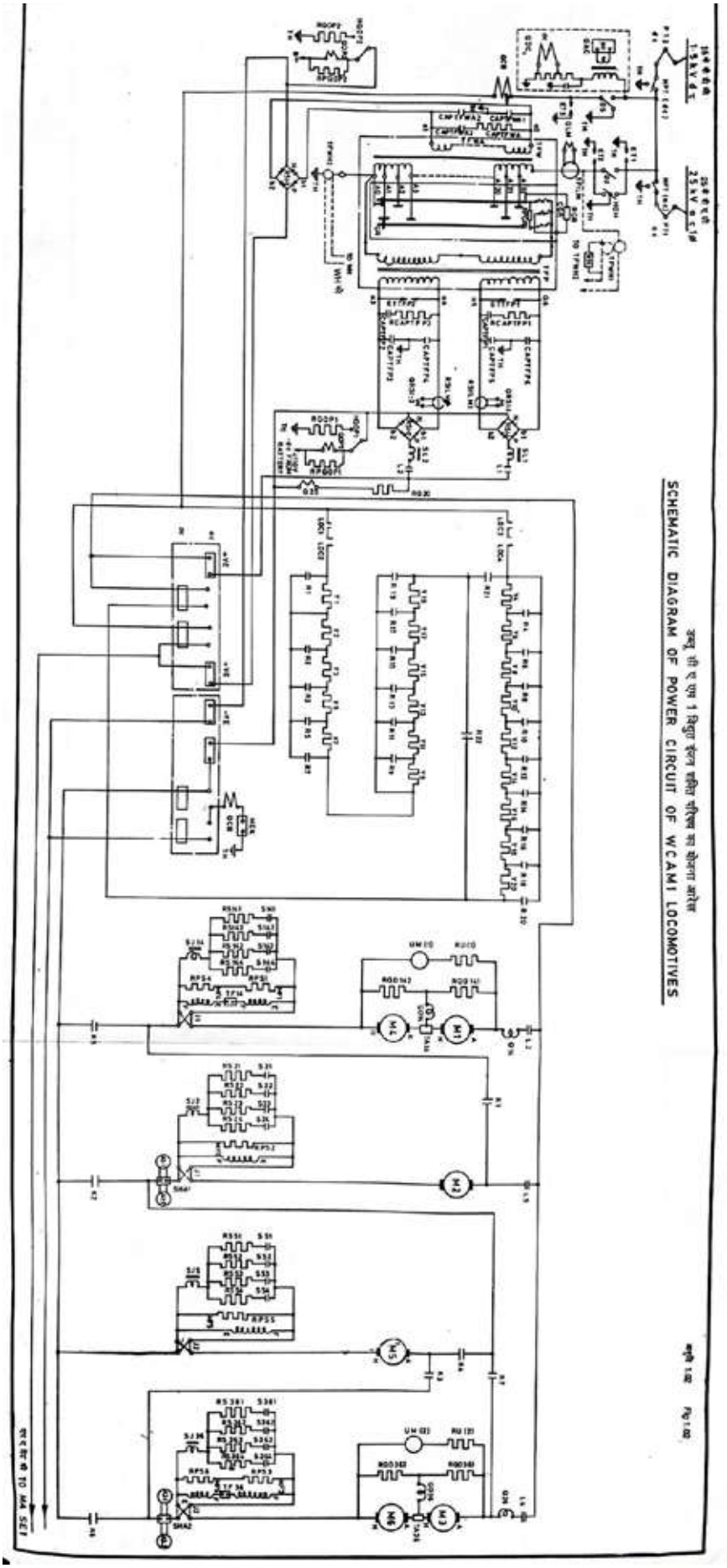
1.1 The development of mercury arc rectifier for rolling stock application, wherein the dc motor could be used for traction became a single major factor for large scale application of single phase 50 Hz 25 kV for mainline electrification. Hitherto the performance of ac traction motor in locomotive had always been considered inferior to its dc counterpart and ac traction was only a compromise solution to save on the cost of OHE. The use of rectifier on the locomotive on the other hand offered an alternative of a superior locomotive to a dc locomotive. Initially water cooled mercury arc rectifiers known as Ignitrons, (ignited internally through an igniting electrode) were used. Indian Railways purchased two types of locomotives of this type (WAM-1 from Europe & WAM-2 from Japan). But they gave way to neater and more reliable solution of externally fired air cooled rectifiers i.e. excitrons. Excitrons had the additional advantage of reversibility i.e. converting dc back to ac and could be utilized for regeneration to a limited extent. Indian Railways imported a few locomotive of this design from Europe (WAG-1) and a sizable fleet was assembled and manufactured at CLW as well. A few Japanese locomotives using silicon rectifiers were also imported (WAG-2).

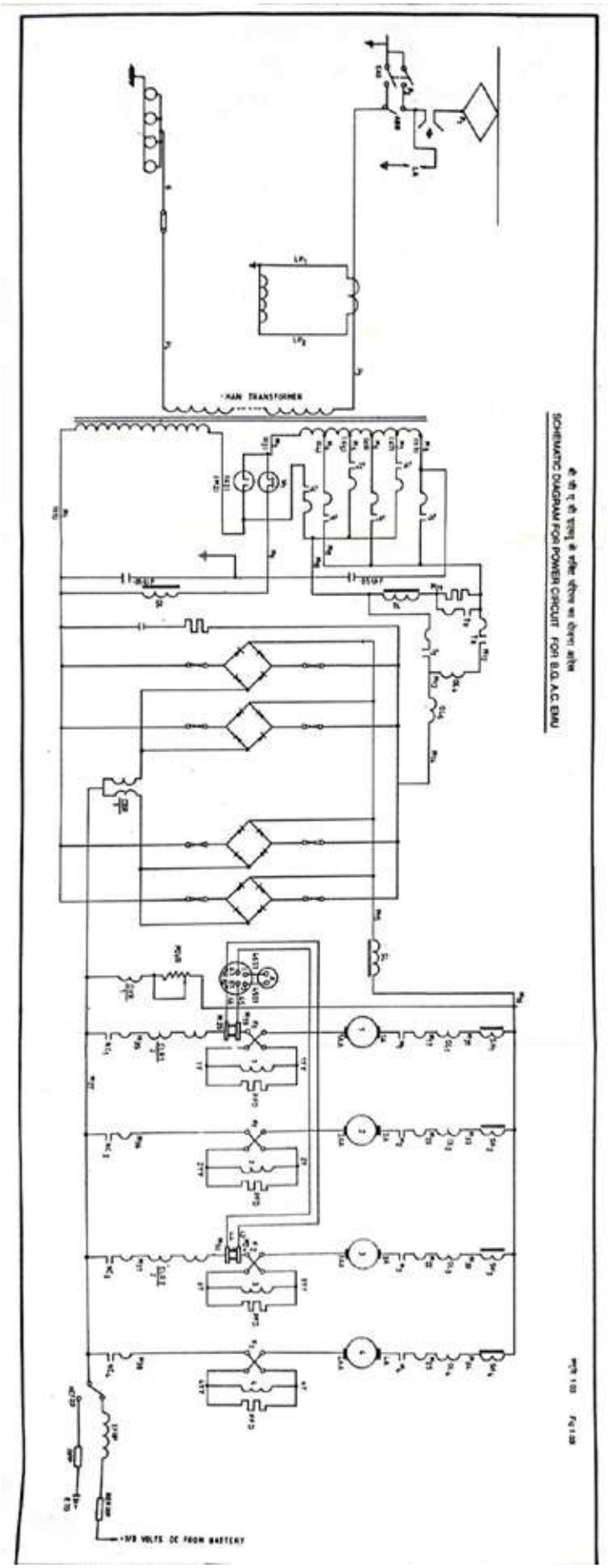
1.2 With the development of High Power Silicon Diode Devices the entire technological development of ac traction stock took a new turn and more powerful units of ac locomotives were conceived. The silicon diode is simple to maintain and is extremely reliable. At present bulk of the fleet of Indian Railways consists of such locomotives.

1.3 Both with mercury arc and silicon rectifiers, the voltage control is achieved by an electro-pneumatically operated tap changer. In the locomotives the high tension tap changer has been

utilized. Typical Power circuit diagrams of WAG-5 and WCAM-1 type locomotives are given in Fig. 1.01 and Fig. 1.02. On some of the WAG-1 and WAM-2 locomotives, silicon rectifier with tap changer control has been replaced by the phase angle controlled thyristor convertor. In three phase locomotives, 3 Phase induction motors are operated on variable voltage variable frequency achieved through GTO thyristors and microprocessor based control system.




SCHEMATIC DIAGRAM OF POWER CIRCUIT OF WCAM1 LOCOMOTIVES


MAIN TRANSFORMER
SCHEMATIC DIAGRAM FOR POWER CIRCUIT FOR B.G.A.C. EMU

1.4 EMU (Electrical Multiple Units) both on MG and BG employ Silicon rectifiers for conversion and LT tap changers are used for voltage control. Salient features of EMU are given in Annexure 1.01/B. A typical power circuit diagram of EMU type WAU-4 is also given in Fig. 1.03. Phase angle controlled thyristor convertor has also been deployed on a few 25kV ac MG EMUs in place of silicon rectifier and LT tap changer on Southern Railway.

1.5 All the Tap changer locomotives were using DC traction motors. The speed/torque regulation is achieved by using either tap changer on transformer or through resistance control on majority of these locomotives. Conventional relay based protection schemes are used. In most of the cases, the driver uses his discretion to diagnose and overcome the problem. Further in view of high failure rate of Tap changer and its associated equipment, inherent problems of brush gear, commutator and low power factor to weight ratio and expensive large diameter cables and large electro-pneumatic reverser, contactors, switches etc., up-gradation is thought of.

1.6 During late 80's, development took place in developed Railways towards three phase induction motor based drives for traction due to the distinct advantages of less maintenance intensiveness in comparison to dc drives. Induction motor drives are also known for extremely effective regeneration, thereby reducing the energy cost.

1.7 IGBT based propulsion technology:

World over GTO technology is getting obsolete. IGBT based propulsion system is already in place in a few countries. To tackle the obsolescence problem and keep abreast of the technology and derive its inherent benefits, CLW has started manufacturing IGBT based propulsion technology. This will be according to TCN open standard interface. In order to sustain 3-phase technology at affordable cost, and to ensure component level standardisation and obsolescence handling, a parallel development has been taken up with C-DAC (under ministry of IT) for indigenous development of TCN based vehicle control system and IGBT based auxiliary converter.

Three phase AC drive technology has become very common and significant for modern rail vehicles. These vehicles are equipped with induction motors as traction motors, power converters with IGBT's and microprocessor control systems. The advantages associated with this technology are evident in technical as well as economic aspects. Three phase induction motors are robust, have high power to weight ratio and better adhesion. The deployment of technically and economically viable system could not be possible without high power IGBTs and microprocessor control system. The use of microprocessor and instrumentation give benefits such as diagnostics, guidance to crew, evolution of condition base monitoring and accurate vehicle control. The regeneration facility offers alternate braking mechanism and energy saving. Unity PF offers great energy saving, possesses low harmonics. Operating software is flexible and can be modified to solve typical traction problems such as pantograph bounce, wheel slip etc

2.0 Sources of Electric Locos

2.1 Indian Railways imported 100 WAM-1 Bo-Bo locomotives from Europe/and 36 WAM-2 and 2 WAM-3 Bo-Bo locomotive from Japan. Subsequent to this, 42 B-B high adhesion (mono motor bogies) locomotives designated as WAG-1 were imported from Europe and 45 designated as WAG-2 from Japan. Ten WAG-3 locomotive of B-B design of higher rating were imported from Europe.

Manufacture of WAG-1 type of locomotive was taken up in Chittaranjan Locomotive Works (CLW) and later on CLW switched over to the manufacture of WAG-4 type of locomotives. After completion of 186 WAG-4 locomotives, Indian Railways switched over to 6-axle locomotive of indigenous design and CLW have "manufactured a series of WAM-4 and WAG-5 locomotives. With a view to improving the performance of the locomotive, WAG-5 locomotives with minor

variations to suit specific application were also manufactured and designated as WAG-5 with different suffixes.

2.2 Eighteen prototype 6000 HP thyristor control locomotives of 3 types designated as WAG- 6A, B & C were imported, six from ASEA and twelve from Hitachi in 1988. A prototype locomotive of 5000 HP capacity with high adhesion bogies, designated as WAG-7 has been designed and manufactured by Chittaranjan Locomotive Works. The Corporate Plan, 1985 for Indian Railways envisaged running of heavy (4500 tonnes) freight trains at a maximum speed of 100 kmph to meet the increasing traffic demands. A tractive power of around 6000 HP is needed for this purpose. In addition improved adhesion characteristics of the locomotive is of a prime requirement. The three phase traction drive in commercial service which can produce high starting torque required for heavy freight operation and at the same time it is possible to operate at higher speeds required for operation of mail/express trains. Taking all these consideration, Railway Board in 1993 placed an order for import of 30 electric locomotives of 4500/4000 KW rating state of art 3 phase technology from M/s ABB Transportation Systems Ltd along with transfer of Technology, Switzerland. Out of these, 10 locomotives (WAP5 class having a speed potential of 160 kmph were for passenger application) and balance 20 locomotives (WAG-9 class were for freight operation up to 100 kmph). With transfer of Technology, CLW has now started manufacturing these locomotives.

2.3 To meet the specific requirements of higher speeds for passenger services, CLW manufactured WAP type locomotive using Co-Co flexi-coil bogies to work upto a speed of 130 km/h designated as WAP-1. This loco has been further upgraded for speed potential of 140 km/h by providing improved version of indigenously designed bogies. This loco is designated as WAP-3. A few WAM-2 locomotives were fitted with modified drive and designated as WAP-2 locomotive.

2.4 A chart exhibiting the salient features of ac electric locomotives is enclosed as Annexure 1.01/B Sheet No. 1 & 2. Major dimensions of the various locos are shown in Annexure 1.02. Load tables for various locomotives are available at Annexure 1.03. Starting tractive effort is limited to 30.0 t for single loco in double headed operation due to limitation of bridges on Indian Railways. Brief write-ups on 6000 HP microprocessor controlled thyristor locomotives are given in Annexure 1.04 and 1.05. Functional description of main circuit of thyristor EMU is given in Annexure 1.06. Functional description of power ckt and Auxiliary ckt of three phase locos is given in Annexure 1.07.

2.5 On 23rd July 1993, through a landmark decision, Indian Railways signed a contract with ABB Transportation (Switzerland) for importing freight and passenger class of locomotives together with transfer of technology agreement for indigenous manufacture. The design was approved by RDSO after many technical interactions, in which, CLW also associated. As ABB did not have much experience in the broad gauge system, they had to customise many aspects of bogies, car body, cab equipment, traction motor etc.

Both WAP5 and WAG9 class have GTO based traction converters and microprocessor based control. This was the first time that CLW handled such high technology locomotives, and it needed a paradigm shift in the management of this technology. The real challenge was posed when the technology was to be absorbed and indigenous production to be done. 11 numbers of passenger locomotives which arrived in 1995-96 were directly put into service after field trials. Rated at 5400 hp, it has a maximum test speed of 180 km/h. These have been tested successfully up to 180 km/h and speed certificate issued for 160-km/h service speed.

6 freight locomotives of WAG9 class received in 1996 in fully assembled and tested condition were also straightaway put on service after trials. This had a rating of 6000 hp with maximum service speed of 100 km/h, capable of delivering 460kN starting tractive effort.

During the year 2000, after mastering vehicle application software by CLW engineers, a new variant WAP7 was built by adapting the original WAG9 design. WAP7 was intended for passenger operation for service speeds up to 130 km/h, which is the maximum speed of Rajdhani and Shatabdi trains today. WAP7 addresses the high-speed segment very well now. With an output of above 6000 hp, this is the most powerful and preferred locomotive for passenger operation today due to its excellent acceleration, deceleration and energy saving features. WAP5 will, however, address the speeds of 160 km/h and above in future, as IR is already working in this direction. CLW went on to build these three classes of locomotives.

A variant WAG9H with an adhesive weight of 135 tonnes was also developed capable of delivering 52 tonnes starting tractive effort targeting 1 in 150 graded sections. Though this locomotive cleared the oscillation trials, this fleet was not built due to other operational reasons-as a result the prototype WAG-9H (#31030) was converted in to WAG-9 class. However, with increased axle loads now being permitted, Railway Board has placed order for 4 locos of WAG-9H class with 22 tonnes axle load. The first locomotive, viz., 31086 with 22 tonnes axle load was flagged off by Hon'ble MR on 29th July 2006 and has entered in to service.

3.0 Mechanical Concepts

3.1 Four axle locomotives had the following types of drives:

1. WAM1 : cordon shaft drive
2. WAM2 and WAM3 : WN coupling drive
3. WAG (1,3 and 4) : coupled gear drive through cordon shaft monomotor bogie European design and also built at CLW.
4. WAG2 : Monomotor bogie with flexible rubber couplings (quill drive) arrangement (Japanese Design)

3.2 The monomotor bogie locomotives had a starting tractive effort of just under 32 tonne with motor power of 790 HP per axle. Except for a few WAG1, WAG2 and WAG3 class locomotives the bulk of the series of WAG1 and WAG4 class were manufactured at Chittaranjan Locomotive Works till early seventies. The performance of these locomotives was also not found to be adequate for meeting increased operating requirements.

3.3 WAM-4 and WAG-5 locomotives which were indigenously manufactured used Co-Co, trimount bogies of ALCO design with axle hung nose-suspended traction motors. Same design of bogie was also used in dual voltage locomotives (WCAM-1). In WAG-6A & B locomotives, with a view to have a high tractive effort and high speeds (beyond 160 km/h), 6-axle locomotive having Bo-Bo-Bo arrangement was adopted. WAG-6A locomotive utilises ASEA hollow shaft drive system whereas WAG-6B locomotive uses WN coupling. In WAG-6 locomotives high, adhesion Co-Co bogies using unidirectional motor and secondary suspension arrangement was adopted. Indigenous high adhesion unidirectional bogies similar to WAG6C have been used in WAG7 locos.

3.4 In WAP1 locomotives, flexicoil bogie modifying the existing WDM-1 (General Motor Design) has been used. WAP4 loco utilises an improved version of this bogie.

3.5 Mechanical features of 3-phase AC loco (WAG-9/ WAP-7)

Flexi float bogie with two stage suspension is used for track friendly design. Fully sprung traction motor is provided in passenger locomotive to reduce stress on track.

The three axle, three motor Co-Co bogie assembly, is one of the major parts of the WAG9 locomotive. Two bogie assemblies support the entire weight of the locomotive and provide a means for transmission of the tractive effort to the rails. General arrangement of the bogie is shown in below Fig.

The bogies are designed to withstand the stresses and vibrations, resulting from normal rolling stock application. An important function of the bogie is to absorb and isolate shocks caused by vibration in the track bed. The suspension system minimizes the transmission of the shocks to the locomotive underframe.

The traction motors are suspended in the bogie frame and on the individual axles. The motors transmit their energy to the driving axles. The motor transmits their energy to the driving axles through a gearbox mounted on the driving axles. The force from the driving axles is transmitted to the contact point between the wheel tread and the rail. Traction force is, in turn transmitted through the axle journal boxes and the guide rods to the bogie frame. The low traction bar, connected between the bogie transom and the car underframe, transmits the tractive forces to the car body.

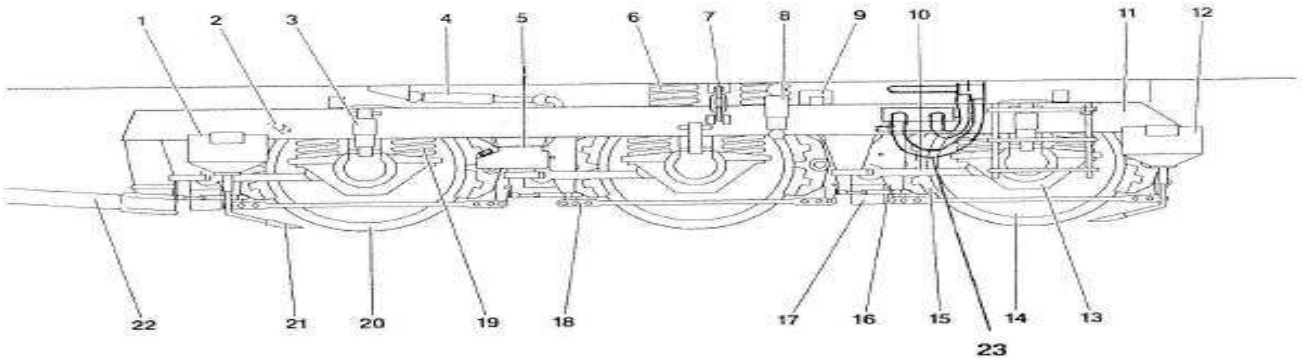
The WAG9 loco is equipped with the following pneumatic braking system: Automatic train brake, direct loco brake, Parking brake and Anti spin brake. As with the tractive effort, braking effort is transmitted to the bogie frame by the axle journal boxes and guide rods and from the bogie frame to the locomotive by the traction rods.

Isolation and absorption of shock loads and vibration is performed by the primary and secondary suspension. Movement between the car body and bogie is smoothly controlled by the primary and secondary suspension. Although the springs permit pre-movement in any direction lateral buffers and dampers limit the amount and rate of lateral movement. Rebound limit change and vertical dampers limit the amount and rate of the vertical rebound of the locomotive car body. Yaw (longitudinal) dampers control the car body pitch rate. Guide rods control the fore and aft movement between the axles and the bogie frame while the link rod controls the fore and aft movement between the bogies and the locomotive car body.

The 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. This “Flexicoil” arrangement permits lateral movement of the axle. Guide rods connected between the axle journal boxes and bogie frame provides longitudinal control on the axle, and the transmission of tractive and braking effort to the bogie frame. Spheribloc rubber bushes in the guide rods allow the axle lateral movement without undue restriction.

Secondary suspension is also provided by coil springs and vertical hydraulic dampers located between the bogie frame and the locomotive underframe on each side of the bogie. The weight of the locomotive car body is carried by the secondary suspension springs. The “Flexi Float” arrangement of the secondary suspension allow the locomotive car body to move both laterally and vertically within certain limits relative to the bogies.

Bogie layout



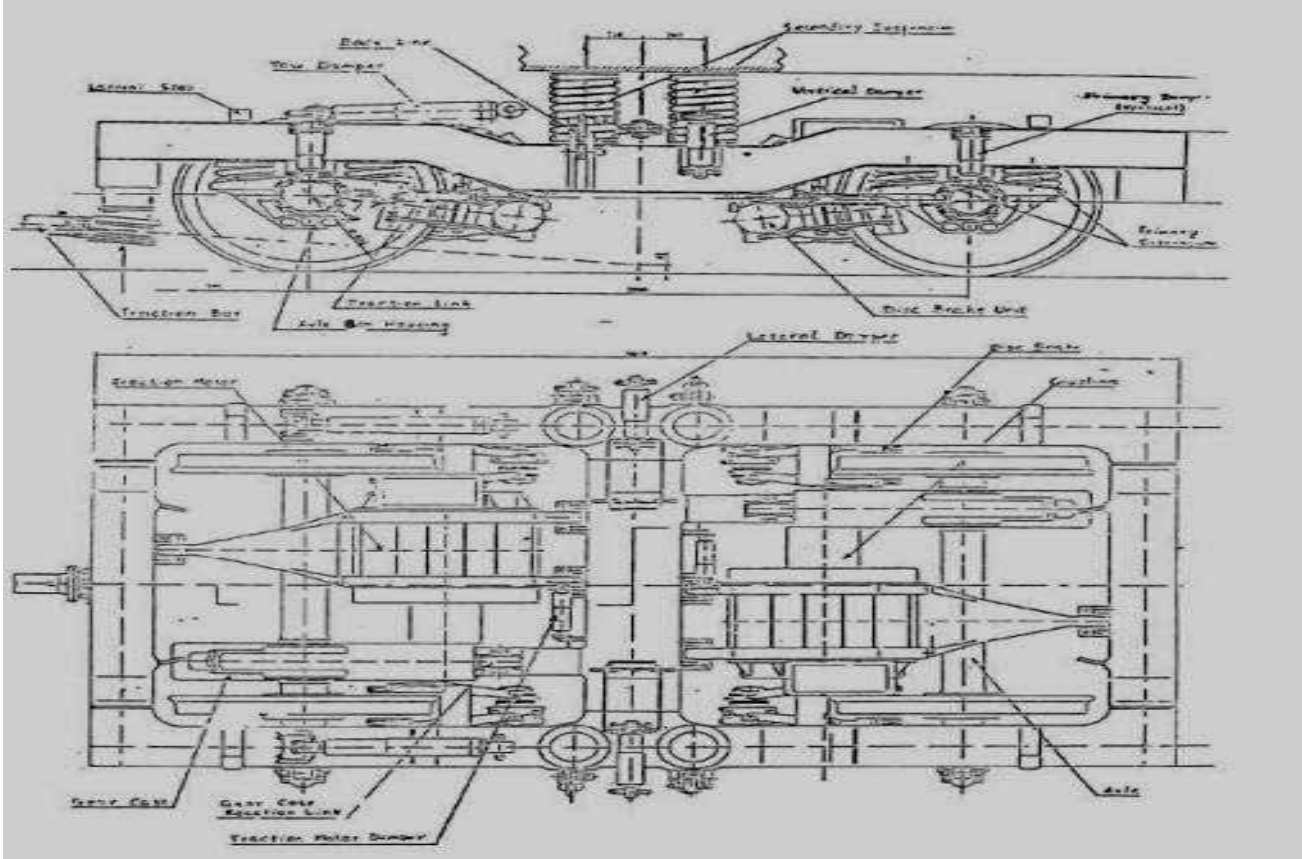
1	Sanding box	2	Wheel flange lubrication nozzle
3	Primary suspension damper	4	Secondary suspension yaw damper
5	Wheel flange lubrication reservoir	6	Secondary suspension spring
7	Safety chain	8	Secondary suspension vertical damper
9	Horizontal damper	10	Wheel set guide
11	Bogie frame	12	Sanding box
13	heel set	14	Wheel
15	Brake blocks	16	Brake lever
17	Brake cylinder	18	Brake rod
19	Primary suspension spring	20	Wheel flange
21	Sanding pipe	22	Traction link
23	Anti compounding valve		

3.6 BOGIE OF WAP5 LOCOMOTIVE:-

The WAP5 locomotive is equipped with 2-axle bolster less Bo-Bo bogies with fully suspended traction motor to reduce unsprung mass. General arrangement of the bogie is shown in below Fig. The bogie has two stages of suspension. The loco body rests on two pairs of secondary helical springs located on bogie long beams. The bogie frame is supported on primary helical spring, resting on the axle boxes. Transverse flexibility between car body and bogie is provided by the flexi-coil action of the secondary helical springs.

Hydraulic dampers are provided in vertical and lateral modes at secondary stage between under frame and bogie frame and in vertical mode in primary stage between axle box and bogie frame to reduce vibrations of the locomotive body. Two dampers provided between loco body and bogie has a special design to give constant damping force in longitudinal mode. One damper is provided on each traction motor to cushion the lateral motion of the motor. Traction links are provided between bogie frame and axle boxes for transfer of traction forces from axle to bogie frame. Traction and breaking forces are transmitted from bogie to under frame through low traction bars. Connection of the traction bars towards the middle of the under frame is aimed to improve the riding behaviour in the cab.

The WAP5 loco is equipped with the following pneumatic breaking systems: Automatic train brake, Direct loco brake, parking brake and Anti spin brake. As with the tractive effort, braking effort is transmitted to the bogie frame by the axle journal boxes and guide rods and from the bogie frame to the locomotive by the traction rods. The locomotive is provided with disc brakes for improved braking performance required for high-speed operation. Fully suspended traction motors have been provided to reduce unsprung mass and improve the riding at high speeds. The smaller wheelbase of the 2-axle bogie and flexi-float suspension arrangement help improve curving behaviour and permit the negotiation of curves at higher speeds.



General Arrangement of Bogie WAP 5 LOCOMOTIVE

1. Bogie Clearance

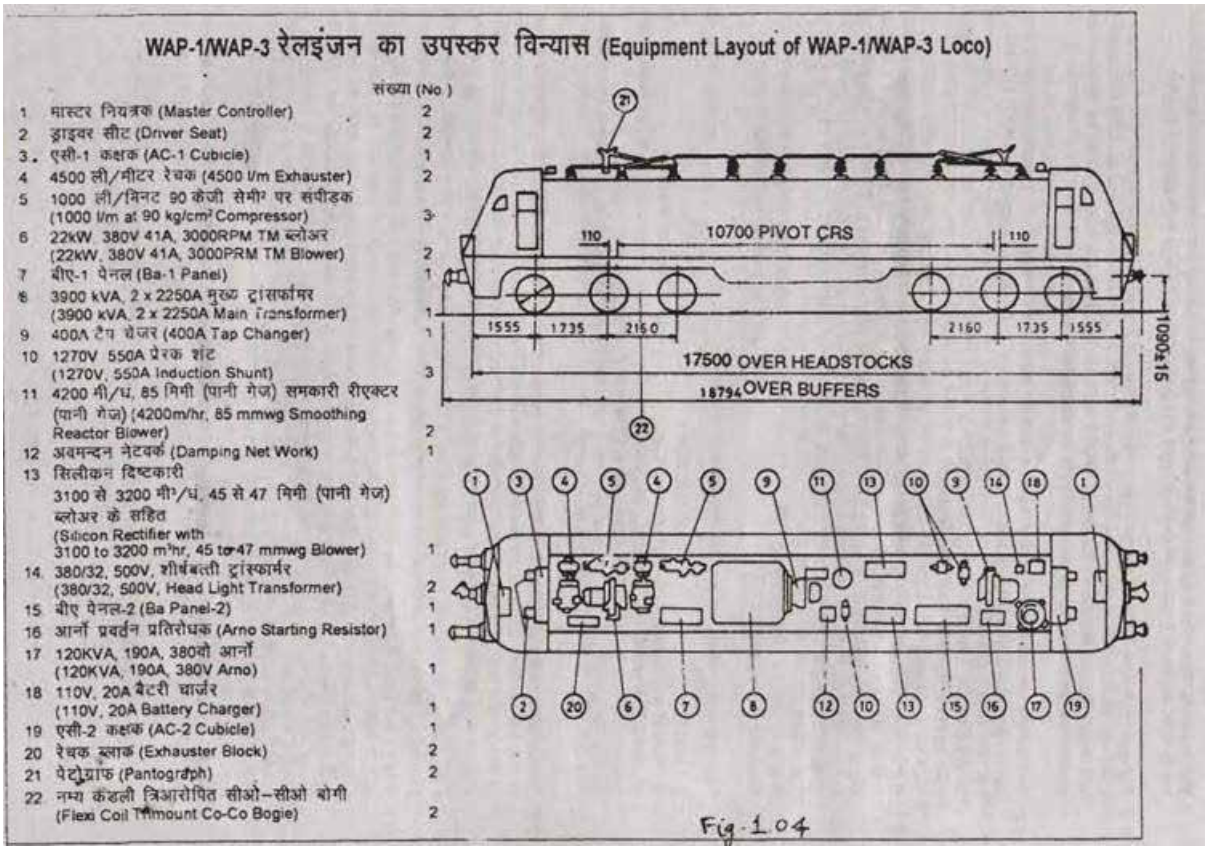
   a. 3-phase locomotives (WAG9/WAP-7) as per Technical circular No. ELRS/TC/0082 (Rev.01) are given below:

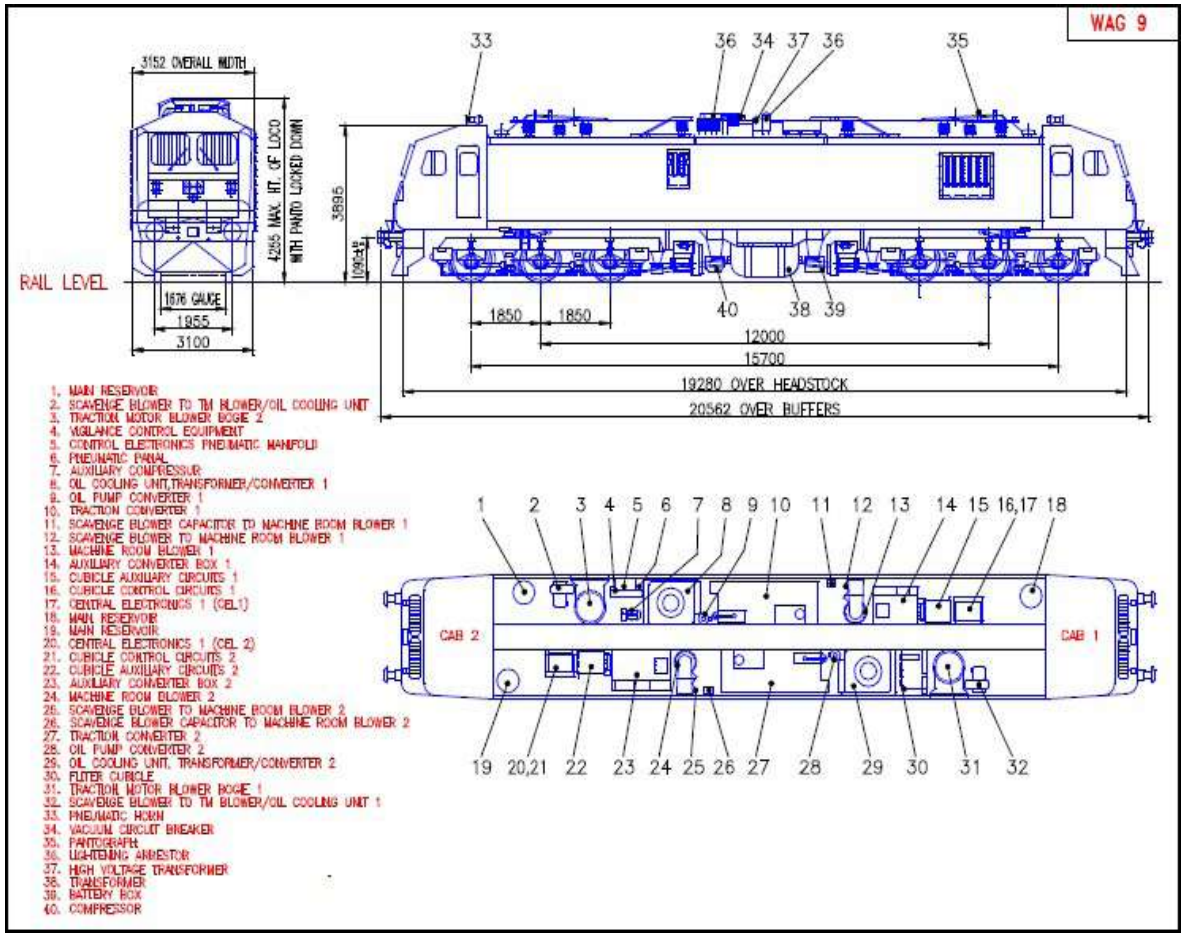
SN.	Clearances	Manufacturing (Design) Limits (mm)	Service Limits (mm)
1	Vertical clearances between Axle box & Bogie frame	30 to 35	27 to 35
2	Lateral clearances between Axle box & Bogie frame	15 to 19	15 to 22
3	Vertical clearances between Bogie frame & Under frame	35 to 60	32 to 60
4	Lateral clearances between Bogie frame & Under frame	45 to 50	o 55

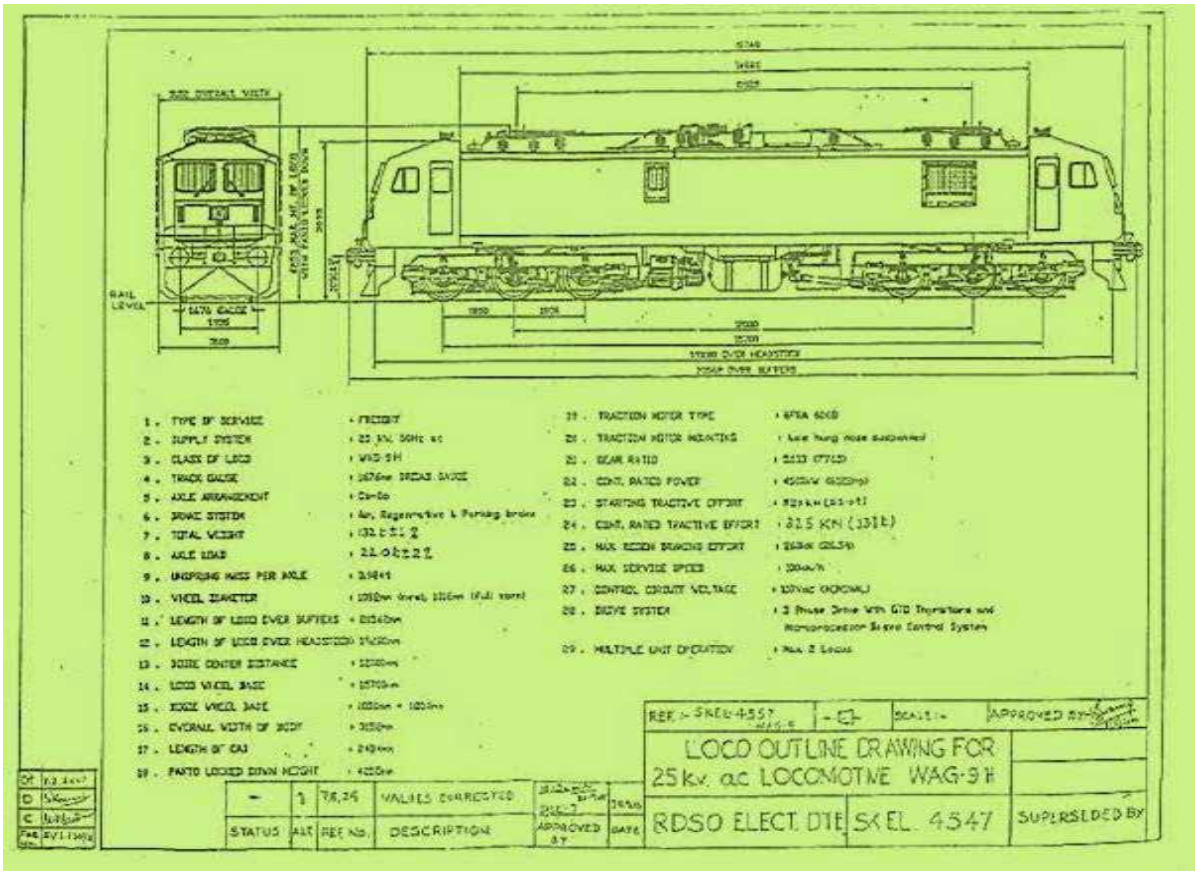
b. Conventional locomotives as per Motive Power Instruction Bulletin No. MP.IB.BD.02.16.01 (Rev. 01) dated 31.12.2009

Loco	Clearance			
	Measurement	New Condition		Service Limit
		Min.	Max.	
WAM-4 (with high Speed axleboxesfitted with Conicalrubber Thrustpads)	Lateral Clearances End Axle per axle (C1 + C2 + C3 + C4)	22.4	24.8	30.0
	Lateral Clearances Middle Axle per axle (B1+B2 +B3+ B4)	4.0	6.6	12.0
	Longitudinal Clearances Middle &End Axle per axle box (A1 + A2)	0.4	1.9	3.5
WAP-1 / WAP-4	Lateral Clearances End Axle per axle (C1 + C2 + C3 + C4)	15.4	18.2	24.0
	Lateral Clearances Middle Axle per axle (B1+B2 +B3+ B4)	3.6	7.2	12.0
	Longitudinal Clearances Middle &End Axle per axle box (A1 + A2)	0.4	2.0	4.0
WAG-7	Lateral Clearances End Axle per axle (C1 + C2 + C3 + C4)	22.0	25.2	30.7
	Lateral Clearances Middle Axle per axle (B1+B2 +B3+ B4)	2.4	6.0	11.5
	Longitudinal Clearances Middle &End Axle per axle box (A1 + A2)	2.0	4.0	6.0

3.7 Outline diagram of all Electric Locomotives (As per Data Book of Electric locomotive Publication No. RDSO/EL/PUB/0001 Rev '0')

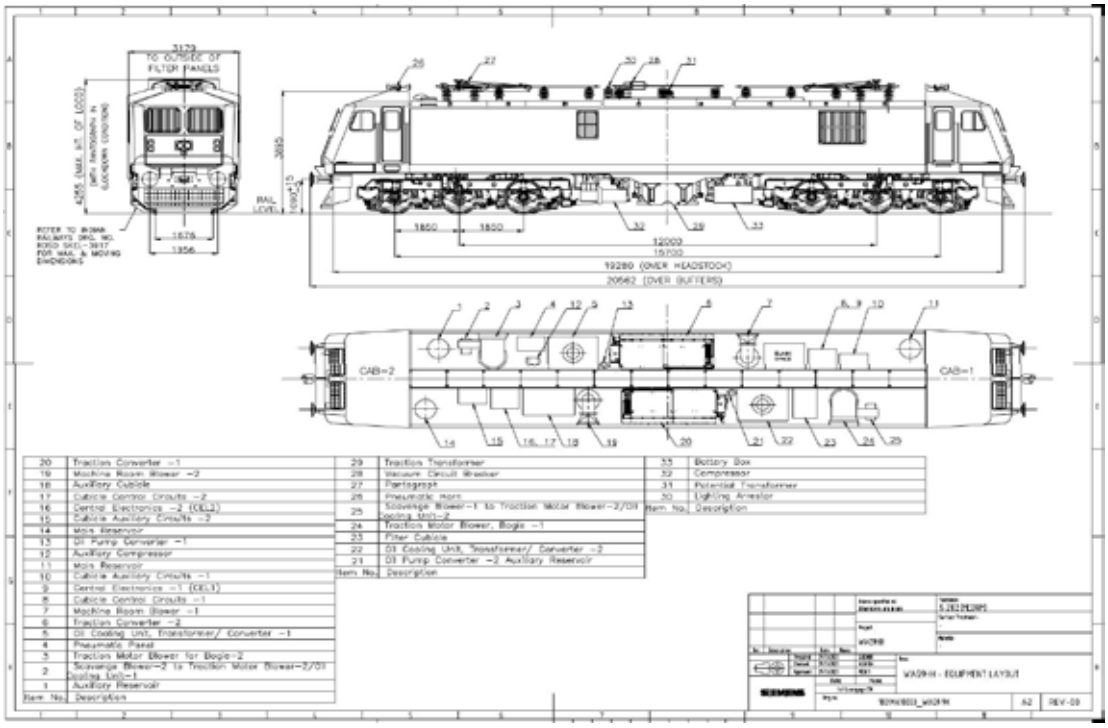



WAG 9
3152 OVERALL WIDTH
4265 MAX. HT. OF LOCO WITH PANTO LOCKED DOWN
3895
RAIL LEVEL
1676 GAUGE
1855
3100
1850
1850
12000
15700
19280 OVER HEADSTOCK
20562 OVER BUFFERS
CAB 2
CAB 1
1. MAIN RESERVOIR
2. SCAVENGE BLOWER TO TM BLOWER/OIL COOLING UNIT
3. TRACTION MOTOR BLOWER BOGIE 2
4. VIGILANCE CONTROL EQUIPMENT
5. CONTROL ELECTRONICS PNEUMATIC MANIFOLD
6. PNEUMATIC PANAL
7. AUXILIARY COMPRESSOR
8. OIL COOLING UNIT,TRANSFORMER/CONVERTER 1
9. OIL PUMP CONVERTER 1
10. TRACTION CONVERTER 1
11. SCAVENGE BLOWER CAPACITOR TO MACHINE ROOM BLOWER 1
12. SCAVENGE BLOWER TO MACHINE ROOM BLOWER 1
13. MACHINE ROOM BLOWER 1
14. AUXILIARY CONVERTER BOX 1
15. CUBICLE AUXILIARY CIRCUITS 1
16. CUBICLE CONTROL CIRCUITS 1
17. CENTRAL ELECTRONICS 1 (CEL1)
18. MAIN RESERVOIR
19. MAIN RESERVOIR
20. CENTRAL ELECTRONICS 1 (CEL 2)
21. CUBICLE CONTROL CIRCUITS 2
22. CUBICLE AUXILIARY CIRCUITS 2
23. AUXILIARY CONVERTER BOX 2
24. MACHINE ROOM BLOWER 2
25. SCAVENGE BLOWER TO MACHINE ROOM BLOWER 2
26. SCAVENGE BLOWER CAPACITOR TO MACHINE ROOM BLOWER 2
27. TRACTION CONVERTER 2
28. OIL PUMP CONVERTER 2
29. OIL COOLING UNIT, TRANSFORMER/CONVERTER 2
30. FLITER CUBICLE
31. TRACTION MOTOR BLOWER BOGIE 1
32. SCAVENGE BLOWER TO TM BLOWER/OIL COOLING UNIT 1
33. PNEUMATIC HORN
34. VACUUM CIRCUIT BREAKER
35. PANTOGRAPH
36. LIGHTENING ARRESTOR
37. HIGH VOLTAGE TRANSFORMER
38. TRANSFORMER
39. BATTERY BOX
40. COMPRESSOR

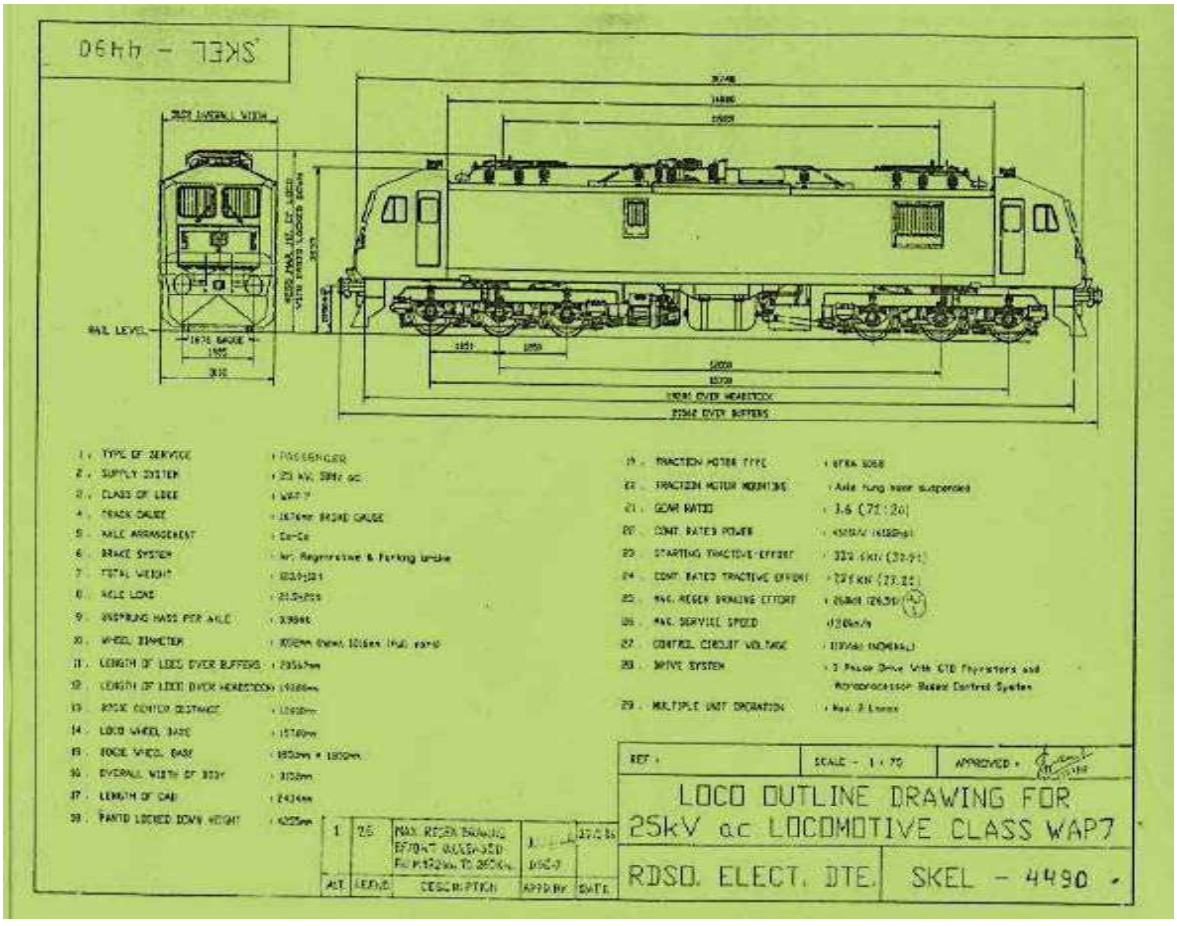

LOCO OUTLINE DRAWING FOR
25 kv. ac LOCOMOTIVE WAG-9 H
RDSO ELECT DTE
SKEL 4547
SUPERSEDED BY
VALUES CORRECTED
DESCRIPTION

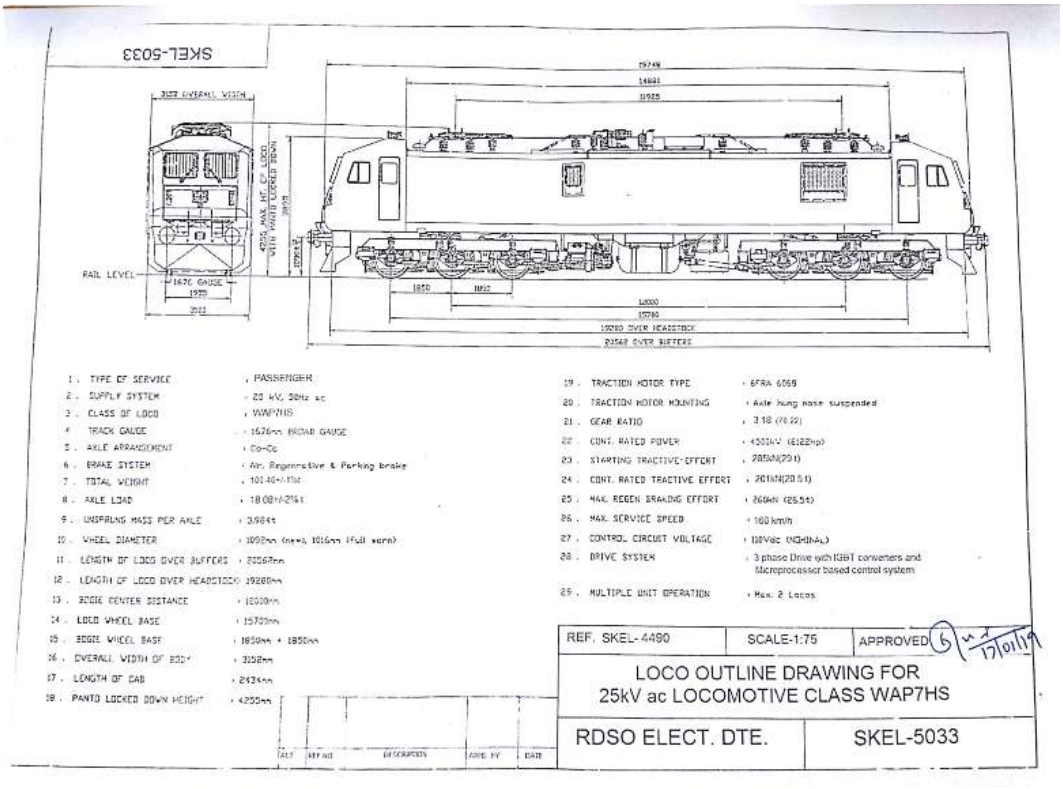
File No. RDSO-EL/0/TPS(UPGR)/2/2020-O/o PED/SE/RDSO

Equipment Layout Drawing of Locomotive

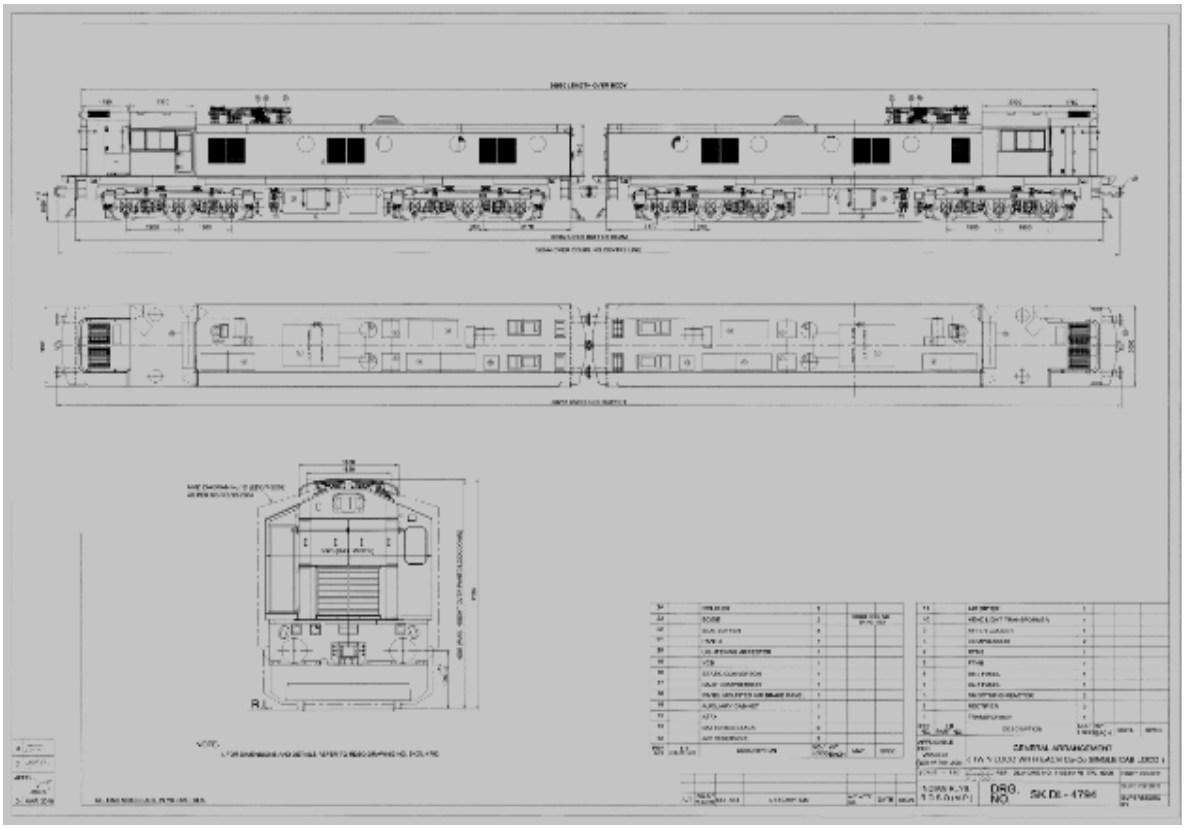


Locomotive equipment Layout WAG-9HH

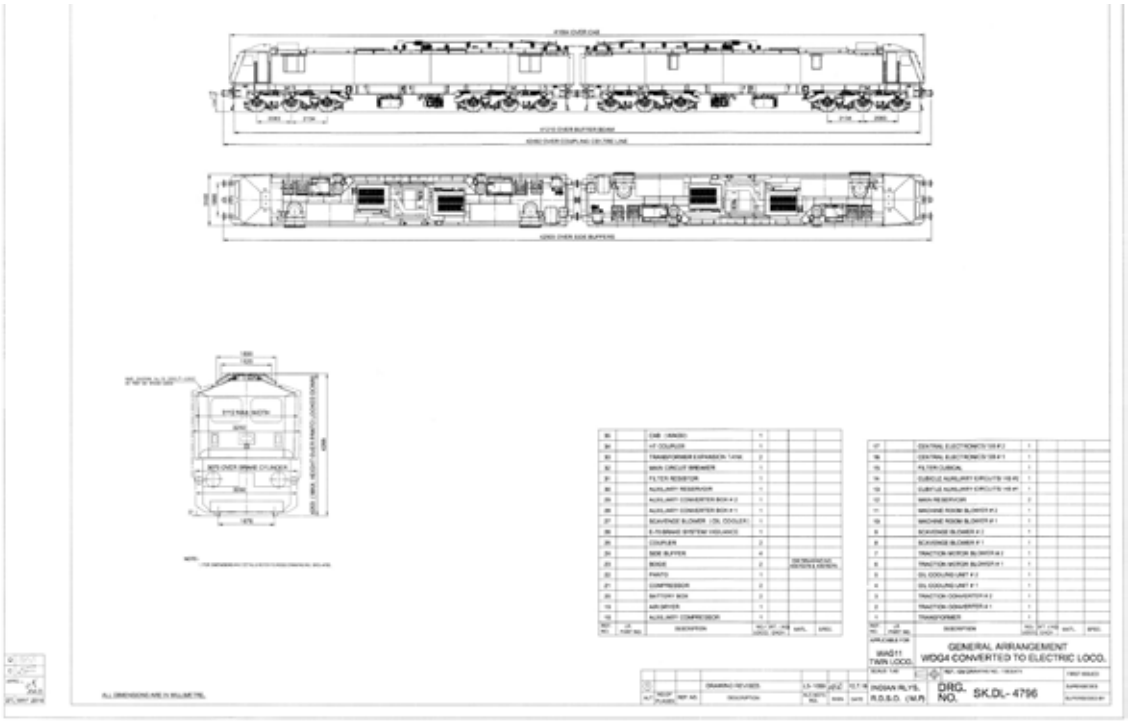




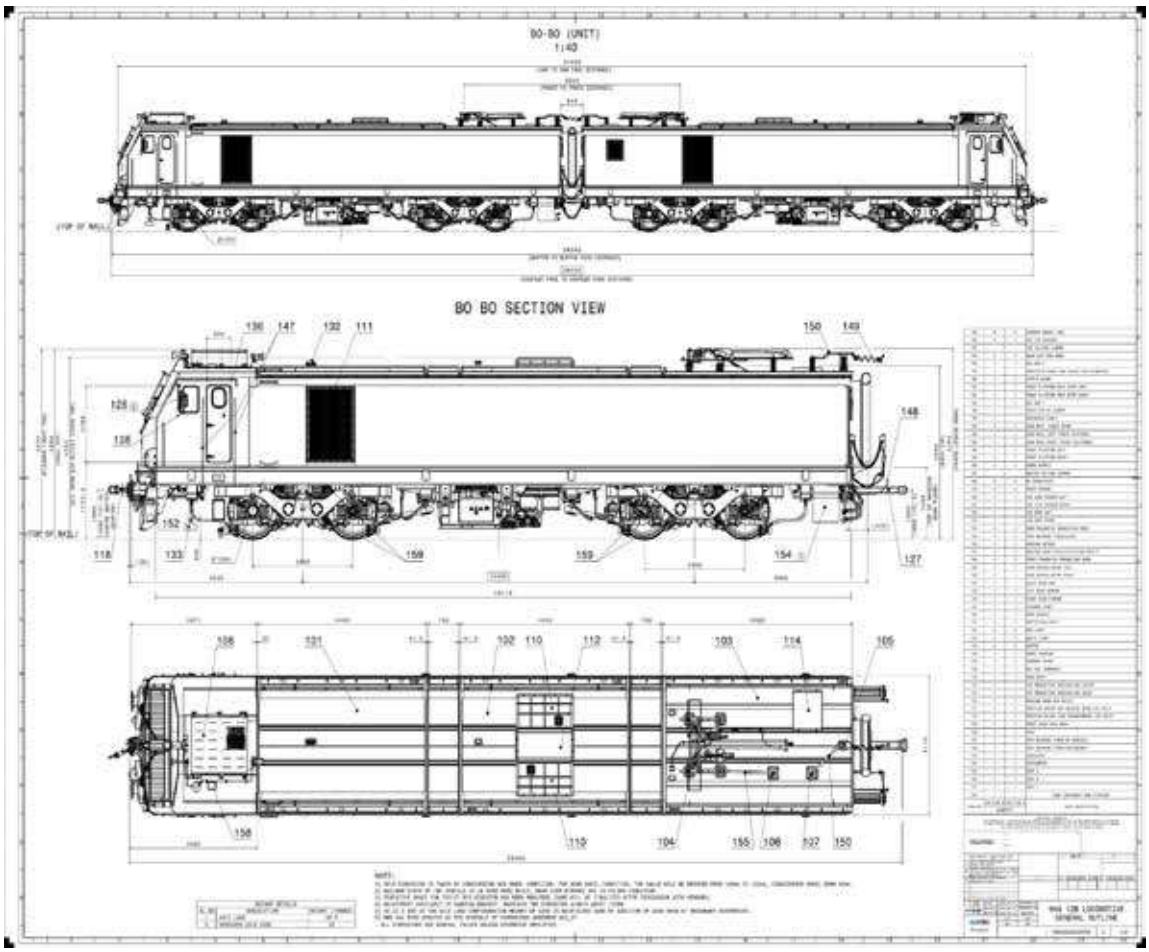
Locomotive equipment Layout WAP-7HS



General Arrangement of twin WAGC3 /WAG-10 loco

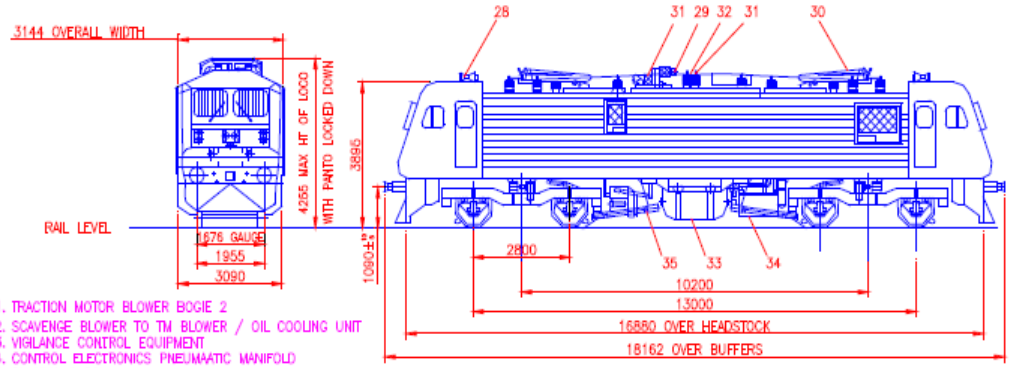


General Layout of WAG-11 Locomotive

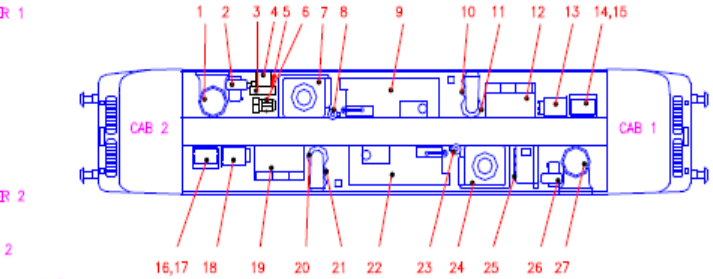


General Layout of WAG-11 Locomotive

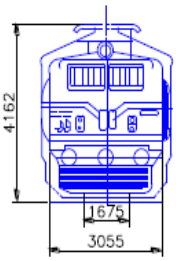
WAP 5

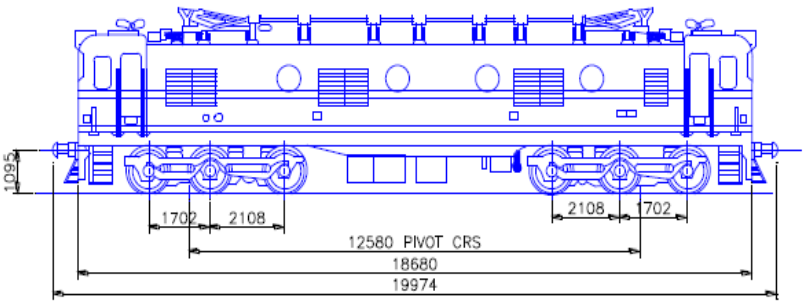


1. TRACTION MOTOR BLOWER BOGIE 2
2. SCAVENGE BLOWER TO TM BLOWER / OIL COOLING UNIT
3. VIGILANCE CONTROL EQUIPMENT
4. CONTROL ELECTRONICS PNEUMAATIC MANIFOLD
5. PNEUMATIC PANEL
6. AUXILIARY COMPRESSOR
7. OIL COOLING UNIT, TRANSFORMER/CONVERTER 1
8. OIL PUMP CONVERTER 1
9. TRACTION CONVERTER 1
10. SCAVENGE BLOWER TO MACHINE ROOM BLOWER 1
11. MACHINE ROOM BLOWER 1
12. AUXILIARY CONVERTER BOX 1
13. CUBICLE AUXILIARY CIRCUITS 1
14. CUBICLE CONTROL CIRCUITS 1
15. CENTRAL ELECTRONICS 1 (CEL1)
16. CENTRAL ELECTRONICS 1 (CEL 2)
17. CUBICLE CONTROL CIRCUITS 2
18. CUBICLE AUXILIARY CIRCUITS 2
19. AUXILIARY CONVERTER BOX 2
20. MACHINE ROOM BLOWER 2
21. SCAVENGE BLOWER TO MACHINE ROOM BLOWER 2
22. TRACTION CONVERTER 2
23. OIL PUMP CONVERTER 2
24. OIL COOLING UNIT, TRANSFORMER/CONVERTER 2
25. FLITER CUBICLE
26. SCAVENGE BLOWER TO TM BLOWER/OIL COOLING UNIT 1
27. TRACTION MOTOR BLOWER BOGIE 1
28. PNEUMATIC HORN
29. VACUUM CIRCUIT BREAKER
30. PANTOGRAPH
31. LIGHTENING ARRESTOR
32. HIGH VOLTAGE TRANSFORMER
33. TRANSFORMER
34. BATTERY BOX
35. COMPRESSOR

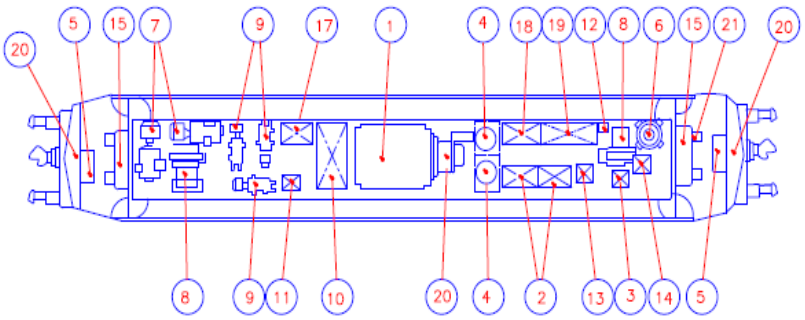


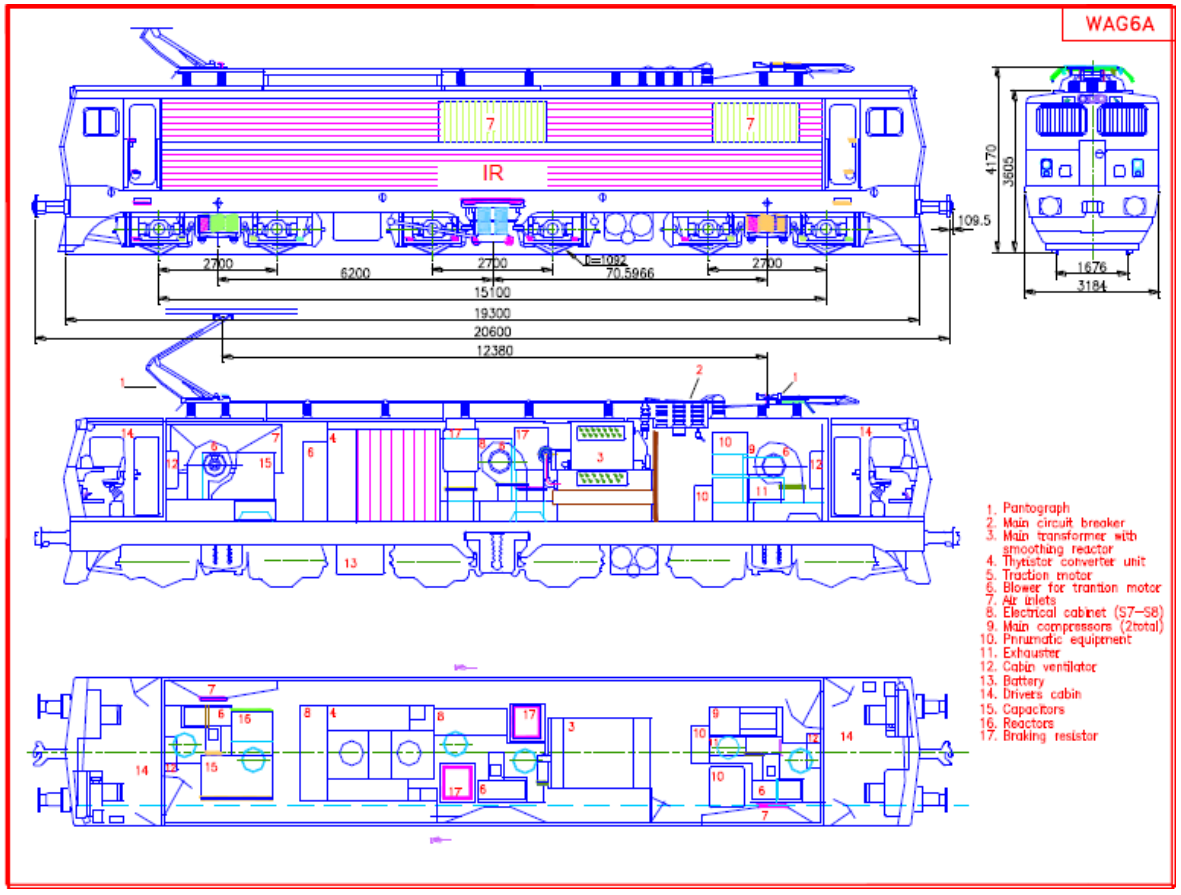
WAG5

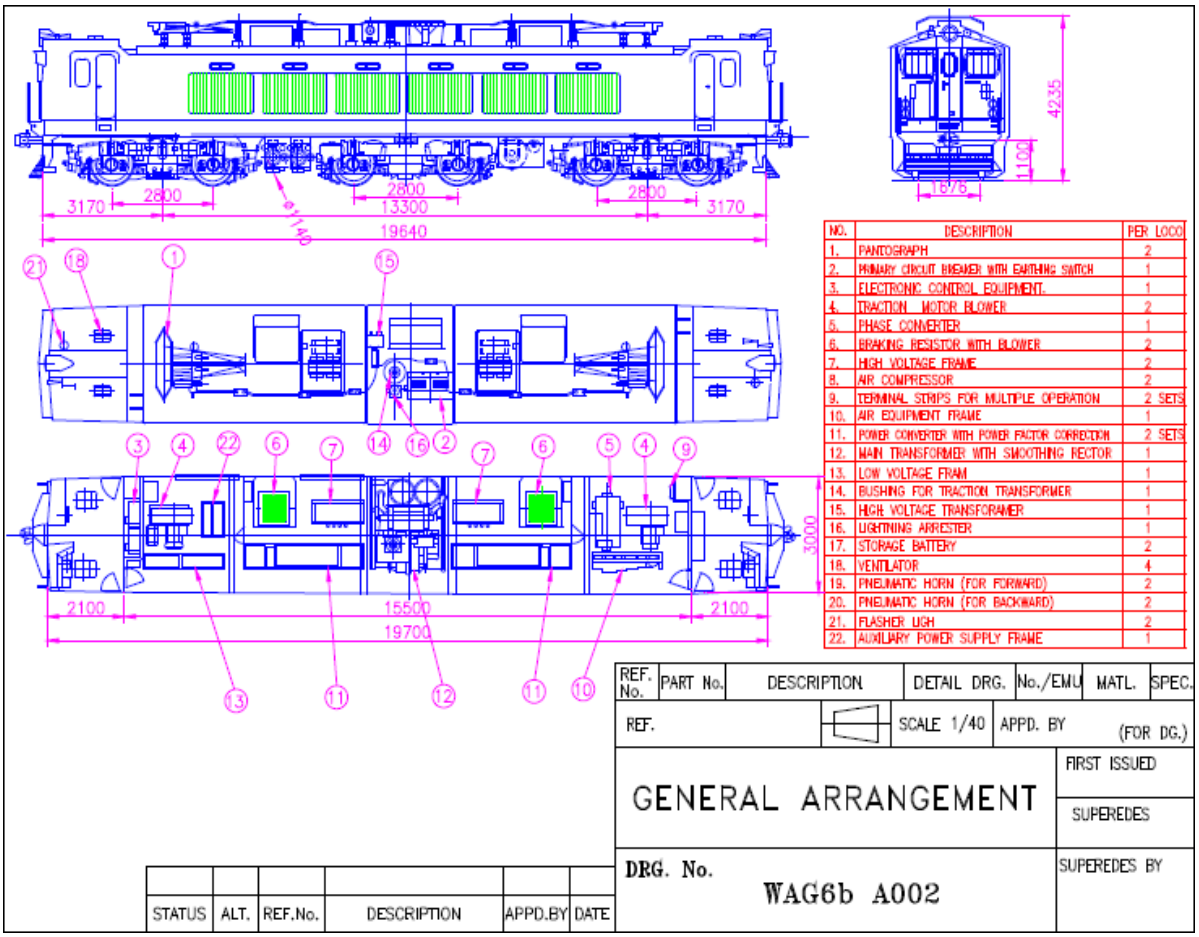




1. TRANSFORMER.
2. SILICON RECTIFIER.
3. BATTERY CHARGER.
4. SMOOTHING RREACTOR.
5. MASTER CONTROLLER.
6. ARNO.
7. EXHAUSTER.
8. T.M.BLOWER.
9. COMPRESSOR.
10. BRAKE RESISTOR.
11. EXCITATION TRANSFORMER.
12. HEAD LIGHT TRANSFORMER.
13. DAMPING NETWORK.
14. ARNO STARTING RESISTOR.
15. PNEUMATIC CABINET.
16. AUXILIARY CABINET.
17. Ba–PANEL.
18. Ba–2 PANEL
19. Ba–3 PANEL
20. DRIVERS DESK.







NO.	DESCRIPTION	PER LOCO
1.	PANTOGRAPH	2
2.	PRIMARY CIRCUIT BREAKER WITH EARTHING SWITCH	1
3.	ELECTRONIC CONTROL EQUIPMENT.	1
4.	TRACTION MOTOR BLOWER	2
5.	PHASE CONVERTER	1
6.	BRAKING RESISTOR WITH BLOWER	2
7.	HIGH VOLTAGE FRAME	2
8.	AIR COMPRESSOR	2
9.	TERMINAL STRIPS FOR MULTIPLE OPERATION	2 SETS
10.	AIR EQUIPMENT FRAME	1
11.	POWER CONVERTER WITH POWER FACTOR CORRECTION	2 SETS
12.	MAIN TRANSFORMER WITH SMOOTHING RECTOR	1
13.	LOW VOLTAGE FRAM	1
14.	BUSHING FOR TRACTION TRANSFORMER	1
15.	HIGH VOLTAGE TRANSFORAMER	1
16.	LIGHTNING ARRESTER	1
17.	STORAGE BATTERY	2
18.	VENTILATOR	4
19.	PNEUMATIC HORN (FOR FORWARD)	2
20.	PNEUMATIC HORN (FOR BACKWARD)	2
21.	FLASHER UGH	2
22.	AUXILIARY POWER SUPPLY FRAME	1

REF. No.	PART No.	DESCRIPTION	DETAIL DRG.	No./EMU	MATL.	SPEC.
REF.			SCALE 1/40	APPD. BY	(FOR DG.)	

GENERAL ARRANGEMENT

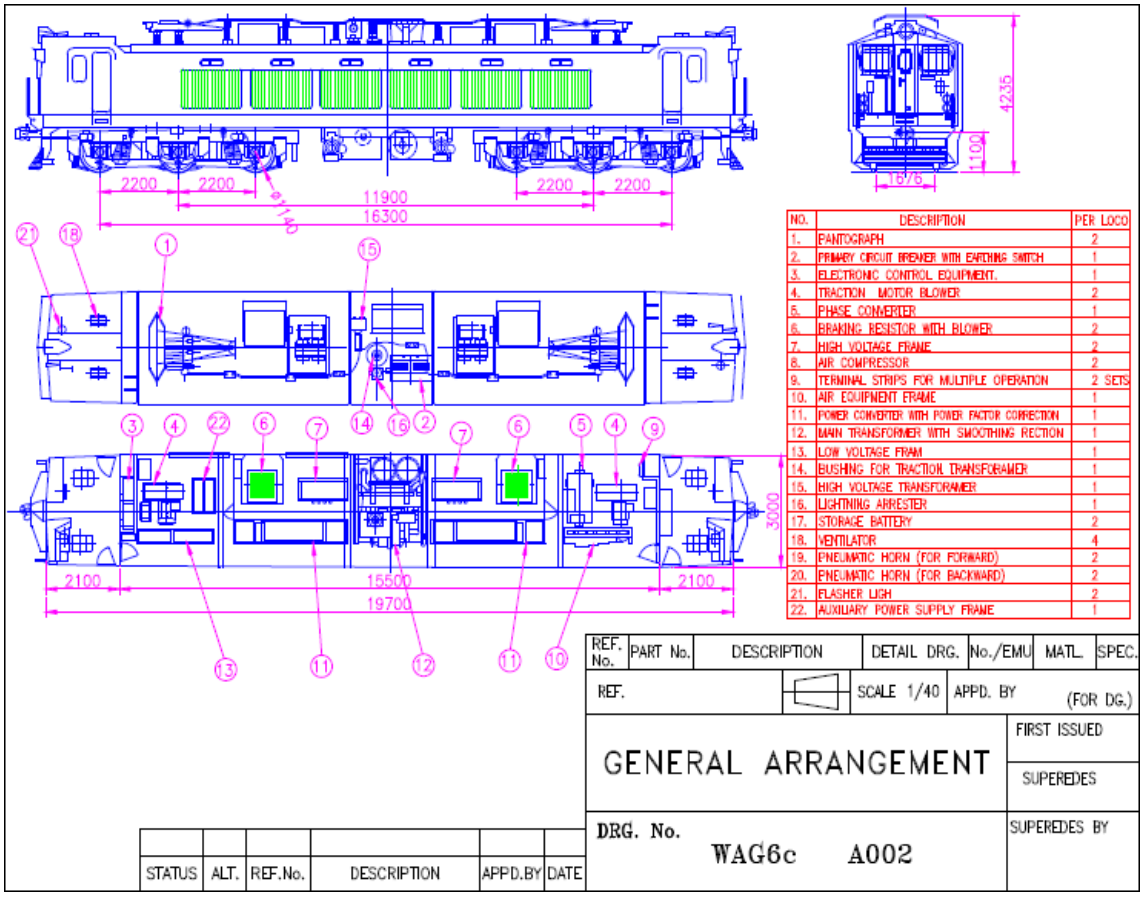
FIRST ISSUED

SUPEREDES

DRG. No. WAG6b A002

SUPEREDES BY

STATUS	ALT.	REF.No.	DESCRIPTION	APPD.BY	DATE



NO.	DESCRIPTION	PER LOCO
1.	PANTOGRAPH	2
2.	PRIMARY CIRCUIT BREAKER WITH EARTHING SWITCH	1
3.	ELECTRONIC CONTROL EQUIPMENT.	1
4.	TRACTION MOTOR BLOWER	2
5.	PHASE CONVERTER	1
6.	BRAKING RESISTOR WITH BLOWER	2
7.	HIGH VOLTAGE FRAME	2
8.	AIR COMPRESSOR	2
9.	TERMINAL STRIPS FOR MULTIPLE OPERATION	2 SETS
10.	AIR EQUIPMENT FRAME	1
11.	POWER CONVERTER WITH POWER FACTOR CORRECTION	1
12.	MAIN TRANSFORMER WITH SMOOTHING RECTION	1
13.	LOW VOLTAGE FRAM	1
14.	BUSHING FOR TRACTION TRANSFORAMER	1
15.	HIGH VOLTAGE TRANSFORAMER	1
16.	LIGHTNING ARRESTER	1
17.	STORAGE BATTERY	2
18.	VENTILATOR	4
19.	PNEUMATIC HORN (FOR FORWARD)	2
20.	PNEUMATIC HORN (FOR BACKWARD)	2
21.	FLASHER LIGH	2
22.	AUXILIARY POWER SUPPLY FRAME	1

REF. No.	PART No.	DESCRIPTION	DETAIL DRG.	No./EMU	MATL.	SPEC.
REF.		SCALE 1/40	APPD. BY	(FOR DG.)		

GENERAL ARRANGEMENT

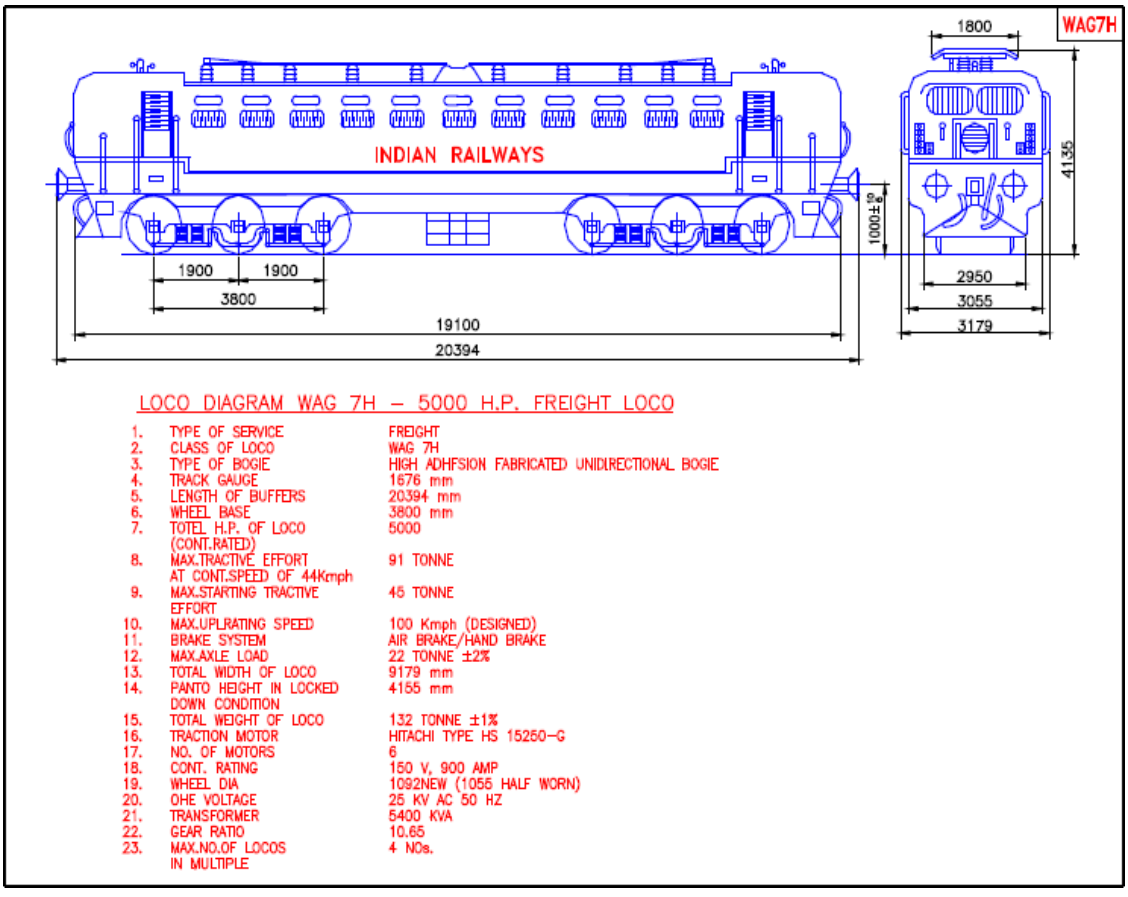
FIRST ISSUED

SUPEREDES

DRG. No. WAG6c A002

SUPEREDES BY

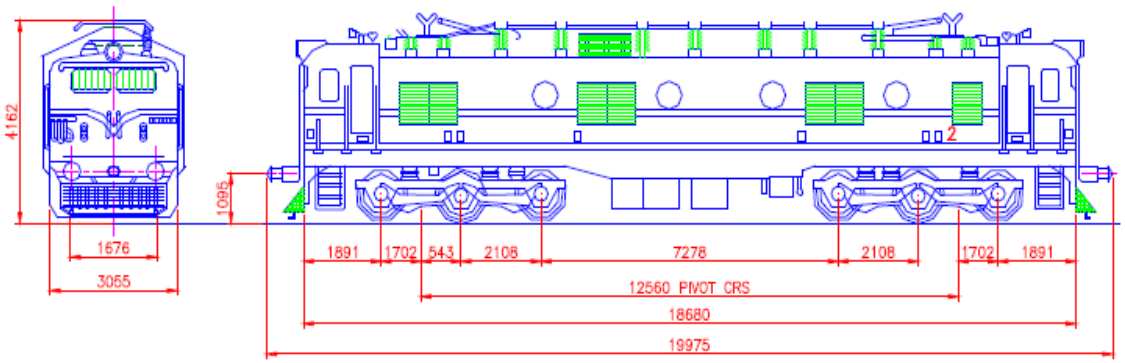
STATUS	ALT.	REF.No.	DESCRIPTION	APPD.BY	DATE



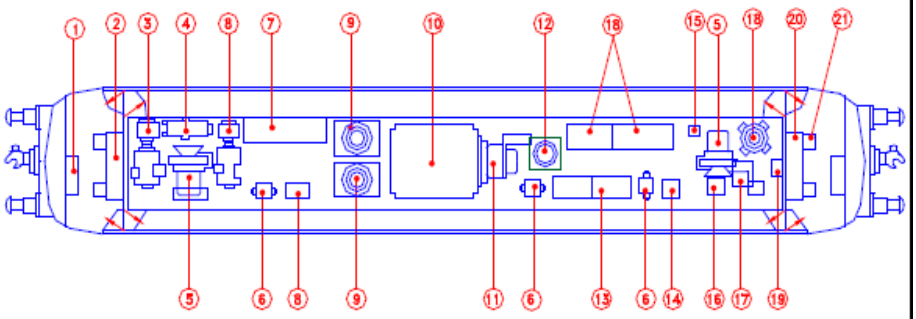
LOCO DIAGRAM WAG 7H – 5000 H.P. FREIGHT LOCO

1.	TYPE OF SERVICE	FREIGHT
2.	CLASS OF LOCO	WAG 7H
3.	TYPE OF BOGIE	HIGH ADHESION FABRICATED UNIDIRECTIONAL BOGIE
4.	TRACK GAUGE	1676 mm
5.	LENGTH OF BUFFERS	20394 mm
6.	WHEEL BASE	3800 mm
7.	TOTEL H.P. OF LOCO (CONT.RATED)	5000
8.	MAX.TRACTIVE EFFORT AT CONT.SPEED OF 44Kmph	91 TONNE
9.	MAX.STARTING TRACTIVE EFFORT	45 TONNE
10.	MAX.UPLRATING SPEED	100 Kmph (DESIGNED)
11.	BRAKE SYSTEM	AIR BRAKE/HAND BRAKE
12.	MAX.AXLE LOAD	22 TONNE ±2%
13.	TOTAL WIDTH OF LOCO	9179 mm
14.	PANTO HEIGHT IN LOCKED DOWN CONDITION	4155 mm
15.	TOTAL WEIGHT OF LOCO	132 TONNE ±1%
16.	TRACTION MOTOR	HITACHI TYPE HS 15250–G
17.	NO. OF MOTORS	6
18.	CONT. RATING	150 V, 900 AMP
19.	WHEEL DIA	1092NEW (1055 HALF WORN)
20.	OHE VOLTAGE	25 KV AC 50 HZ
21.	TRANSFORMER	5400 KVA
22.	GEAR RATIO	10.65
23.	MAX.NO.OF LOCOS IN MULTIPLE	4 NOs.

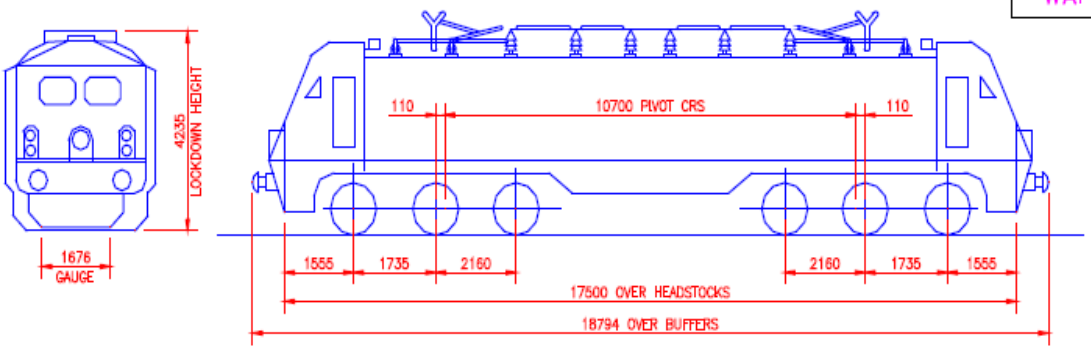
WAM4



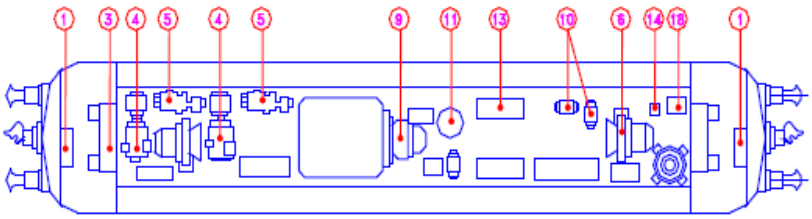
1. DRIVER'S DESK
2. PNEUMATIC CABINAT
3. EXHAUSTER SET
4. COMPRESSOR SET
5. T.M. BLOWER SET
6. INDUCTIVE SHUNT
7. H.T. PANNEL
8. EXCITATION TRANSFORMER
9. BRAKE RESISTER
10. TRANSFORMER ASSEMBLY
11. TAP CHANGER
12. SMOOTHING REACTOR
13. RECTIFIERS
14. R.C. NETWORK
15. HEAD LIGHT TRANSFORMER
16. BATTERY CHARGER
17. ARNO STARTING RESISTER
18. ARNO
19. CONTROL PANNEL TK-2
20. CONTROL CABINATE
21. DRIVER'S SEAT



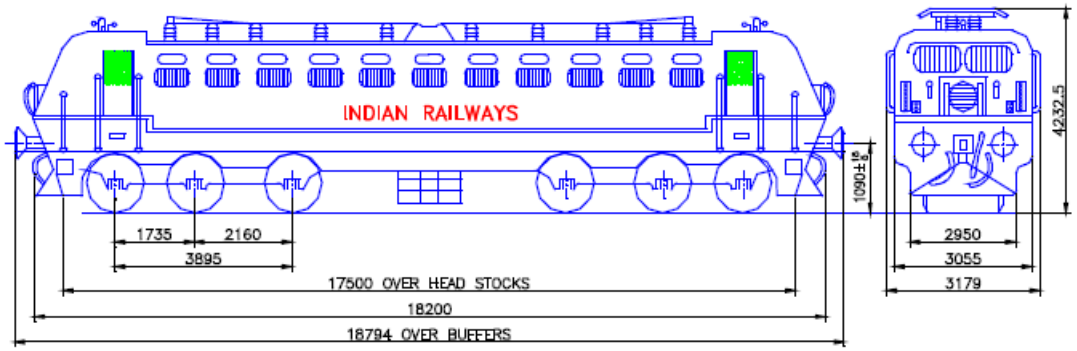
WAP1



1. MASTER CONTROLLER
2. DRIVER'S SEAT
3. AC-1 CUBICLE
4. EXHAUSTER.
5. COMPRASSOR.
6. T-M BLOWER.
7. Ba PANNEL-1.
8. MAIN TRANSFORMER.
9. TAP CHANGER.
10. INDUCTIVE SHUNT.
11. SMOOTHING REACTOR WITH BLOWER.
12. DAMPING NETWORK.
13. SILICON RECTIFIRE WITH BLOWER.
14. HEAD TRANSFORMER.
15. Ba PANNEL - 2.
16. ARNO STARTING REACTOR.
17. ARNO.
18. BATTERY CHARGER.
19. AC-2 CUBICLE.
20. EXHAUSTER BLOCK.



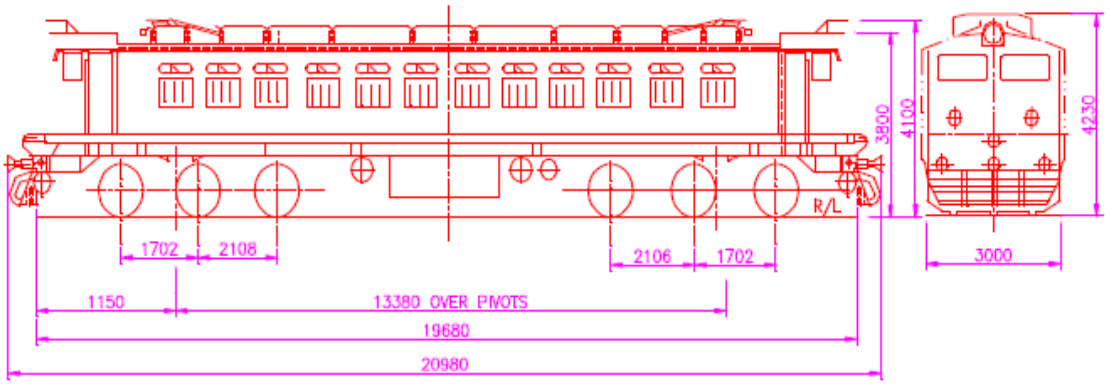
WAP4



SALIENT DATA OF WAP 4 – 5000 H.P.

1.	TYPE OF SERVICE	HIGH SPEED PASSENGER
2.	CLASS OF LOCO	WAP 4 – 5000 H.P.
3.	TYPE OF BOGIE	FLEXICOIL (CO–CO) MARK I
4.	TRACK GAUGE	1676 mm
5.	LENGTH OF BUFFERS	18794 mm
6.	WHEEL BASE	3895 mm
7.	TOTEL H.P. OF LOCO (CONT.RATED)	5060
8.	MAX.TRACTIVE EFFORT AT CONT.SPEED OF 72Kmph	19 TONNE
9.	MAX.STARTING TRACTIVE EFFORT	30.8 TONNE
10.	MAX.UPRATING SPEED	140 Kmph
11.	BRAKE SYSTEM	AIR BRAKE/HAND BRAKE
12.	MAX.AXLE LOAD	18.8 TONNE ±2%
13.	TOTAL WIDTH OF LOCO	3179 mm
14.	PANTO HEIGHT IN LOCKED DOWN CONDITION	4232.5 mm
15.	TOTAL WEIGHT OF LOCO	112.3 TONNE ±1%
16.	TRACTION MOTOR	HITACHI TYPE HS 15250–A
17.	NO. OF MOTORS	6
18.	CONT. RATING	750 V, 900 AMP
19.	WHEEL DIA	1092NEW (1055 HALF WORN)
20.	OHE VOLTAGE	25 KV AC 50 HZ
21.	TRANSFORMER	5400 KVA

WCAM-2

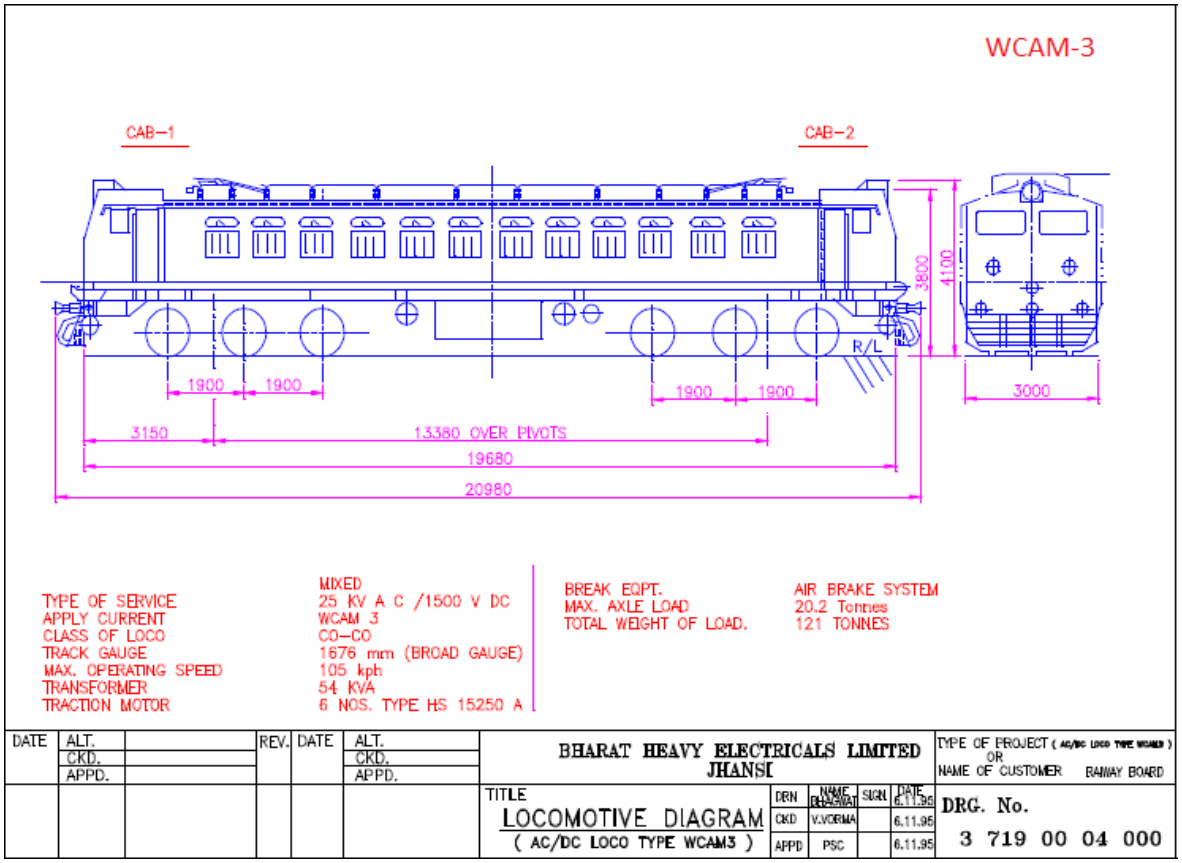


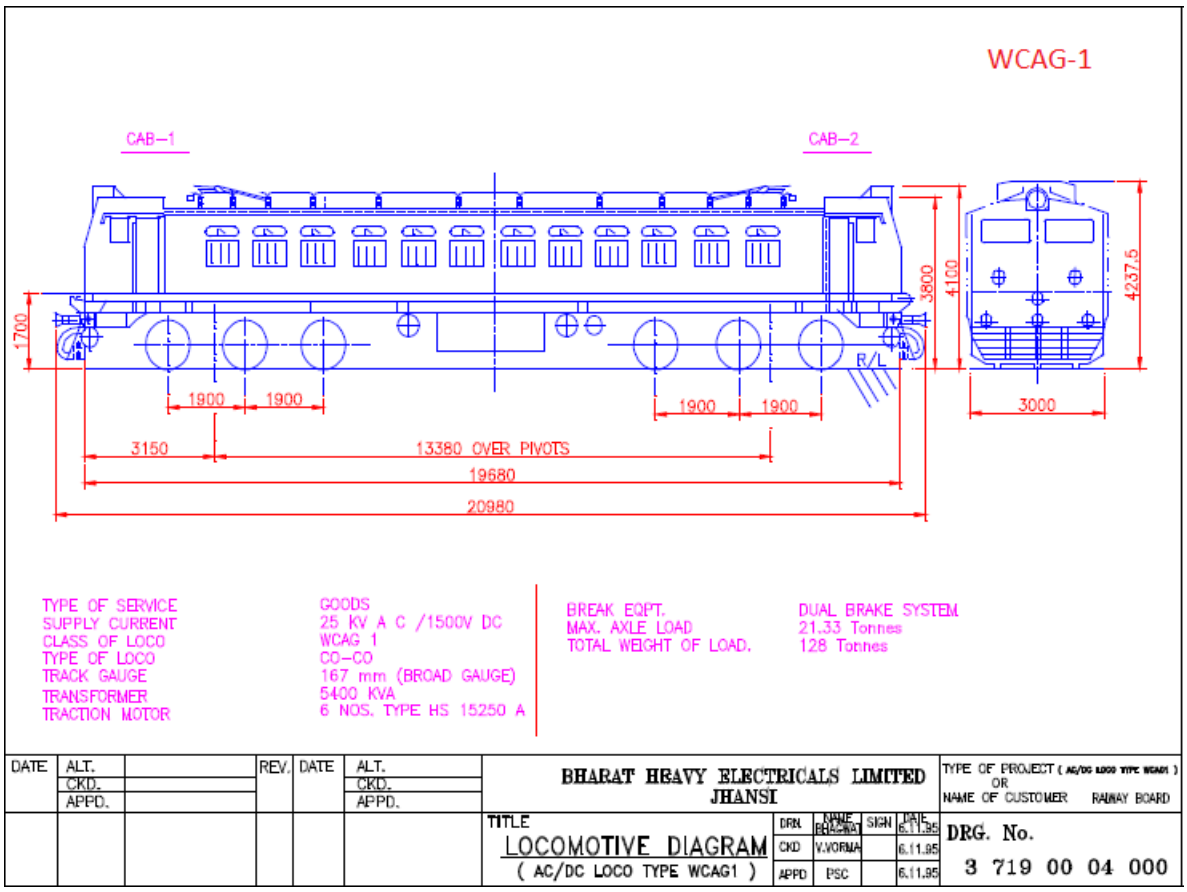
TYPE OF SERVICE	MIXED
APPLY CURRENT	25 KV A C /1500 V DC
CLASS OF LOCO	WCAM 2
CRACK GAUGE	CO–CO
MAX. OPERATING SPEED	1676 mm (BROAD GAUGE)
TRANSFORMER	120 kph
ACTION MOTOR	5400 KVA
	6 NOS. TYPE IAO 650
BREAK EQPT.	DUAL BRAKE SYSTEM WITH IRAVB–2 WITH TWIN PIPE
MAX. AXLE LOAD	18.8 TONNES
TOTAL WEIGHT OF LOAD.	112.8 TONNES

DATE	ALT. / CKD. / APPD.		REV.	DATE	ALT. / CKD. / APPD.	BHARAT HEAVY ELECTRICALS LIMITED JHANSI				TYPE OF PROJECT (AC/DC LOCO TYPE WCAM2) OR NAME OF CUSTOMER RAILWAY BOARD
						TITLE: LOCOMOTIVE DIAGRAM (AC/DC LOCO TYPE WCAM2)	DBN	NAME (BHUSHAN)	SIGN	DATE 6.11.95
							CKD	V.SINGH		6.11.95
							APPD	VKV		6.11.95

DRG. No. 3 719 00 03 003

SHEET NO. 01 NO OF SHTS 01


WCAM-3
CAB–1
CAB–2
3800
4100
R/L
1900
1900
1900
1900
3000
3150
13380 OVER PIVOTS
19680
20980
TYPE OF SERVICE
APPLY CURRENT
CLASS OF LOCO
TRACK GAUGE
MAX. OPERATING SPEED
TRANSFORMER
TRACTION MOTOR
MIXED
25 KV A C /1500 V DC
WCAM 3
CO–CO
1676 mm (BROAD GAUGE)
105 kph
54 KVA
6 NOS. TYPE HS 15250 A
BREAK EQPT.
MAX. AXLE LOAD
TOTAL WEIGHT OF LOAD.
AIR BRAKE SYSTEM
20.2 Tonnes
121 TONNES
DATE
ALT.
CKD.
APPD.
REV.
BHARAT HEAVY ELECTRICALS LIMITED
JHANSI
TYPE OF PROJECT (AC/DC LOCO TYPE WCAM3)
OR
NAME OF CUSTOMER RAILWAY BOARD
TITLE
LOCOMOTIVE DIAGRAM
(AC/DC LOCO TYPE WCAM3)
DRN
CKD
APPD
NAME
SIGN
DATE
V.VERMA
PSC
6.11.95
DRG. No.
3 719 00 04 000


WCAG-1
CAB–1
CAB–2
1700
3800
4100
4237.5
R/L
1900
1900
1900
1900
3000
3150
13380 OVER PIVOTS
19680
20980
TYPE OF SERVICE
SUPPLY CURRENT
CLASS OF LOCO
TYPE OF LOCO
TRACK GAUGE
TRANSFORMER
TRACTION MOTOR
GOODS
25 KV A C /1500V DC
WCAG 1
CO–CO
167 mm (BROAD GAUGE)
5400 KVA
6 NOS. TYPE HS 15250 A
BREAK EQPT.
MAX. AXLE LOAD
TOTAL WEIGHT OF LOAD.
DUAL BRAKE SYSTEM
21.33 Tonnes
128 Tonnes
DATE
ALT.
CKD.
APPD.
REV.
BHARAT HEAVY ELECTRICALS LIMITED
JHANSI
TYPE OF PROJECT (AC/DC LOCO TYPE WCAG1)
OR
NAME OF CUSTOMER RAILWAY BOARD
TITLE
LOCOMOTIVE DIAGRAM
(AC/DC LOCO TYPE WCAG1)
DRN
CKD
APPD
NAME
SIGN
DATE
V.VERMA
PSC
6.11.95
DRG. No.
3 719 00 04 000

Annexure 1.01/A

Sheet 1

SALIENT DATA OF MIXED/PASSENGER ELECTRIC LOCOMOTIVES

S No	Descriptions	WAM4	WAP1	WAP4	WAP5	WAP7/ WAP7 HS	WCAM1	WCAM2	WCAM3
1	Type of Traction	25 KV AC	25 KV AC	25 KV AC	25 KV AC	25 KV AC	25 KV AC 1500V DC	25 KV AC 1500V DC	25 KV AC 1500V DC
2	Gauge (mm)	1676	1676	1676	1676	1676	1676	1676	1676
3	Driving Wheel Dia (New) (mm)	1092	1092	1092	1092	1092	1092	1092	1092
4	Bogie Wheel Base (mm)	3810	3895	3895	2800	3700	3810	3810	3810
5	Total wheel Base (mm)	14432	14390	14390	13000	15700	14432	15698	15698
6	Length over coupler (mm)	19974	18794	18794	18162	20562	20950	20980	20980
7	Max. Width (mm)	3055	3179	3179	3144	3152	3055	3050	3050
8	Height with Panto down (mm)	4162	4235	4235	4255	4255	4121	4230	4237.5
9	Axle Load Max(t)	18.8	18.8	19.0	19.5	20.5/ 18.08	18.8	18.8	20.2
10	Weight Total(t)	112.8	112.8	114	78	123/ 108.48	112.8	112.8	121
11	Bogie Arrangement	Co-Co	Co-Co	Co-Co	Bo-Bo	Co-Co	Co-Co	Co-Co	Co-Co
12	Traction Motor Suspension	NS	NS	NS	NS	NS	NS	NS	NS
13	Brake System	Air Rheo.	Air	Air	Air Reg	Air Reg	Air	Air	Air
14	Max. Tractive Effort(t)	33.84	22.4	30.8	26.3	32.9	AC-33.84 DC-28.20	AC-33.4 DC-26.0	AC-40.2 DC-26.8
15	Cont. T.E.(t)	17.6	13.8	19	22.4	23.2	AC-16.8 DC-87.8	AC-23.8 DC-24.6	AC-26.8 DC-26.8
16	Max Speed(Km/h)	120	130	140	160	130	105	120	105
17	Horse Power(HP)	3640	3800	5050	5442	6120	AC-3640 DC-2930	AC-4715 DC-2916	AC-5000 DC-4600
18	Voltage Control Arrangement	T.C.	T.C.	T.C	V.V.V.F.	V.V.V.F.	AC-T.C. DC-Resis	AC-T.C. DC-Resis	AC-T.C. DC-Resis
19	Cont. Transformer Rating (KVA)	3460	3900	5400	7475	7775	3460	5400	5400
20	Gear Ratio	4.13	2.76	23:58	3.91	3.6/ 3.18	3.43	4.13	3.56

F.S.—Fully Suspended, N S – Axle Hung Nose Suspended, T C – Tap Changer

Annexure 1.01/A

Sheet 2

SALIENT DATA OF GOODS ELECTRIC LOCOMOTIVES

S No.	Description	WAG5	WAG5H	WAG6A	WAG6B	WAG6C	WAG7	WAG7H	WAG9	WAG 9H/9 HC
1	Type of Traction	25 KV AC	25 KV AC	25 KV AC	25 KV AC	25 KV AC	25 KV AC	25 KV AC	25 KV AC	25 KV AC
2	Gauge (mm)	1676	1676	1676	1676	1676	1676	1676	1676	1676
3	Driving Wheel Dia (New) (mm)	1092	1092	1092	1140	1140	1092	1092	1092	1092
4	Bogie Wheel Base (mm)	3810	3810	2700	2800	4400	3800	3800	3700	3700
5	Total wheel Base (mm)	15984	15984	15100	16300	16300	11078		15700	15700
6	Length over coupler (mm)	19974	19974	20600	20928	20928	20394	20394	20562	20562
7	Max. Width (mm)	3055	3055	3164	3000	3000	3055		3152	3152
8	Height with Panto down (mm)	4162	4162	4170	4235	4235	4162	4155	4255	4255
9	Axle Load Max(t)	19.8	21	20.5	20.5	20.5	20.5	22±2	20.5	22±2
10	Weight Total(t)	118.8	126	123	123	123	123	132±1	123	132
11	Bogie Arrangement	Co-Co	Co-Co	Bo-Bo-Bo	Bo-Bo-Bo	Co-Co	Co-Co	Co-Co	Co-Co	Co-Co
12	Traction Motor Suspension	NS	NS	FS	FS	NS	NS	NS	NS	NS
14	Brake System	Air Rheo	Air Rheo	Air Rheo	Air Rheo	Air Rheo	Air Rheo Regen	Air Rheo	Air Reg.	Air Reg.
15	Adhesion in dry condition(t)	33.5	33.5	37	36.5	36.5	35.7	34.1	38.1	38.1
16	Max. Tractive Effort(t)	33.5	38.7	46	45	45	44	45	46.89	52
17	Cont. T.E.(t)	20.6	20.6	32	32	32	30.8	30.8	33.129	46
18	Cont. Speed (Km/h)	50.5	50.5	53	51	51	50	44	50	50
19	Max Speed(Km/h)	80	80	100	100	100	100	100	100	100
20	Horse Power(HP)	3850	3850	6280	6040	6040	5000	5000	6120	6120
21	Voltage Control Arrangement	T.C.	T.C.	Thy	Thy	Thy	T.C.	T.C	V. V. V. F.	V. V. V. F.
22	Cont. Transformer Rating (KVA)	3900	3900	6398	6325	6325	5400	5400	6531	6531
24	Voltage (V)	750	750	780	850	850	750	750	2180	2180
25	Current (A)	840	900	1090	960	960	900	900	270	270
26	Output (KW)	585	630	785	760	760	630	630	850	850
27	Auxiliaries	50 Hz 3 phase	50 Hz 3 phase	50 Hz 3 phase	50 Hz 3 phase	50 Hz 3 phase	50 Hz 3 phase	50 Hz 3 phase	50 Hz 3 phase	50 Hz 3 phase
28	Gear Ratio	3.61	3.61	3.75/4.53	3.94	3.94	3.61	10.65	5.133	5.4

F.S.—Fully Suspended, N S – Axle Hung Nose Suspended, T C – Tap Changer

Annexure 1.01/B

SALIENT DATA OF ELECTRICAL MULTIPLE UNIT STOCK

S. No.	Descriptions	WAU1		WAU2		WAU3		WAU4		YAU1	
1.	Coach Builder	JESSOPS		SIG		ICF		ICF		ICF	
2.	Manufacturer of traction equipment	AEI		SECHERON		HITACHI		BHEL		NICHIMEN	
3.	Unit formation	DT-MC-DT		DT-MC-DT		DT-MC-TC-DT		DMC-TC-TC-DT		MC-TC-TC-DT	
4.	Train formation	3 Unit		2/3 Unit		2 Units+1 TC		2 Units+1 MC		2 Units	
5.	No. of Driving Cabs per unit	3		3		3		2		2	
6.	Type of Traction	25 KV AC		25 KV AC		25 KV AC		25 KV AC		25 KV AC	
7.	Wheel Arrangement	Bo-Bo		Bo-Bo		Bo-Bo		Bo-Bo		Bo-Bo	
8.	Max. Axle load(DCL condition)(t)	20.3		17.5		18.92		19.24		13.76	
9.	Wheel Diameter (New)(mm)	952		952		952		952		788	
10.	Gear Ratio	19:61		21:65		18:64		20:91		15:53	
11.	Train performance per										
	Unit Rating	Cont.	1 Hr	Cont.	1 Hr	Cont.	1 Hr	Cont.	1 Hr	Cont.	1 Hr
	Horse Power	940	1032	848	1040	860	1072	896	1004	688	780
	Tractive Effort (t)	4.6	6.2	4.4	5.9	4.2	5.6	4.8	5.8	2.5	3.08
	Speed	49.75	48.25	50	46.6	55.5	50.5	49.5	46.3	70.7	67.3
12.	Traction Motor										
	Volts(V)	1450	1450	1450	1450	570	570	535	535	540	540
	Current(A)	117	145	115	145	305	380	340	380	260	295
	Output(HP)	210	258	212	260	215	268	224	251	172	195
	Type	MV-252		TM-520		EFZO-H60		253BX		TDX-5442A	
	Make	Metro Wick		Oerlikon		Hitachi		BHEL		TDK	
13.	KVA Rating of Transformer excluding Aux. Load	785		1016		990		950		760	
14.	No. of Pass/Unit										
	Normal	288		268		406		400		300	
	Crush	567		567		786		774		590	
	Dense Crush	844		844		1164		1148		880	

Annexure 1.02

Sheet 1/2

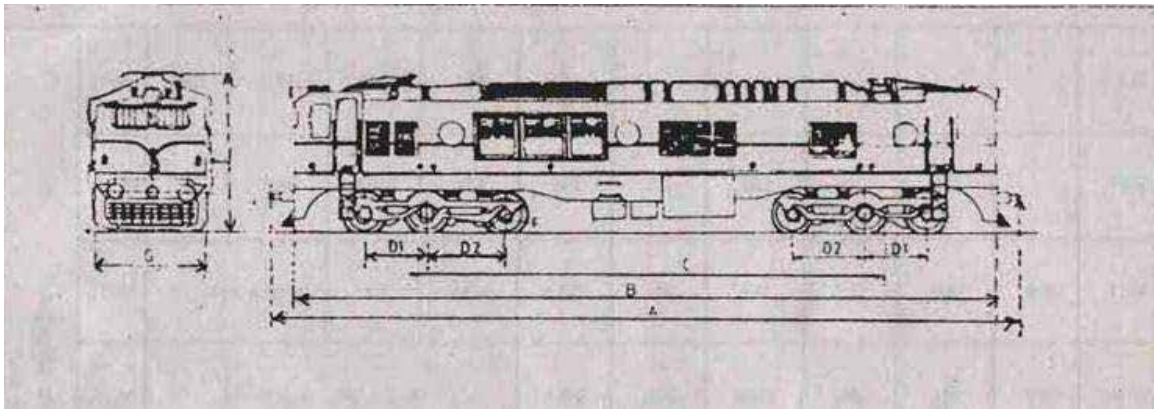
WEIGHT AND DIMENSIONS OF AC LOCOMOTIVES Bo-Bo TYPE

S. No.	TYPE	WEIGHT IN TONNES	DIMENSIONS IN MM						
			A	B	C	D	E	F	G
1	WAP 5	78	18162	13000	10200	2800	4255	1092	3090

Annexure 1.02

Sheet 2/2

WEIGHT AND DIMENSIONS OF AC LOCOMOTIVES Co-Co TYPE



S. No.	TYPE	WEIGHT IN TONNES	DIMENSIONS IN MM							
			A	B	C	D1	D2	E	F	G
1.	WAM 4	112.8	19974	18680	12580	1702	2108	4162	1092	3055
2.	WAG 5	118.8	19974	18680	12580	1702	2108	4162	1092	3055
3.	WAG 6C	123	---	19640	13300	1400	1400	4235	1092	3000
5.	WAG 7	123	20394	19100	13000	1900	1900	4185		3055
6.	WAG9	123	20582	19280		1850	1850	4255		3100
7.	WAG9H	132	20582	19280		1850	1850	4255		3100
7.	WAP 1/3	108.3	19974	17500	10700	1735	2160	4235	1092	-
8.	WAP 4	112.8	18794	17500		1735	2160	4232		3055
9.	WAP 7	123	20562	19280		1850	1850	4255		3100
10.	WAP 7HS	108.48	20562	19280		1850	1850	4255		3100
10.	WCAM 1	112.8	20950	19680	13380	1702	2108	4162(AC) 4121(DC)	1092	3055
11.	WCAM 2	112.8	20980	19680	13380	1702	2108	4230		3000
12.	WCAM3	121	20980	19680	13380	1900	1900	4100		3000

ANNEXURE 1.03
WAP - 1
SHEET - 1/13

HAULAGE CAPACITY (WITHOUT 5% ACCELERATION RESERVE)

SERVICE	GRADE	TONNES AT km/h (TANGENT TRACK)										
		20	40	60*	70	80	90	100	110	120	130	START*
PASSENGER SERVICE ICF COACHING STOCK	LEVEL	ABOVE 1500									1235	4340
	1/500	ABOVE 1500							1350	1100	835	3070
	1/200	ABOVE 1500				1460	1215	1010	860	715	545	2115
	1/150	ABOVE 1500		1415	1360	1185	990	830	710	590	450	1790
	1/100	1120	1060	1000	965	850	715	600	515	425		1370
	1/50	540	520	500	490	430						775

*MAXIMUM STARTING T.E. = 25.0 t

HAULAGE CAPACITY (WITHOUT 5% ACCELERATION RESERVE)

WAM-4
SHEET - 4/13

SERVICE		GRADE	TONNES AT km/h (TANGENT TRACK)											START# 33.8 t.	START* 30 t.
			20	30	40	50	60	70	80	90	100	110	120		
GOODS SERVICE	BOGIE WAGONS (BOX)	LEVEL	ABOVE 6000						5750					Above 6000	Above 6000
		1/500	ABOVE 6000		5900	4825	4270	3460	2860					4720	4220
		1/200	3940	3850	3070	2555	3200	1900	1595					3280	2910
		1/150	3080	3020	2410	2010	1820*	1505	1270					2800	2480
		1/100	2120	3080	1670	1400	1270	1050	885					2140	1900
		1/50	1055	1050	835	695	635							1240	1090
	4-WHEELER WAGONS	LEVEL	ABOVE 6000					4530	3430					Above 6000	Above 6000
		1/500	ABOVE 6000		4970	3970	3410	2675	2110					Above 6000	5260
		1/200	3640	3540	2800	2290	2025	1630	1330					3330	2750
		1/150	2880	2820	2230	1845	1640	1330	1090					2600	2130
		1/100	2020	1990	1580	1320	1175	970	790					1790	1480
		1/50	1030	1025	810	670	610							1070	940
PASSENGER SERVICE		LEVEL	Above 1000										945		
		1/500	Above 1000									935	2670		
		1/200	Above 1000								830	620	450		
		1/150	Above 1000							900	690	520			
		1/100	Above 1000					955	790	665	505				
		1/50			810	670	605	490							

Note:
STARTING TRACTIVE EFFORT IS 33.8 T.
* STARTING TRACTIVE EFFORT IS LIMITED TO 30 TONNES DUE TO BRIDGE LIMITATIONS.
HAULAGE CAPACITY BETWEEN 50 KM/H TO 90 KM/H BEING LIMITED BY THE TRANSFORMER CAPACITY

HAULAGE CAPACITY OF WAG-5 LOCO WITH HITACHI T.M. (FULL FIELD)
(WITHOUT 5% ACCELERATION RESERVE)

WAG-5HB
SHEET - 10/13

SERVICE		GRADE	TONNES AT km/h (TANGENT TRACK) CURVE	20	30	40	50	60	70	80	*START 4 kg/t	*START 4-5 kg/t
GOODS SERVICE	BOX WAGONS	LEVEL	0°	ABOVE 6000					5580	3790	Above 6000	Above 6000
		1/500	0°	ABOVE 6000				3770	2530	1810	5775	5330
		1/200	0°	3602	3512	3411	3310	1984	1350	977	3810	3609
		1/150	0°	2782	2762	2663	2599	1558	1060	765	3198	3055
		1/100	0°	1890	1863	1832	1798	1073	724	519	2407	2324
		1/50	0°	920	912	902	893	519	336	228	1354	1327

HAULAGE CAPACITY OF WAG-5 LOCO WITH HITACHI T.M. (FULL FIELD)
(WITHOUT 5% ACCELERATION RESERVE)

WAG-5HB
SHEET - 10/13

SERVICE		GRADE	TONNES AT km/h (TANGENT TRACK) CURVE	20	30	40	50	60	70	80	*START 4 kg/t	*START 4-5 kg/t
GOODS SERVICE	BOX WAGONS	LEVEL	0°	ABOVE 6000					5580	3790	Above 6000	Above 6000
		1/500	0°	ABOVE 6000				3770	2530	1810	5775	5330
		1/200	0°	3602	3512	3411	3310	1984	1350	977	3810	3609
		1/150	0°	2782	2762	2663	2599	1558	1060	765	3198	3055
		1/100	0°	1890	1863	1832	1798	1073	724	519	2407	2324
		1/50	0°	920	912	902	893	519	336	228	1354	1327

HAULAGE CAPACITY (WITHOUT 5% ACCELERATION RESERVE)

WAG-6A
SHEET - 11/13

SERVICE		SPEED / GRADE	TONNES AT km/h (TANGENT TRACK)									START	
			20	30	40	50	60	70	80	90	100	YARD	MAIN LINE
GOODS SERVICE	BOX WAGONS	LEVEL	ABOVE 7500							7450	5500	10000	11300
		1/500	ABOVE 7500					6200	4850	3850	2950	6900	7500
		1/200	ABOVE 5000			4950	4150	3550	2700	2200	1700	4700	5000
		1/150	ABOVE 4200			3900	3300	2700	2150	1750	1400	4000	4200
		1/100	ABOVE 3100		2900	2700	2300	1900	1500	1250	1000	3050	3150
		1/50	1650	1550	1500	1400	1150	950	750	600	500	1750	1800

HAULAGE CAPACITY (WITHOUT 5% ACCELERATION RESERVE)

WAG-6B&C
SHEET - 12/13

SERVICE		SPEED / GRADE	TONNES AT km/h (TANGENT TRACK)									START*	
			20	30	40	50	60	70	80	90	100	YARD	MAIN LINE
GOODS SERVICE	BOX WAGONS	LEVEL	ABOVE 7500							6800	4900	9850	11000
		1/500	ABOVE 5000				7450	5950	4900	3500	2600	6750	7300
		1/200	ABOVE 7500			4900	4100	3250	2700	2000	1500	4600	4800
		1/150	4100	4000	3950	3850	3150	2600	2150	1600	1200	3900	4100
		1/100	2800	2750	2700	2700	2200	1800	1550	1100	850	3000	3100
		1/50	1400	1400	1400	1350	1100	950	800	550	400	1700	1750

*MAXIMUM STARTING T.E. = 45.0 t
LOADS ARE LIMITED BY 37.5 t OF STARTING TRACTIVE EFFORT DUE TO BRIDGES.

WAG 7

HAULAGE CAPACITY OF WAG 7(TAP CHANGR) LOCOMOTIVE

(WITHOUT ACCELERATION RESERVE)

G.R. 1:3.55 (18:64) T.M. HS-15250A

SERVICE		GRADE	TONNES AT KMPH (TANGENT TRACK)											START
			20	30	40	50	60	70	80	90	100	110	120	
GOODS SERVICE	4 WHEELER WAGONS	LEVEL												
		1/500												
		1/200												
		1/150												
		1/100												
		1/50												
	BOGIE WAGONS (BOXN)	LEVEL	← ABOVE 7500 →							5236	3732			ABOVE 7500
		1/500	5858	5859	5859	5859	5765	4555	3808	2714	2003			5858
		1/200	4065	4065	4065	3982	3125	2510	2135	1540	1148			4065
		1/150	3330	3272	3210	3145	2476	1995	1703	1229	916			3468
		1/100	2294	2265	2234	2201	1736	1401	1198	861	838			2669
		1/50	1149	1140	1131	1121	879	704	599	419	300			1512
	BOGIE WAGONS (BOXN)	LEVEL	← ABOVE 7500 →							5404	3793			ABOVE 7500
		1/500	6836	6836	6836	6836	6016	4712	3904	2759	2021			6836
		1/200	4453	4328	4209	4088	3198	2558	2166	1555	1154			4516
		1/150	3425	3361	3288	3212	2523	2026	1723	1238	920			3790
		1/100	2340	2308	2272	2233	1759	1416	1208	866	640			2858
		1/50	1161	1152	1141	1130	885	708	602	420	300			1575

Dt	22.12.93
D	L.K.MISRA
T	
C	R.C.AGARWAL

WAG 9

HAULAGE CAPACITY OF 3 PHASE FREIGHT LOCOMOTIVE

(WITHOUT ACCELERATION RESERVE)

G.R. 1:5.1 T.M. 6FRA-6068

SERVICE		GRADE	TONNES AT KMPH (TANGENT TRACK)											START
			20	30	40	50	60	70	80	90	100	110	120	
GOODS SERVICE	4 WHEELER WAGONS	LEVEL												
		1/500												
		1/200												
		1/150												
		1/100												
		1/50												
	BOGIE WAGONS (BOXN)	LEVEL	← ABOVE 6000 →											ABOVE 6000
		1/500	← ABOVE 6000 →						4985	4150	3500			ABOVE 6000
		1/200	5060	5060	5060	5060	4045	3325	2780	2365	2040			5060
		1/150	4250	4165	4080	3985	3200	2640	2220	1895	1640			4250
		1/100	2910	2870	2825	2775	2240	1855	1565	1345	1165			3205
		1/50	1455	1445	1435	1420	1440	945	795	680	590			1820
PASSENGER SERVICE	ICF COACH	LEVEL												
		1/500												
		1/200												
		1/150												
		1/100												
		1/50												

Dt	20.12.93
D	L.K.MISRA
T	
C	R.C.AGARWAL

WAG 7

HAULAGE CAPACITY OF WAG 7 LOCOMOTIVE
(WITHOUT ACCELERATION RESERVE)
G.R. 1:4.06 (16:65) I.M. HS-15250A LOCO WT 123T

SERVICE		GRADE	TONNES AT KMPH (TANGENT TRACK)									START *
			20	30	40	50	60	70	80	90	100	
GOODS SERVICE	4 WHEELER WAGONS	LEVEL										
		1/500										
		1/200										
		1/150										
		1/100										
		1/50										
	BOGIE WAGONS (BOX)	LEVEL										
		1/500										
		1/200										
		1/150										
		1/100										
		1/50										
	BOGIE WAGONS (BOXN)	LEVEL	ABOVE 7500						7302	4619	2785	10815
		1/500	7169	7169	7169	7169	6192	5005	3465	2345	1465	7169
		1/200	4738	4738	4738	4085	3285	2715	1915	1295	820	4738
		1/150	3960	3880	3795	3210	2590	2150	1515	1020	645	3977
		1/100	2705	2665	2625	2225	1805	1500	1055	725	450	3002
		1/50	1345	1335	1320	1120	905	750	515			1700

* 441 starting TE as per RDSO report No. M-531

Dt
D
T

Haulage Capacity of three phase WAG9H locomotive (without acceleration reserve)

GR-1:1.51, TM-6FRA 6068(Three phase)

Service		Grade	Tomes at KMPH (Tangent Track)									Start
			20	30	40	50	60	70	80	90	100	
Goods	BOXN	Level	Above 7500								6465	Above 7500
		1/500	Above7500				7570	6095	4995	4015	3475	-do-
		1/200	5800	5800	5800	5050	4035	3320	2780	2280	2015	5800
		1/150	4745	4650	4550	3950	3185	2635	2215	1825	1620	4870
		1/100	3250	3205	3155	2765	2225	1845	1560	1290	1150	3680
		1/50	1630	1615	1600	1405	1130	935	785	645	575	2090

Code: 251099 haulage WAG7

WAP 5

HAULAGE CAPACITY OF 3 PHASE PASSENGER LOCOMOTIVE
(WITHOUT ACCELERATION RESERVE)
G.R. 1:3.92 T.M. 6FXA-7059

SERVICE		GRADE	TONNES AT KMPH (TANGENT TRACK)														START
			20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	
GOODS SERVICE	4 WHEELER WAGONS	LEVEL																
		1/500																
		1/200																
		1/150																
		1/100																
		1/50																
	BOGIE WAGONS (BOX)	LEVEL																
		1/500																
		1/200																
		1/150																
		1/100																
		1/50																
PASSENGER SERVICE	ICF COACH	LEVEL	ABOVE 1500													1470	1230	ABOVE 1500
		1/500	ABOVE 1500											1470	1250	1065	910	ABOVE 1500
		1/200	ABOVE 1500									1350	1160	995	860	745	645	ABOVE 1500
		1/150	ABOVE 1500								1310	1125	970	840	730	635	550	ABOVE 1500
		1/100	ABOVE 1500					1460	1325	1125	970	840	730	635	555	480	420	ABOVE 1500
		1/50	980	965	955	940	865	780	710	610	525	455	400	345	305	265	230	1010

D1	
D	
T	
C	

WAP 4

HAULAGE CAPACITY OF WAP 4 LOCOMOTIVE
(WITHOUT ACCELERATION RESERVE)
G.R. 2.52 (23:58) T.M. HS-15250A

SERVICE		GRADE	TONNES AT KMPH (TANGENT TRACK)													START
			20	40	60	70	80	90	100	110	120	130	140	150	160	
GOODS SERVICE	4 WHEELER WAGONS	LEVEL														
		1/500														
		1/200														
		1/150														
		1/100														
		1/50														
	BOGIE WAGONS (BOX)	LEVEL														
		1/500														
		1/200														
		1/150														
		1/100														
		1/50														
PASSENGER SERVICE	ICF COACH	LEVEL	ABOVE 1500										1155	805	570	ABOVE 1500
		1/500	ABOVE 1500									1105	805	565	400	-DO-
		1/200	ABOVE 1500						1320	1230	1035	730	535	375	260	-DO-
		1/150	ABOVE 1500					1405	1090	1020	860	610	445	310	215	-DO-
		1/100	1570	1490	1405	1365	1195	1020	795	750	635	445	320	220	145	-DO-
		1/50	770	750	720	710	625	530	410	390	325	220	150	90	45	1160

NOTE : AVERAGE WEIGHT OF ICF COACH IS 55 TONNE

D1	22.8.94
D	I.K.MISRA
T	
C	P.N.SETH

Haulage Capacity of three phase WAP7 locomotive (without acceleration reserve)

GR-20:72, TM-6FRA 6068(Three phase)

Service		Grade	Tomes at KMPH (Tangent Track)													Start
Passenger	ICF		20	30	40	50	60	70	80	90	100	110	120	130	140	
Coach	Coa -ch	Level	Above 1500													Above 1500
		1/500	Above 1500												1395	-do-
		1/200	Above 1500									1485	1275	1100	950	-do-
		1/150	Above 1500								1440	1235	1065	920	800	-do-
		1/100	Above 1500						1465	1235	1055	910	790	685	595	-do-
		1/50	970	955	940	925	910	895	765	650	555	480	415	360	310	1235

File No.RDSO-EL/0/TPS(UPGR)/2/2020-O/o PED/SE/RDSO

Haulage Capacity of WAG 9HH Locomotive

Axle Load … T, Normal Mode (6 Motors Working) & Dry Track Case: 0° Curve

Speed (kMPH)	Level Track	Slope 1/500	Slope 1/200	Slope 1/150	Slope 1/100	Slope 1/50
Start	10800t	8310t	5495t	4615t	3485t	1975t
20					3240t	1620t
30					3190t	1610t
40				4540t	3145t	1595t
50				4435t	3100t	1577t
60				4335t	3050t	1560t
70			5285t	4215t	2900t	1535t
80		8000t	4500t	3605t	2560t	1315t
90		6700t	3840t	3100t	2210t	1125t
100		5650t	3320t	2680t	1935t	900t

Note: Hauling capacity at start is limited by starting tractive effort.

Haulage capacity Normal Mode, Dry & 00 Curved Track

File No.RDSO-EL/0/TPS(UPGR)/2/2020-O/o PED/SE/RDSO

Haulage Capacity of WAG 9HH Locomotive

Axle Load …. T, Degraded Mode (5 Motors Working) & Dry Track Case: 0° Curve

Speed (kMPH)	Level Track	Slope 1/500	Slope 1/200	Slope 1/150	Slope 1/100	Slope 1/50
Start	10400t	6900t	4550t	3800t	2880t	1625t
20					2670t	1330t
30					2635t	1320t
40				3755t	2600t	1310t
50				3675t	2555t	1298t
60				3585t	2515t	1287t
70			4400t	3500t	2470t	1275t
80		6600t	3715t	2975t	2100t	1085t
90		5530t	3175t	2550t	1815t	940t
100	8600t	4685t	2730t	2215t	1580t	815t

Haulage capacity Degraded Mode, Dry & 00 Curved Track

Haulage Capacity of WAG 12B Locomotive

Axle Load 22.5T, Normal Mode (8 Motors Working) & Dry Track Case: 0° Curve

Speed in kmph	Level Track	Slope 1/500	Slope 1/200	Slope 1/150	Slope 1/100	Slope 1/75	Slope 1/50	Slope 1/40
START	7600	7318	6471	6000	4651	3764	2704	2221
10	7600	7318	6471	6000	4651	3764	2704	2221
15	7600	7318	6471	6000	4651	3764	2704	2221
20	6000	6000	6000	6000	4651	3764	2704	2221
30	6000	6000	6000	6000	4651	3764	2704	2221
40	6000	6000	6000	6000	4651	3764	2660	2131
50	6000	6000	6000	6000	4651	3647	2488	1994
60	6000	6000	6000	6000	4312	3348	2288	1835
70	6000	6000	6000	4991	3601	2800	1913	1531
80	6000	6000	5194	4229	3064	2386	1629	1302
90	6000	6000	4443	3633	2643	2061	1407	1122
100	6000	6000	3840	3153	2304	1800	1228	977
110	6000	5332	3350	2763	2027	1586	1082	859
120	5626	4593	2931	2427	1789	1402	955	757

Haulage capacity Normal Mode, Dry & 00 Curved Track

Axle Load 22.5 T, Degraded Mode (6 Motors Working) & Dry Track Case: 0° Curve

Speed in kmph	Level Track	Slope 1/500	Slope 1/200	Slope 1/150	Slope 1/100	Slope 1/75	Slope 1/50	Slope 1/40
START	7600	7318	5282	4489	3439	2774	1981	1618
10	7600	7318	5282	4489	3439	2774	1981	1618
15	7600	7318	5282	4489	3439	2774	1981	1618
20	6000	6000	5282	4489	3439	2774	1981	1618
30	6000	6000	5282	4489	3439	2774	1981	1618
40	6000	6000	5282	4489	3439	2774	1981	1618
50	6000	6000	5282	4489	3439	2774	1981	1618
60	6000	6000	5282	4489	3439	2774	1979	1582
70	6000	6000	5282	4343	3127	2426	1650	1316
80	6000	6000	4518	3674	2656	2063	1402	1115
90	6000	6000	3859	3151	2287	1778	1207	958
100	6000	5401	3330	2731	1989	1549	1050	831
110	5728	4622	2896	2384	1743	1359	919	725
120	4882	3981	2533	2093	1537	1199	810	637

Haulage capacity Degraded Mode, Dry & 00 Curved Track

Haulage capacity of three phase WAGC3 locomotive (20.5T Axle Load)

(Without acceleration reserve)

GR- 74:18 (4.11), Curve- 0o

Service		Grade	Ton at kmph							Start (Ton)
			20	30	40	50	60	70	80	
Goods	*WAGONS (BOXN)	Level	Up to 11800							Up to 11800
		1/500	Up to 11800				11060	8260	6055	Up to 11800
		1/200	9305		9160	7700	5870	4470	3335	9305
		1/150	7810		7160	6045	4625	3535	2640	7810
		1/100		5820	4955	4200	3220	2460	1835	5895
		1/50	3165	2935	2495	2115	1610	1215	885	3335

1. *Train resistance has been computed as per RDSO report No. M-422 August, 1984 by using formula.
2. R= 0.6438797+0.01047218V+0.00007323V2 Kg/ton, where V is speed in KMPH and Starting train resistance has been taken as 4 kg/ton.
3. The load chart is based upon maximum load of 2 X 59 BOXN (100 t i.e. 25t axle load).
4. Actual permissible loads should be worked out based on load trial.

Haulage capacity of three phase WAGC3 locomotive (20.5T Axle Load)

(Without acceleration reserve)

GR- 74:18 (4.11), Curve- 1o

Service		Grade	Ton at kmph							Start (Ton)
			20	30	40	50	60	70	80	
Goods	*WAGONS (BOXN)	Level	Up to 11800						10350	Up to 11800
		1/500	Up to 11800				9910	7440	5475	Up to 11800
		1/200	8940		8590	7225	5515	4205	3140	8900
		1/150	7550		6800	5745	4400	3360	2515	7520
		1/100	5725	5605	4775	4045	3100	2370	1770	5725
		1/50	3100	2875	2445	2070	1575	1190	865	3275

1. *Train resistance has been computed as per RDSO report No. M-422 August, 1984 by using formula.
2. R= 0.6438797+0.01047218V+0.00007323V2 Kg/ton, where V is speed in KMPH and Starting train resistance has been taken as 4 kg/ton.
3. The load chart is based upon maximum load of 2 X 59 BOXN (100 t i.e. 25t axle load).
4. Actual permissible loads should be worked out based on load trial.

Haulage capacity of three phase WAGC3 locomotive (20.5T Axle Load)

(Without acceleration reserve)

GR- 74:18 (4.11), Curve- 2o

Service		Grade	Ton at kmph							Start (Ton)
			20	30	40	50	60	70	80	
Goods	*WAGONS (BOXN)	Level	Up to 11800						8810	Up to 11800
		1/500	Up to 11800				8975	6760	4995	Up to 11800
		1/200	8565		8080	6810	5205	3970	2965	8525
		1/150	7280		6475	5475	4190	3205	2395	7250
		1/100	5560	5410	4605	3905	2995	2290	1705	5560
		1/50	3040	2815	2395	2030	1540	1165	845	3220

1. *Train resistance has been computed as per RDSO report No. M-422 August, 1984 by using formula.
2. R= 0.6438797+0.01047218V+0.00007323V2 Kg/ton, where V is speed in KMPH and Starting train resistance has been taken as 4 kg/ton.
3. The load chart is based upon maximum load of 2 X 59 BOXN (100 t i.e. 25t axle load).
4. Actual permissible loads should be worked out based on load trial.

Haulage capacity of three phase WAGC3 locomotive (20.5T Axle Load)

(Without acceleration reserve)

GR- 74:18 (4.11), Curve- 3o

Service		Grade	Ton at kmph							Start (Ton)
			20	30	40	50	60	70	80	
Goods	*WAGONS (BOXN)	Level	Up to 11800					10580	7660	Up to 11800
		1/500	11745			10840	8195	6190	4590	11745
		1/200	8220		7630	6435	4920	3760	2810	8180
		1/150	7025		6175	5225	4005	3060	2290	6995
		1/100	5435	5225	4450	3775	2890	2210	1645	5410
		1/50	2980	2760	2350	1990	1510	1140	830	3165

1. *Train resistance has been computed as per RDSO report No. M-422 August, 1984 by using formula.
2. R= 0.6438797+0.01047218V+0.00007323V2 Kg/ton, where V is speed in KMPH and Starting train resistance has been taken as 4 kg/ton.
3. The load chart is based upon maximum load of 2 X 59 BOXN (100 t i.e. 25t axle load).
4. Actual permissible loads should be worked out based on load trial.

RDSO publication no. RDSO/2016/EL/PUB/0002 Rev.'0' may be referred for haulage capacity of locomotives. Technical circulars being issued from time to time may also be referred for haulage capacity of electric locomotives.

Annexure 1.04

Functional description of main circuit of WAG-6A

1. General Outline

Fig. 1. shows a simplified diagram of the main circuit. The current is taken from the 25 kV 50 Hz overhaead line by pantograph and passes through the main circuit breaker to the primary winding of the main transfoermer, and then through the grounding transformer (GT) to the car body. The purpose of the GT is to ensure that the current going through the car body finally finds its way through the wheels and is then earth via the rails.

In addition to the four traction windings, secondary windings are connected to the auxiliary power system, hotel load and motor field circuit respectively.

As can be seen in Fig. 1, the main circuit is divided in two parts, called traction motor modules. These are controlled individually, depending on adhesion conditions.

2. *Traction motor modules*

Fig 2. shows the armature circuit for one motor module. In the convertors, which are built up from thyristors and diodes, the 50 Hz supply voltage is rectified and fed to the traction motors. To smooth the current from the convertors smoothing reactor is connected in series with each motor.

Connected parallel to each traction winding, the power factor control has the form of three tuned LC- links.

Between the transformer and the convertors, automatically operated module disconnectors (MD) are connected (Fig.2) which also disconnect the field circuit of the module (Fig.3).

3. *The Convertors*

The convertors consist of thyristors and diode to allow a path for the free wheeling current when the thyristors are not fired.

During acceleration, one bridge only is being fired until shortly before it is fully advanced. Then the two bridges are both fired until the first one is fully advanced, after which the second is further advanced, until it too is fully fired. This procedure is called "overlapping control".

Phase angle control of the thyristors will introduce harmonics and because of this, both power factor and psophometric current will vary considerabley at different speeds. In order to minimize the influence on the supply network, Power Factor Control equipment (PFC) is used.

4. *The Motors*

The traction motors are separately excited, bogie suspended dc motors. Each motor is individually fed from a convertor, consisting of two rectifying bridges.

4.1 *The Field Circuit*

The field circuit (Fig. 3) feeds the motor field windings, each of which is individually controlled. During acceleration from stand still, the field current is kept approximately constant until maximum motor voltage (or maximum available voltage) is reached. In order to further increase the speed, field weakening must take place, which leads to lower tractive effort. At over speed i.e. when slip tends to occur on one axle, the field is weakened, tractive effort of the motor concerned thus lowered, thereby, lowering its armature current and subsequently decreasing the over speed.

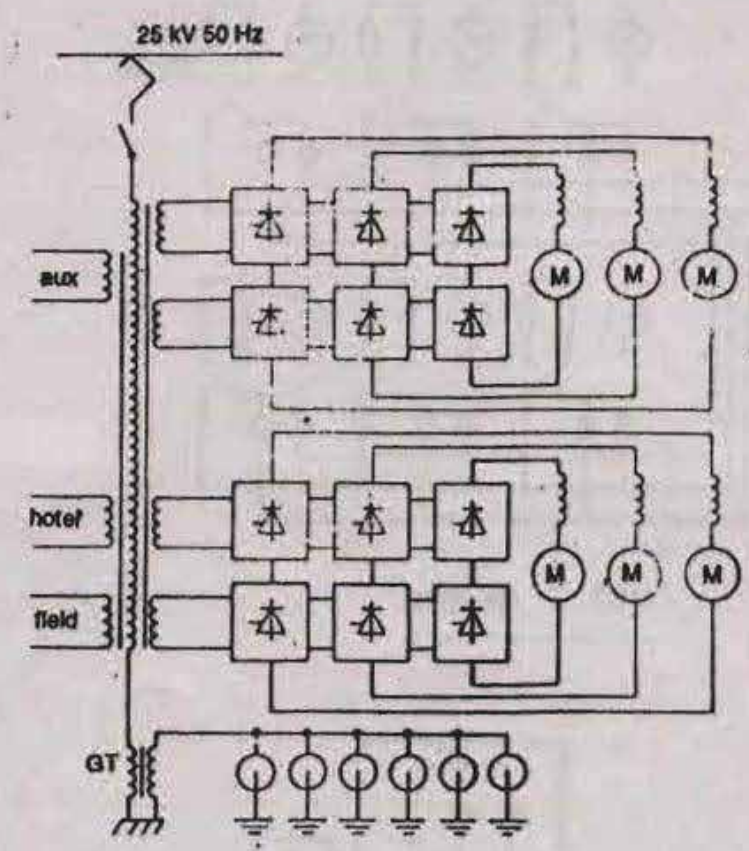


Fig. 1 – SIMPLIFIED DIAGRAM OF THE MAIN CIRCUIT

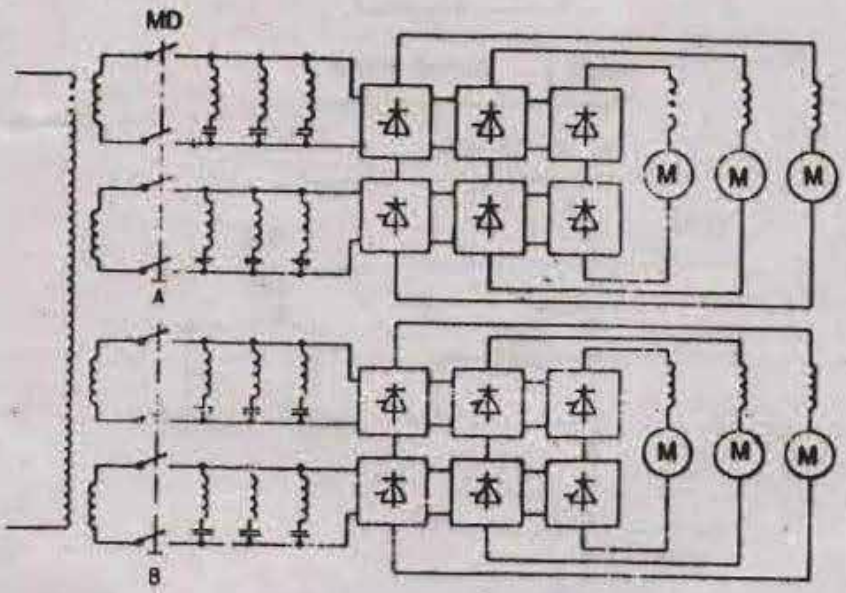


Fig. 2 - ONE MOTOR MODULE

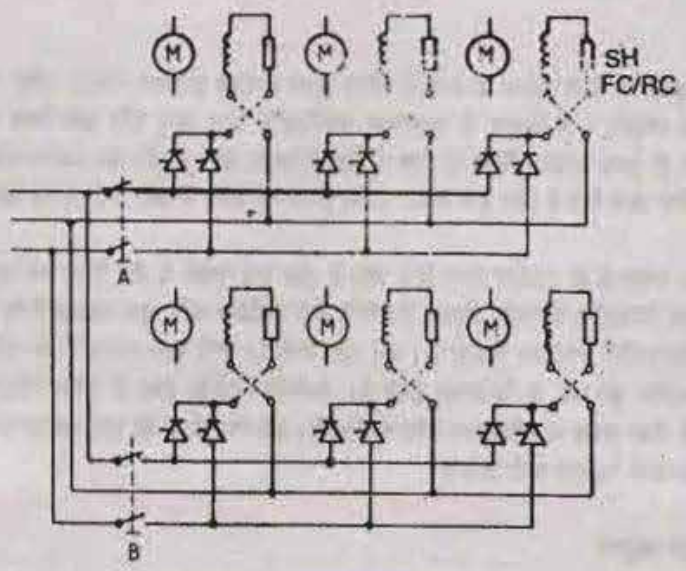


Fig. 3 – FIELD CIRCUIT

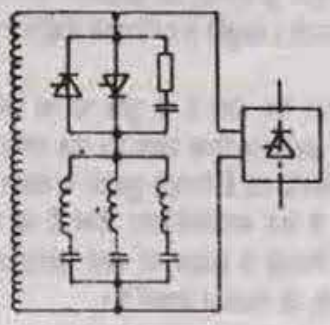


Fig. 4 – PFC SYSTEM

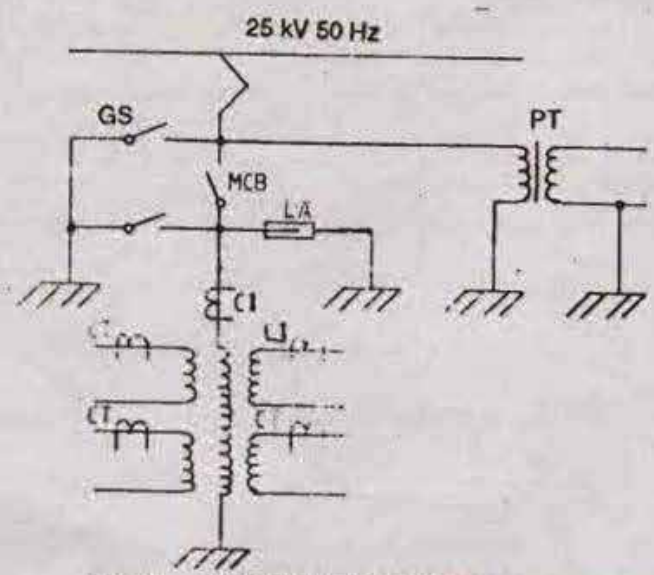


Fig. 5 – SAFETY & MONITORING SCHEME:

4.2 The PFC System

Parallel to each of the four traction windings of the main transformer, Power Factor Control equipment (PFC) is connected and this has the form of three tuned LC-1 links, switched in and out by two anti-parallel thyristors as shown in Fig. 4. The PFC has two purposes. One is to be a capacitive compensation for the otherwise inductive traction circuit, thus raising the power factor. The other is to filter the harmonics out from the transformer windings, thus further increasing the power factor and, at the same time, decreasing the psophometric current.

The two purposes are fulfilled by using tuned LC-links, in this case three links showing best filtering performance at 3rd, 5th and 7th harmonics respectively. The demand for capacitive compensation and filtering performance varies strongly with the speed and with the tractive effort i.e. with the firing angle of the main thyristors and the current through these. The PFC is controlled so that each locomotive will appear as an inductive or a resistive load, seen from the overhead line at the pantograph. When the ac current to the locomotive tends to go capacitive, one or more the PFC modules are cut to avoid over compensation.

4.3 Safety monitoring and fault detection

For safety and monitoring purposes, current transformers and breakers are used (Fig. 5). To curb over voltage, a lightning arrestor (LA) is used, limiting the maximum voltage over the main transformer. The curent in all windings of the main transformers and all motor fields (Fig. 3) is monitored continuously, through the use of current transformer (CT).

Should an over current occur on any of the monitoring transformers, the main circuit breaker (MCB) will open immediately. The potential transformer (PT) is used for monitoring the supply voltage. When the supply is too high or too low, the MCB is opened. To enable the driver to immediately discover any faults in the locomotive and, if possible, reset from the cab, a computerized fault indicating system (FIS) has been incorporated. This system consists of a microprocessor which supervises all running conditions. Together with a display panel in each driver's cab this gives the driver all the incessary information during fault conditions and also provides possibility to reset most of the faults from the driver's cab through a push button.

Annexure 1.05

Functional description of main circuit of WAG-6B/WAG-6C

1. General Outline

Fig. 1 shows a simplified diagram of the main circuit. The current is taken from 25 kV 50 Hz overhead line by pantograph and passes through the main circuit breaker to the primary winding of the main transformer and then through the ground brushes to wheels and is then to earth via the rails.

In addition to the four traction windings, secondary windings for auxiliary power system, hotel load and motor field circuit have been provided.

2. Traction Motor Groups

Traction motor armature circuit is divided into two groups of three traction motors each. The output from convertor is fed to the traction motors through smoothing reactors in series with each traction motor.

Power factor correction LC banks are connected across the traction windings.

3. The Convertors

The convertors consist of thyristors and diodes to allow path for the free wheeling current when the thyristors are not fired. During acceleration, one bridge only is initially fired until shortly before it is fully advanced. Then the second bridge is also fired. This procedure is called 'overlapping control'

Phase angle control of the thyristors will introduce harmonics and because of this, power factor and psophometric current will vary considerably at different speeds. In order to minimise the influence on the supply net work, power factor control equipment (PFC) is used.

4. Traction Motors

The traction motors are compound wound motors having a ratio of approximately 60:40 for the separate field strength to series field strength. Motors are fully suspended in WAG-6B and axle hung, nose-suspended in WAG-6C. Three motors in parallel are fed from a convertor consisting of two sequence control bridges shown in Fig. 1.

5. The Field Circuit

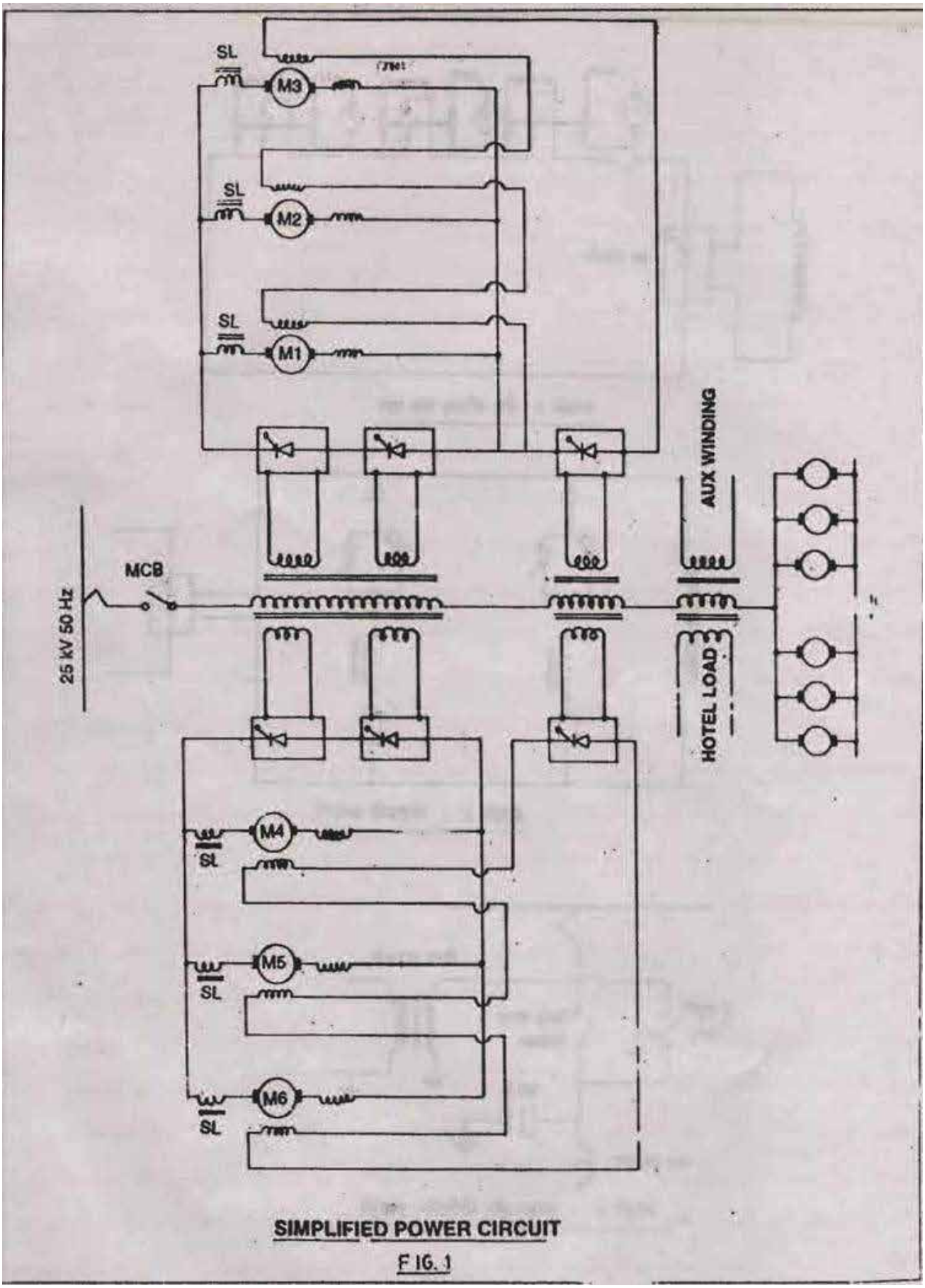
The field circuit arrangement is shown in Fig. 2. There is one field convertor for each of the traction motor groups i.e., three traction motors are fed by one field convertor. During acceleration, the field current is kept proportional to the armature current until maximum motor voltage reference is reached. After this the field current is reduced to get a constant power characteristic till the weakest field strength is reached.

The field convertor also performs the required field current control during rheostatic braking to get the desired braking characteristics.

6. Power Factor Correction System

Each traction group has a power factor correction equipment which consists of two independent LC-links which can be switched on/off through thyristors. The arrangement in shown in Fig. 3.

When the primary current of the traction transformer reaches about 100A, the switching thyristors switch on the PFC unit No. 1 of both traction groups to improve the power factor. If the current increases to about 150A, the 2nd PFC unit is switched on.



SIMPLIFIED POWER CIRCUIT

FIG. 1

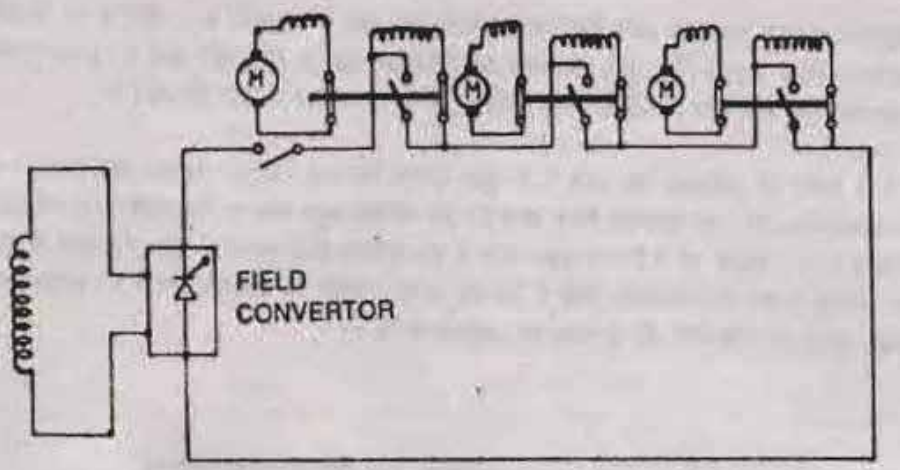


FIG. 2 - FIELD CIRCUIT ONE GROUP

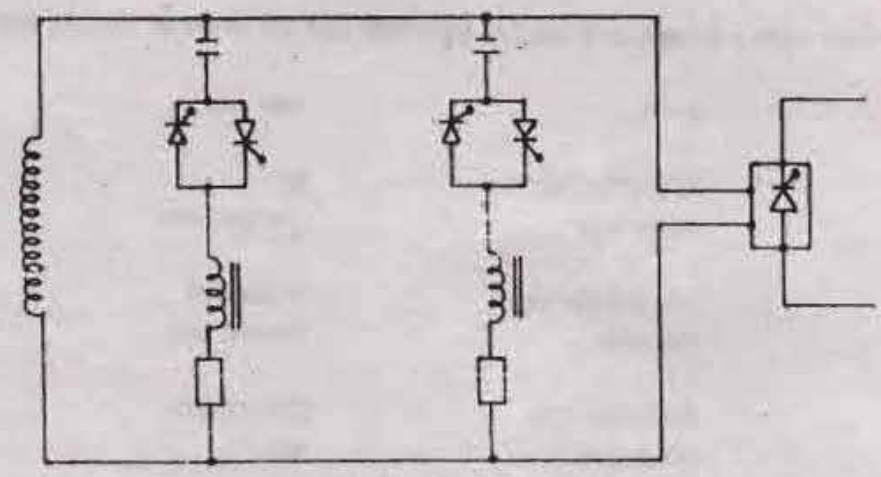
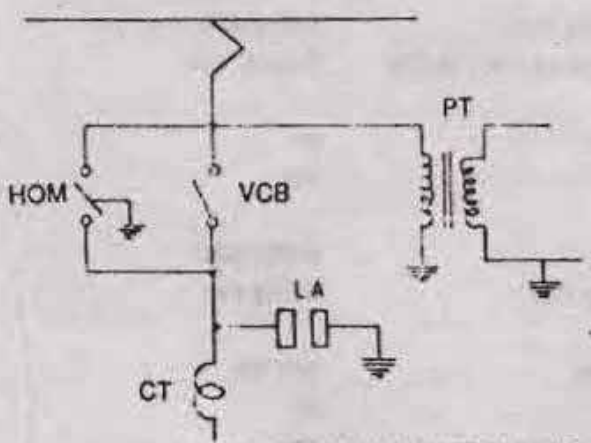


FIG 3 - PFC SYSTEM



SAFETY AND MONITORING SYSTEM

FIG 4

7. *Safety Monitoring and Fault Detection*

For safety and monitoring purposes, current transformers and breakers are used (Fig. 4). To curb over voltage, a lightning arrestor (LA) is used, limiting the maximum voltage over the main transformer. The current in all windings of the main transformer and all motor fields is monitored continuously, through the use of current transformer (CT).

Should an over current occur on any of the monitoring transformers, the main circuit breaker (MCB) will open immediately. The potential transformer (PT) is used for monitoring the supply voltage. When the supply is too high or too low, the MCB is opened. To enable the driver to immediately discover any faults in the locomotive and, if possible, reset from the cab, a computerized fault indicating system (FIS) has been incorporated. This system consists of a microprocessor which supervises all running conditions. Together with a display panel in each driver's cab this gives the driver all the necessary information during fault conditions and also provides possibility to reset most of the faults from the drivers cab through a push button.

Annexure 1.06

Functional description of the main circuit of Thyristor EMU

1. *Power Circuits*

The power circuits are shown in the Fig. 1. The symbols appearing in it are listed below together with the location of the equipment.

Symbol	Description	Location
ABB	Air-Blast circuit-breaker	Roof
AF1-3	Auxiliary fuses	Main transformer
CMD1-2	Current-monitoring device	Contactor case
D1-4	Main diodes	Rectifier case
DX1-2	Di/Dt inductors	Rectifier case
EAS	Earthing switch	Roof
EFR	Earth-fault relay	Contactor case
ERF	Electronics reference fuse	Rectifier case
FRS	Forward and reverse switch	Contactor case
HFSK1-4	High-frequency surge-suppression capacitors	Rectifier case
LA	Lighting arrestor	Roof
M1-4	Traction Motors	Bogies
MC1-4	Motor contactors	Contactor case
MOR1-2	Motor overload relays	Contactor case
MT	Main transformer	Underframe
P	Pantograph	Roof
POCT	Primary-overload current transformer	Roof

POR	Primary-overload relay	Contactor case
SOCT	Secondary-overload current transformer	Rectifier case
SOR	Secondary overload relay	Contactor case
SSF1-4	Surge-suppression fuses	Rectifier case
SSK1-4	Surge-suppression capacitor	Rectifier case
SSR1-2	Surge-suppression relays	Rectifier case
SST1-2	Surge-suppression transformer	Rectifier case
SSZ1-4	Surge-suppression resistors	Rectifier case
SX1-4	Smoothing inductor	Underframe
T1-4	Thyristors	Rectifier case
WSR1-2	Wheel slip relays	Contactor case
WSZ1-4	Wheel slip resistor	Contactor case

2. Description of Circuit

The supply current is taken from the overhead conductor by the pantograph P, through the air-blast circuit-breaker ABB and the H.T. bushing and cable, to the primary winding of the main transformer MT. The return circuit to the running rails is via an insulated earth cable to the axle earth-brushes fitted on each traction-motor axle-suspension. Also conneted to the high-voltage end of the transformer primary winding are a two pole earthing switch EAS and a lightning arrestor LA.

A primary-overload relay POR with its associated current transformer POCT protect the main transformer. The main transformer has two equal secondary winding supplying two half controlled asymmetrical bridges T1, T2, D1, D2 and T3, T4, D3, D4 the dc outputs of which are conntected in series. The rectifier bridges supply the four traction motors M1-M4 which are permanently connected in series parallel configuration, with their fields and compoles arranged in the centre (virtual earth postion). The main smoothing inductor SX is divided into four sections, so that in the event of a motor fault, a high impedance is in circuit and motor cut-out is simplified. The output voltage of the rectifier is controlled to maintain a constant current in the armatures during acceleration, the current being measured by current monitoring devices CMD1-2. Overload protection is provided by the two current-monitoring devices and two motor-over load relays MOR1-2.

A single twin-circuit linear reversing switch FRS is used. Motor isolation is provided by the motor contactors MC1-4 and the motors can be cut out in pairs. Wheel slip detection is provided by voltage-sensitive circuits comprising resistors WSZ1-4 and wheel slip relays WSR1-2.

The power circuit includes four surge-suppression circuits:

1. High frequency surge-suppression capacitors HFSK1-4 connected between each secondary terminal and earth.
2. Resistor/capacitor snubber-circuits connected across each power device in the main bridges.
3. Limiting inductors DX1-2 for rate-of-rise of current.
4. Main surge-suppression networks SSF1-4, SSZ1-4, SSK1-4. These networks are connected in pairs across each secondary winding; a failure of any component in these energizes one of the surge-suppression relays SSR1-2

The main rectifier bridges are protected from overload by the secondary-overload-relay circuits SOR, SOCT1-2.

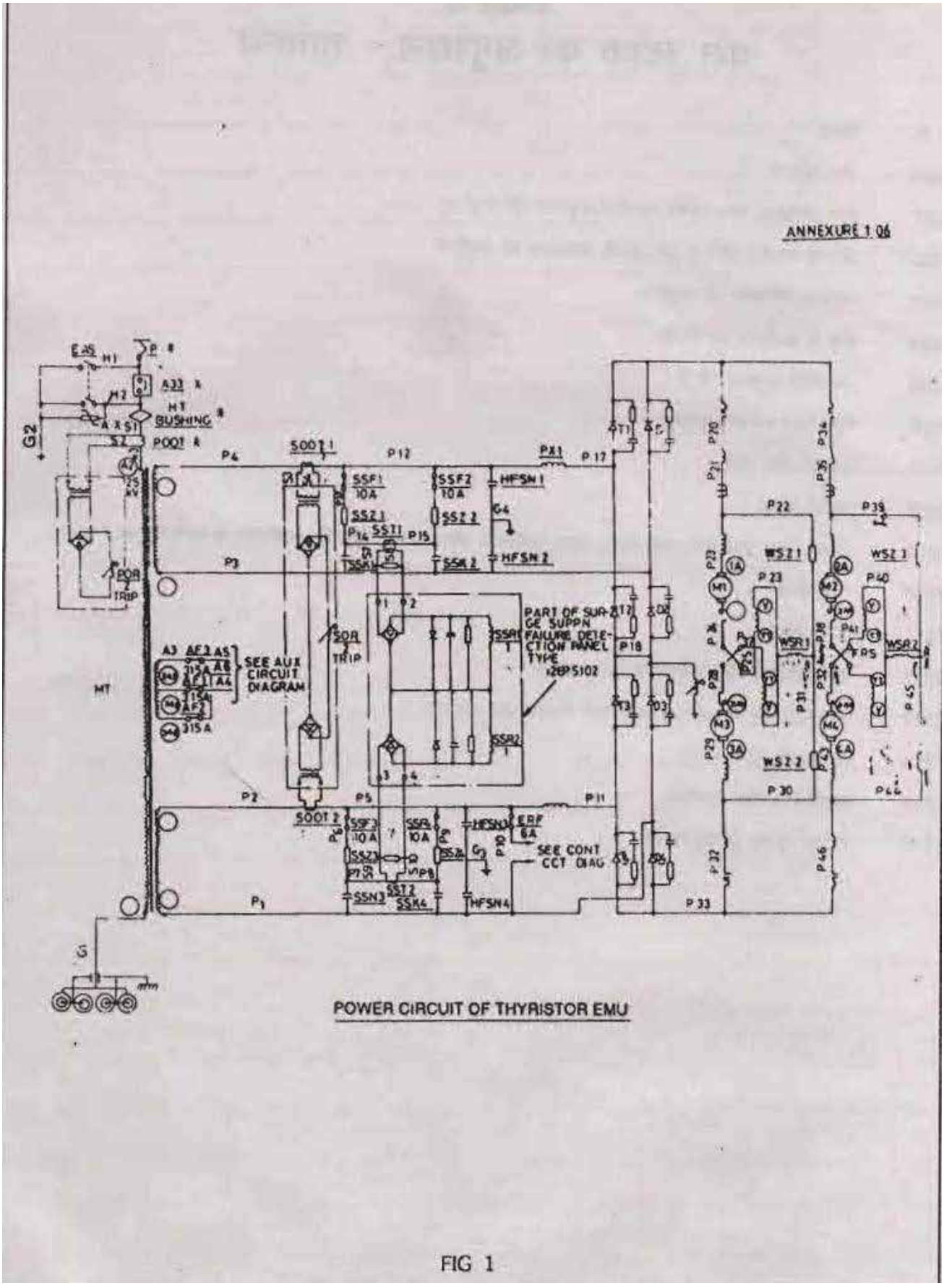
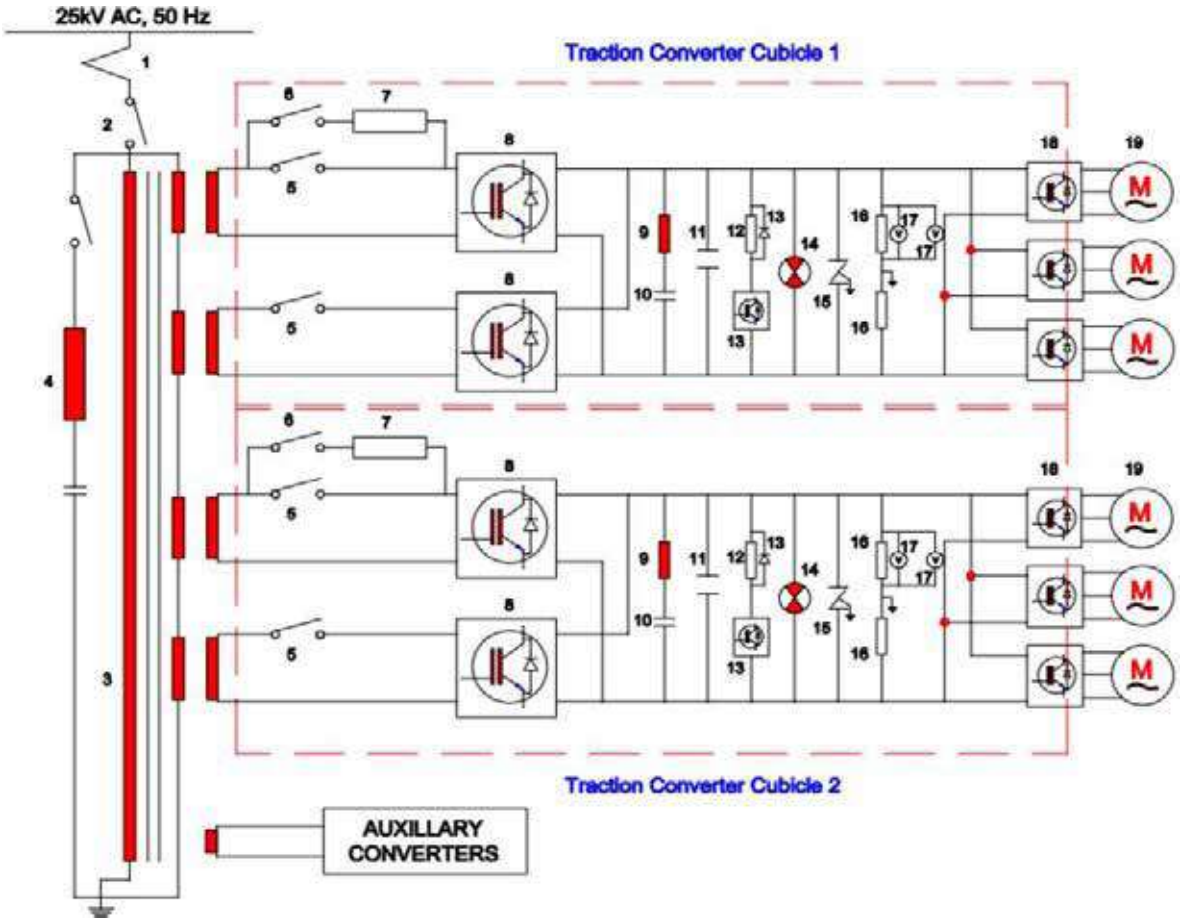
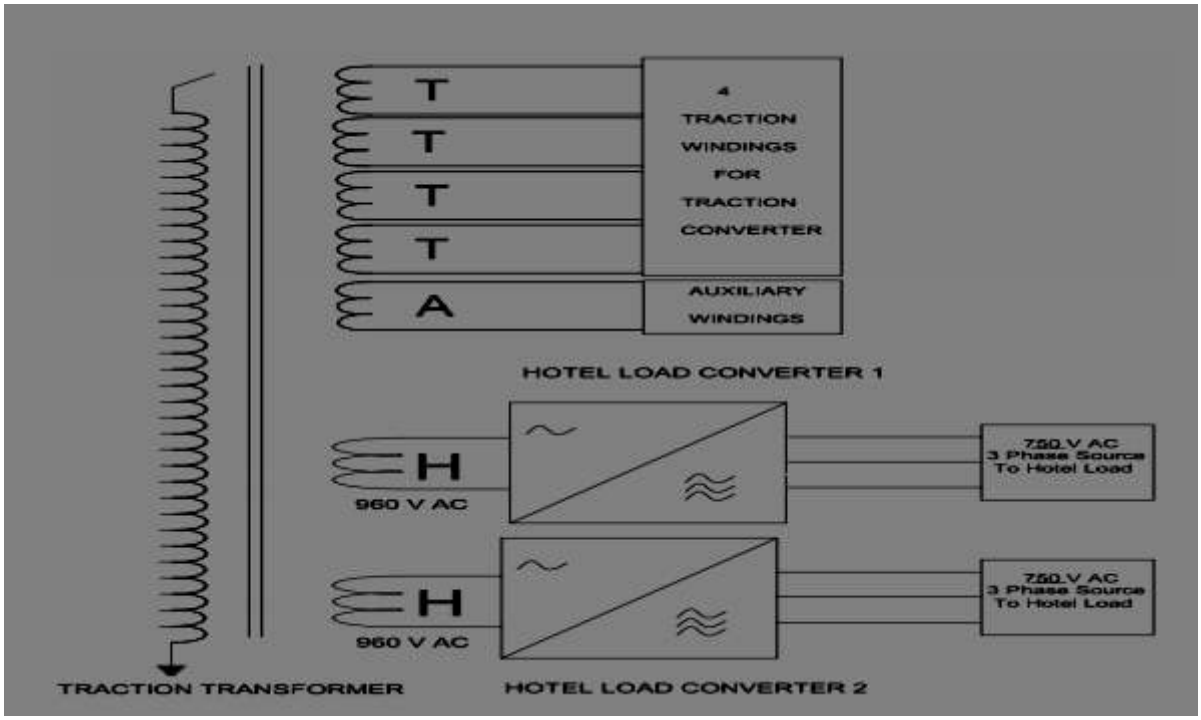

ANNEXURE 1.06
G2
MT
G
SEE AUX CIRCUIT DIAGRAM
PART OF SURGE SUPPN FAILURE DETECTION PANEL TYPE ZEPS102
SEE CONT CCT DIAG
POWER CIRCUIT OF THYRISTOR EMU

FIG 1

Annexure 1.07: Functional description of main circuit of WAG9/ WAP7 loco

Power Circuit Description of Three phase locomotive





Schematic of WAP7 loco with Hotel load winding

S.No.	Details
1	Pantograph
2	Vacuum Circuit Breaker (VCB)
3	Transformer
4	Filter Winding with Contactor, Harmonic Filter (RC)
5	Converter Contactor
6	Pre-charging Contactor
7	Pre-charging Resistor
8	Line Converters
9	100 Hz Resonant Filter Choke
10	100 Hz Resonant Filter Capacitor
11	DC Link Capacitor Bank
12	Over voltage limiting Resistor
13	Over voltage limiting IGBT with Freewheeling Diode
14	Voltage Indicator Lamp
15	Earthing Switch
16	Earth fault Detection Resistors
17	Earth fault Detection Voltage Sensor
18	Motor Drive Converter (3 per Traction Converter)
19	Traction Motors

Transformer secondary has four Traction windings rated at 1449 kVA each, one Auxiliary Converter winding rated at 334 kVA, one Filter winding rated at 400 kVA and a Hotel Load winding rated at 945 kVA. Apart from the above, the Transformer also holds Series resonant filter choke and Auxiliary converter filter chokes. Transformer is oil cooled with the help of two Oil pumps and two blowers which cool the radiator through which oil is circulated using the Oil pump.

For the 4-Q operation of 3-phase locomotives, the most important component is the Traction- Converter assembly. It consists of broadly three main parts --- 1) the Line side Converter 2) the DC link Capacitor and 3) the Drive Converter.

Traction converter converts single-phase 25 KV AC supply into 3 phase AC, with Variable Voltage (max 2180 V) and variable frequency (from 0 to 65 hz. in constant troque mode, from 65 Hz to 132 Hz in constant power mode).

As such 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 electrical braking, the traction motor works as a generator and feed 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 feed 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.

Each Traction Converter consists of two Line Converters, DC Link and three Motor Drive Converters. The Line Converters interface with Transformer secondary Traction windings on one side and DC Link on the other side. The Line Converter consists of single-phase full bridge rectifier with IGBTs as active switching devices. The DC Link consists of 100 Hz Resonant filter,

Earthing switch, Earth leakage detection circuit, DC Link capacitor bank and brake chopper (for over voltage protection).

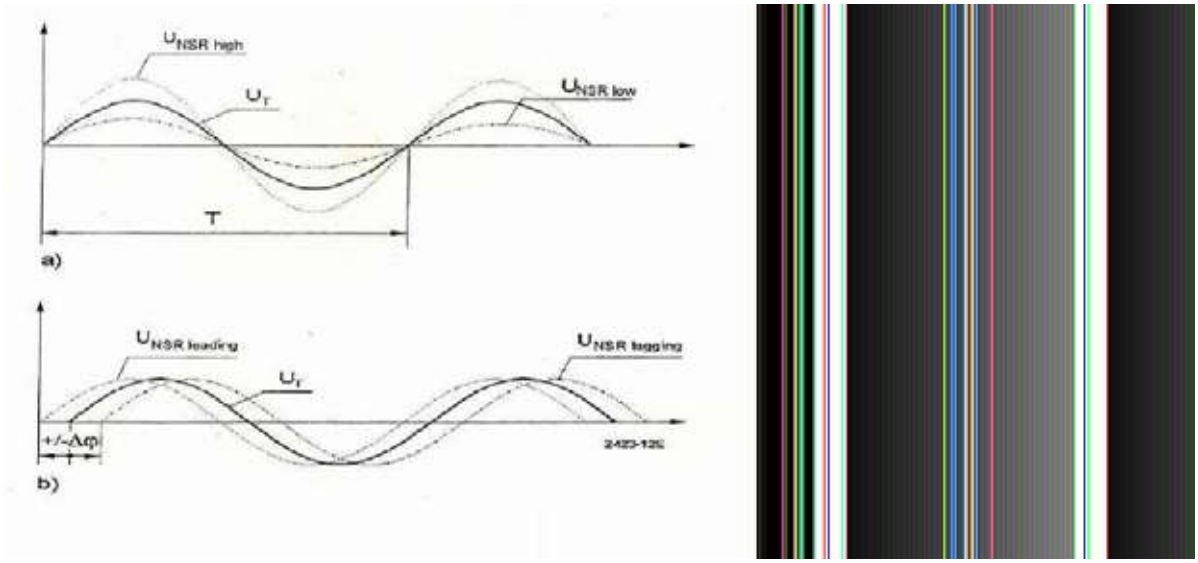
The Motor Drive Converter consists of a 3-phase full bridge inverter with IGBTs as active switching devices. The Traction Converters have their own Traction Computers, which control and protect the Converters as well as communicate with the Vehicle Control Electronics through CAN interface on Optical Fiber Cables.

Two Vehicle Control Units (VCU) are provided in two cabinets (SB1 & SB2). The VCUs communicate amongst themselves and with Traction Converters and Auxiliary converters through the CAN interface on Optical Fiber Cables. Multiple Unit communication is also carried out via the WTB interface. Driver display unit with interface to VCU provides all the vital information and fault status of various equipment on the locomotive.

FOUR QUADRANT OPERATION:

The Line Side Converter is primarily utilized in 4-Q operation. It is a PWM (pulse width modulated) converter.

1. The line converter is a self-commutating 4-quadrant converter. The AC terminals of the two bridge circuits (A11, A12) (refer to fig) see AC voltages formed by square-wave pulses of identical amplitude.
2. These pulses are produced by pulse-width-modulating the DC-link voltage. The fundamentals of these alternating voltages are at line frequency and form the counter-emf. to the two transformer secondary voltages. Their aptitudes and their phase angle with respect to the transformer primary voltage, can be changed independently of each other. This allows the regulation of the power factor to unity in either driving or braking mode.

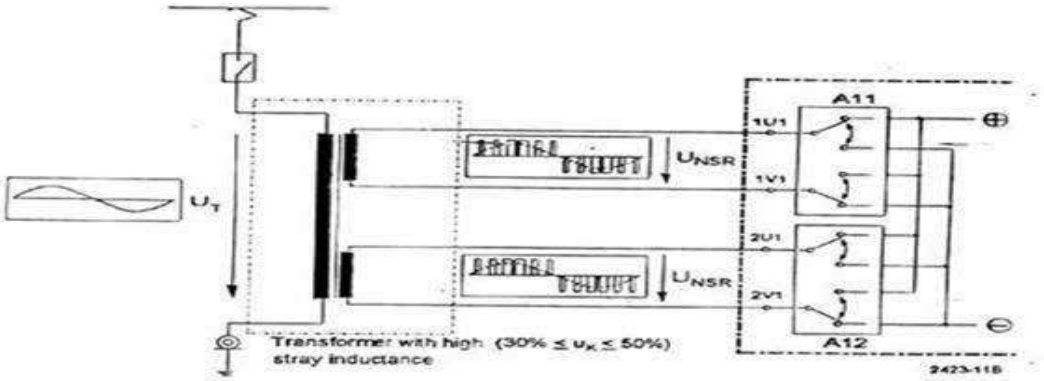


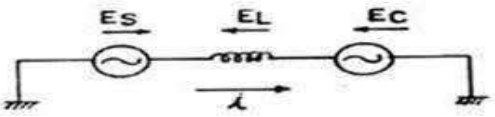
UNSR is the fundamental frequency voltage of NSR ac side as seen by the secondary winding (Stray Inductance). When observed from DC link Side the NSR can be seen as inverting the DC link voltage to its AC side. UT is the transformer voltage as stepped down from primary to secondary.

The UNSR and UT can be seen to form two equivalent AC machines connected across an inductance (the stray inductance of transformer).

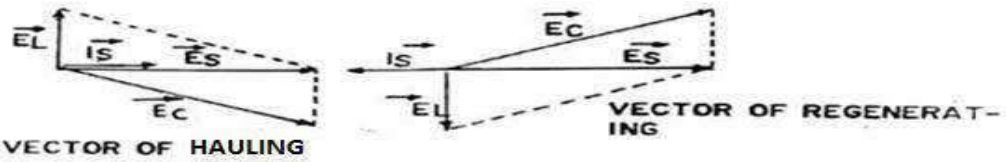
PWM is used for NSR to control the phase of UNSR with respect to UT. Thus not only the power factor but also the direction of power flow can be controlled. This is the key to 4-Q operation.

In forward motoring mode, the drive side converter ASR is used as VVVF drive to control the hauling operation. The NSR is switched in a way that the UNSR lags the line voltage UT. The energy is transferred from line to the DC link and through it to motors.

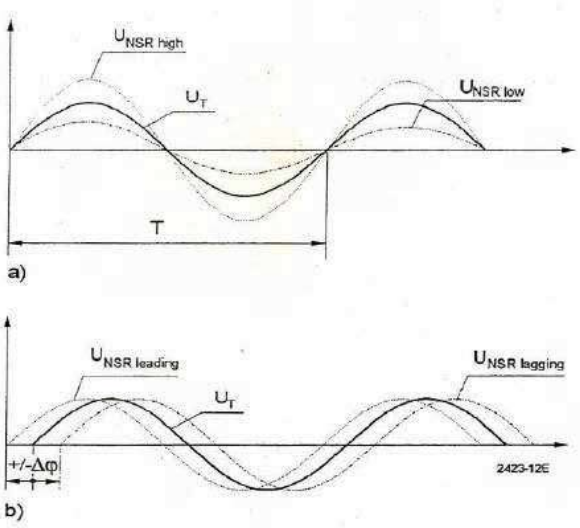




EQUIVALENT CIRCUIT OF FUNDAMENTAL COMPONENT



In Forward generating mode i.e. the quadrant 2 operation, the switching Pulses to ASR are blocked and the ASR simply acts as the 3-phase diode bridge rectifier as seen from motor side to DC link capacitor side. The capacitor voltage builds up. In this mode the NSR is switched in a way that the UNSR leads the line voltage thus the energy is transferred to the line.



Auxiliary Circuit Description: - Three phase locomotive has single phase as well as 3-phase auxiliary machines. The circuits feeding single phase as well as 3-phase machines are separately but fed through same auxiliary winding (1000V) of main transformer.

Single Phase Circuit: - The auxiliary winding voltage is stepped down by an auxiliary transformer to give 415 V & 110 V AC output. The following loads are connected at 415 V AC circuit.

1. Machine Room Blowers.
2. Scavenge blowers for machine room blowers.
3. Cab heaters.

Loads connected with 110 V AC circuit are

1. Cab fans
2. Blowers for cab heaters.

The 415V AC, 110 V AC auxiliary circuit get energised as soon as VCB is closed.

Three Phase Circuit: - For running three phase auxiliary motors WAP5 & WAG9 locomotives are equipped with 3-phase static auxiliary converters to supply the auxiliary machines of locomotive. Auxiliary Converters are known as BURs. These are three BURs provided in one locomotive. The load distribution among the BURs is such that required redundancy is achieved by automatically switching load from one BUR to another.

BUR 1 & 2 feed VVVF supply to traction motor blowers and scavenge blower of bogie 1 & 2 respectively. BUR 3 feeds a fixed frequency supply to two compressor motors and two converters and transformer oil pumps and also feeds the Battery Charger. If BUR 1 fails and get isolated, BUR 2 feeds the auxiliaries for ventilation of both bogies up to a maximum frequency limited to 42 Hz. If BUR 2 fails & get isolated BUR 1 feeds the auxiliaries at 42 Hz. If BUR3 fails and isolated, BUR2 feeds the compressor motors, oil pumps and battery charger at a fixed frequency of 50 Hz and BUR1 feeds the auxiliaries for ventilation of both bogies up to a maximum frequency of 42 Hz. Detailed circuit are shown in figure.

Hotel Load Winding: To cater for the Hotel Load of the train, power is taken from the OHE through pantograph to traction transformer of the locomotive which is provided with a hotel load winding of 945 kVA, at nominal voltage of 750 V single-phase, which varies with the OHE voltage variations. This 750 Volts single-phase supply is fed to Hotel Load Converter, which gives 750 Volts 3- phase 50 Hz supply as output, for feeding the hotel load of the train.

3-Phase Goods Locomotive:-

WAG9 class of locomotive with Co-Co bogies are imported locomotives from M's ABB Switzerland outline of locomotives is as per drawing no. SKEL 4357. The axle load of the locomotive is 20.5 ± 2% t . WAG9 loco permitted to run upto a maximum speed of 100kmph vide this office letter no. SD.WAG9.11 dated 25.10.2005 on the basis of satisfactory test results contained in RDSO's report no. MT-81. In order to achieve starting tractive effort of 50.97 t, the axle load of the locomotive was increased to 22.0±2%t and the locomotive had been named as WAG9H. WAG9H loco was permitted to run upto a maximum speed of 100 kmph vide this office letter no. SD.WAG9.11 dated 03.07.2014 on the basis of satisfactory test results contained in RDSO's report no. MT 1302/F dated 16.01.2014.

Railway Board approved the conventional brake rigging arrangement in WAG9H and Railway board allotted separated transportation code WAG9HC vide letter no 201 ME (TRS)/440/2 dated 03.07.2017.

Further, Railway Board approved the conventional brake system (type IRAB) in WAG9HC and Railway board allotted separated transportation code WAG9C vide letter 2017/Elect (TRS) 440/2 dated 14.01.2019.

Comparative statement of important aspects of WAG9H (With TBU/PBU Brake system) vis-a-vis WAG9H (with conventional brake rigging) locomotive

SN	Design parameter	WAG9H with TBU/ PBU	WAG9H with conv. Brake rigging.	Remarks
1	Overall dimensions of locomotive (in mm)	20562X3152X4255 as per RDSO drawing No. SKEL-4547	20562X3152X4255as per RDSO drawing No. SKEL-4547	No Change
2	Overall principal dimension of bogie (in mm)	6209X2962X1240 as per ABB manual	6209X2962X1240 as per ABB manual	No Change
3	Bogie frame	Fabricated as per CLW drawing no. 1209-01.012-011	Fabricated as per CLW drawing no. 1209-01.112-180	No Change
4	Brake system	Air brake system to RDSO specification no. RDSO/EL/ SPEC/2017/0126 Rev. '0'	Air brake system to RDSO specification no. RDSO/EL/ SPEC/2017/0126 Rev. '0'	No Change
5	Suspension	Two stage suspension (Primary & Secondary)	Two stage suspension (Primary & Secondary)	No Change
6	Axle load	22.0t ±2%	Within limit of ±2% of WAG9H fitted with TBU/PBU	No Change
7	Gross weight	132t ±1%	Within limit of ±1% of WAG9H fitted with TBU/PBU	No Change
8	Track loading density (TLD)	6.91t/m	6.91t/m	No Change
9	Centre of gravity	1357mm above rail level	1357mm above rail level	No Change
10	Weight distribution	Secondary suspension spring (total eight springs) carries vertical load of car body which get transmitting to bogie frame.	Secondary suspension spring (total eight springs) carries vertical load of car body which get transmitting to bogie frame.	No Change

Changes in WAG-9HC locomotive over WAG-9H locomotive for providing conventional brake system in place TBU/PBU brake system (Ref: RDSO Modification Sheet No. RDSO/2009/EL/MS/0381 Rev-0.)

SN	Item/Equipment	WAG9H with TBU/PBU	WAG9H with conv. Brake rigging.	Remarks
1.	TBU / PBU hanger brackets	Available	Not Available	Removed from bogie frame
2.	Yaw damper brackets	Available	Available	Relocated under frame as per RDSO's drawing No.SKVL-588
3.	Pneumatic pipe lines, brake cylinders	Available	Available	Mounted on bogie frame as per RDSO drawing no. SKVL-584 alt.1 & 585.
4.	conventional hand brake arrangement	Not Available	Available	Mounted at Cab-1 side, inside the machine room just behind the assistant driver side as per the layout shown in Sketch-1 of MS no. 381
5.	Foot Step	Available	Available	Modified as per the layout shown in sketch-2 of MS no. 381
6.	Pneumatic pipe lines and brackets	Available	Available	Relocated as per the layout shown in sketch-3 of MS no. 381
7.	Indication lamp for parking brake on the driving desk(BPPB)	Available	Not Available	Removed
8.	Conventional Hand brake display arrangement	Not Available	Available	Suitable instruction for availability displayed in both the cabs of the locomotives.
9.	Box arrangement for Hand brake assembly	Not Available	Available	Mounted in machine room covered with enclosures as per the layout shown in sketch-4 of MS no. 381.

3-Phase Passenger Locomotive:-

WAP-5 Locomotive- The first 10 locomotives were imported from ABB in Switzerland in 1995. They are supposed to be a variant of the Swiss Lok 2000 (Design concept) and German DB Class 120 (mechanical chassis).

One of the notable features of WAP-5 is regenerative braking. Other notable features of this loco are the provision of taps from the main loco transformer for hotel load, pantry loads, flexible gear coupling, wheel-mounted disc brakes, and a potential for speed enhancement to 200 km/h (120 mph). Braking systems include 160 kN (36,000 lbf) regenerative brakes, loco disc brakes, automatic train air brakes, and a charged spring parking brake

Option for Capacity upgradation of WAP5 loco to 6000HP (WAP5H Locomotive)

Apart from term of references for upgradation of speed potential of WAP7 Locoomotive, it is noted during study/discussions that the designed capacity of existing WAP5 loco is not fully utilised a same may be upgraded to 6000HP4 SMW) with slight modification in software. The existing Traction Motors & Gear coupling requires no modification in upgrading the WAPS loco to 6000HP. Studies indicate that 45 MW WAP-5 locomotive gives comparable performance with respect to proposed upgraded WAP-7. This is due to the lighter weight of WAP5 (75T) vis-a- vis modified WAP7 (1085 T). Utilisation of WAR5 at 4.5 MW was earlier not considered due to reliability issues of Hurth Coupling which discouraged increase in transmitted power. The studies indicate that this is an option which merits examination now, as flexible coupling of WAP5 has stabilised. This is expected to be only a software level change with potential of delivering similar run time performance of a WAP-7 derived locomotive.

WAP-7 Locomotive:- WAP7 class of locomotive with Co-Co bogies have been manufactured by CLW adopting the basic design of WAG9 class of locomotives imported from M/s Bombardier Transportation, Switzerland (earlier Adtranz, Switzerland). The outline of the WAP7 locomotive is as per drawing no. SKEL-4490 alt-2. The axle load of WAP7 locomotive is 20.5±2%t. This locomotive has already been cleared to haul passenger trains up to a maximum speed of 140 km/h on track maintained as per standard specified under para 607 of IRPWM, vide RDSO's speed certificate no. EL 3.1.35/4 dated 13.10.2009 and followed by its amendment no. I dated 12.12.2013.

Railway Board vide letter no. 2017/Elect(TRS) /440/2 dated 11.10.2018. has allotted the unique transportation code of WAP7 locomotive with enhanced speed from 140 to 160 kmph as WAP7HS. Axle load of WAP7HS class of locomotive is 18.08±2%t and General arrangement of the locomotive is as per drawing SK EL-5033.

Wheel flange Lubrication: When WAG-9 locomotives were received from Adtranz Switzerland these were provided with wheel flange lubricators. Function details of that wheel flange system was as follows:

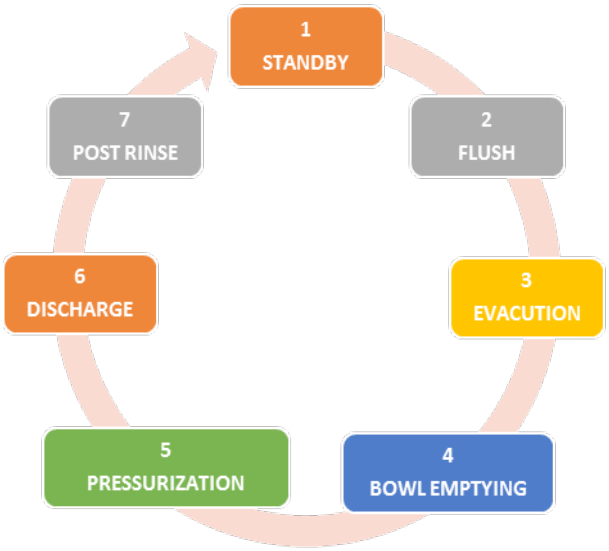
The flange lubrication is pneumatically operated by control valves located on the Brake Frame, which are controlled by the Memotel system. Lubricant is periodically released from the reservoir tank through a pneumatically operated distribution valve and is sprayed onto the wheel flanges from nozzles situated above each end wheel.

A pneumatic and hydraulic pipe is connected to each nozzle. The hydraulic piping connects the distribution valve to the nozzles on the individual wheels. The pneumatic piping provides pressured air to create a low pressure point at each nozzle. The low pressure point at the tip of the nozzle draws oil through the hydraulic piping and sprays atomised oil onto the wheel flanges

Provision of Water closet in electric locomotives:

Many a time requirement of provision of water closet in locomotives was raised in many forums for the Loco Pilots. For taking care of convenience and health of the loco crew, Railway Board asked RDSO to create the specification for water closet for Electric Locomotives.

RDSO in consultation with zonal railways issued the specification no. RDSO/2016/EL/Spec/0121 (Rev-0) for water closet for electric locomotives. The system consists of a vacuum toilet system, fresh water tank, an automatic door and an on-board sewage treatment system (Bio-Digester Tank).



Flushing Sequence for Vacuum Toilet

Main Features of Water Closet as per spec:

1. **Power Supply and power consumption**: The system will operate at 110V DC.
2. **Automatic Door**: Water closet module is fitted with an automatic door controlled by Micro-processor unit. The control unit open the door the integrated modesty lock when the locomotive is not movi
3. **Micro-processor bases control panel**: The Micro-Controller monitors the vacuum toilet system status and parameters of the water close
4. **On-board sewage treatment tank:** It is consist compartment for bacteria to decompose waste along with a chlorinator chamber at the end compartment for clean water to be disposed via the drain port and corban di-oxide gas through the tank vent.
5. **Water consumption per flush:** Not more than 250 ml.
6. Air consumption per flush: 40 litres.

Diesel to Electric converted Locomotives

1. WAGC3/WAG-10 Electric Locomotive (Converted from WDG3A locomotive)

Indian Railways has two modes of traction i.e. diesel traction & electric traction for hauling freight & passenger trains .Both the traction have different designs, rated power , weight and haulage capacity. With the rapid pace of electrification, Railway Board directed RDSO to convert some fleet of diesel traction into electric traction to meet the rapid requirement of electric locomotives and cost cutting on the diesel fuel required to operate diesel locomotives.

Railway Board vide letter No. 2017/M (L)/466/21, dated 12.12.2017 circulated the MoM wherein Railway Board directed RDSO, DLW and CLW to jointly work on conversion of WDG3A diesel electric locomotive to twin Co-Co electric locomotive.

In line with Railway Board directives as above, few WDG3A diesel locomotives have been converted to electric locomotive jointly by DLW, RDSO & CLW. This converted locomotive has been designated as WAGC3(2x5000hp=10000HP) as per Railway Board's letter no. 2017/M(l)/466/21 dated 07.02.2018.

The basic architecture of the locomotive is built on the basis of the extended capability of 4907 Traction Motor and adhesion obtained of WDG3A locomotive during its performance trials by RDSO

The General Arrangement of twin WAGC3 loco is as per drawing no. SK.DL-4794. The axle load of the locomotive is 20.5t and horse power of twin WAGC3 locomotive is 10000HP (2x5000HP). The WAGC3 locomotive consists of two locomotives connected with the help of CBC coupling and each loco will comprise of one cab. Each loco is having one pantograph & equipped with the feature of dynamic braking (re-generative).As far as possible, standard equipment of WAG5/WAG7 & WAM5 has been used in WAGC3 locomotives.

The basic features of the twin Co-Co WAGC3 locomotive are as under:

a. Weight of twin WAGC3 loco =2x123t=246t
b. Axle load=20.5t
c. Adhesion=35%
d. Starting Tractive Effort(kg)=86000
e. Continuous tractive effort(kg)=52800
f. Maximum speed=80kmph
g. Horse Power=10000hp
h. Gear Ratio=18:74
i. No. of transformer=2
j. Type of traction motor=TM4907BZ(BHEL)
k. Rating of traction motor(continuous)= 750V,900A,600kW(800hp)
l. Haulage Capability= WAGC3 locomotive in twin mode can start & haul 1 in 100 up-gradient with load of 58BOXN (CC+8+2t) i.e. 5294t with balancing speed of 34km/h.

Comparison of WDG3A Diesel Loco & WAGC3 Electric Loco

(Converted from WDG3A Diesel Loco to Electric Loco)

Sl.	Parameters	WDG3A	WAGC3
1.	Car Body Design	Non- Monocoque	Monocoque
2.	Bogie Arrangement	Co-Co	Co-Co
3.	Under Frame Width	2950 mm	3055 mm
4.	Interface of bogie under frame	Pivot, Side bearer	Pivot, Side Bearer (Same as WDG3A)
5.	Bogie	High Adhesion with Equaliser Beam	High adhesion with Equaliser Beam (Same as WDG3A)
6.	Under Frame Weight	20300 kg	27840 kg
7.	Weight of Component mounted on Under Frame	45560	30517
8.	Weigh of Super Structure excluding component	5100	10100
9.	Weight of Ballast Added	2040	4543
10.	Bogie Assembly Weight	50000	50000
11.	Axle Load	20.5 t	20.5 t
12.	Total Weight of Loco	123 t	123 t
13.	C.G. above rail level	1488 mm	1158 mm
14.	Horse Power	3100hp	5000hp
15.	Maximum Tractive Effort	40.5t	43t
16.	Adhesion	33%	35%
17.	Gear Ratio	18:74	18:74
18.	Maximum Speed	100kmph	80kmph
19.	Traction Motor	BHEL 4907BZ	BHEL 4907BZ



WAG-10 Locomotive

WAG-11 Locomotive:-

In line with Railway Board's minutes of meeting held on 06.04.2018, few WDG4 Diesel locomotive have been converted to Electric locomotive by DLW & CLW. This locomotive has been designated as WAG11 (2 x 6000 hp 12000 hp). General arrangement of the locomotive is as per drawing no. SK.DL-4796 and bogie general arrangement of the locomotive is as per GM drawing no. 40075079. The axle load of the locomotive is 21.01 and horse power of twin WAG11 locomotive is 12000 hp The WAG11 twin locomotive is a consist of two locomotives connected with the help of CBC coupling and operating with. single pantograph.

Technical Data of WAG-11 Locomotives

1.	Weight	2x126t = 252 t
2.	Weight of Bogie	21.7 t
3.	Starting Tractive Effort	106 t
4.	Continuous Tractive Effort	66 t
5.	Maximum Braking Effort	55 t
6.	Max. Speed	95kmph
7.	Cont. Rated Power	12000 HP
8.	Nos. of Transformer	2
9.	Type of Traction Motor	ITB2525-0TA02 (Siemens) A2916-8 (EMD)
10.	Gear Ratio	17:90
11.	Rating of TM (Continuous)	1520V/202A/485KW – Siemens 1550V/265A/435KW – EMD
12.	Length of Bogie	6120 mm
13.	Width of Bogie	3074 mm
14.	Bogie Wheel Base	4216.4 mm
15.	Lateral Spacing of primary spring	2251.1 mm
16.	Lateral Spacing of secondary spring	2246.9 mm
17.	Axle load	21.0 t mm
18.	Wheel diameter New	1092 mm
19.	Wheel diameter condemning	1016 mm
20.	Wheel profile	SK.DL-2561 (Alt.08)
21.	Verticle clearance between bearing adopter and bogie frame	50.8 mm
22.	Lateral clearance between bogie frame and under frame	44.5 mm

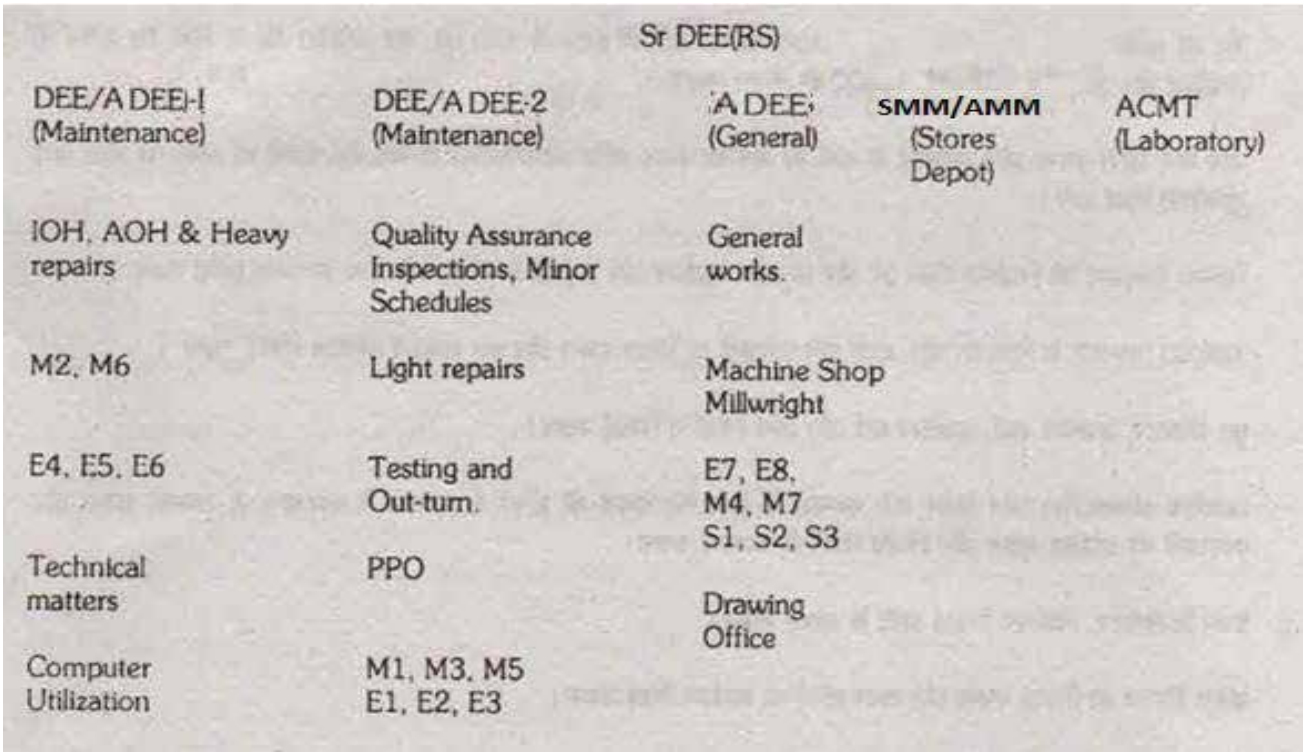


WAG-11 Locomotive

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30200 Shed Organisation

1. The head of an electric loco(or EMU) shed will be Senior Divisional Electrical Engineer (Rolling Stock) whose duties will be generally as defined in para 10108. He will be assisted by one or more officers in lower ranks depending upon the work load.
2. The organization pattern in a loco shed will be generally as shown below:



30202 Duties of SSE/ PPO (Planning and Progress Office)

1. To maintain liaison with the operating wing and ensure timely availability of locos from the shed.
2. To plan the scheduled and unscheduled repairs of locos to the shed as required, keeping in view the shed capacity and proper utilization of inspection, lifting and heavy repair berths.
3. To issue job cards and to coordinate the working of the sections so as to ensure timely turn- out of the locos after attention / repair.
4. To maintain necessary documents to enable scheduled attention to various locos and for revision of maintenance practices and instructions.
5. To keep a watch on tests and trials and performance of modified equipment and maintenance of requisite records in this connection.
6. To maintain the History Register, Equipment Cards, Modification Charts and other prescribed records.

7. To coordinate with the workshops regarding release of locos for POH and special shop repairs and to arrange for dispatch of requisite information and records to shops.
8. To maintain statistics of engine-kilometres, failure records etc.
9. To keep a record of wheel wear and to programme for wheel turning.
10. Furnishing shed statistics to HQ office.
11. To coordinate with TLC regarding withdrawal of locos for shed attention, POH and nomination of relief locos from shed.

30203 Duties of Section Supervisors

Each of the sections mentioned in 30200 will be under a supervisor of appropriate rank (SSE) who will be directly responsible for the following:

1. He will scrutinize the job card for the loco received for inspection/unscheduled repairs, carefully study the work to be carried out and based on his personal inspection, list out additional items of work, if any, for approval as explained in para 30210.
2. He will allot the work to the staff under him with special instructions, if any.
3. He will ensure that the work is carried out within the time allotted and the loco released in time.
4. The supervisor will maintain a record of work done by staff including implementation of modifications, Special maintenance instructions, Technical circulars issued by RDSO and provision of new equipment/components with the purpose of taking corrective action in the event of reported malfunctioning of the equipment immediately after overhaul/repair.
5. He is responsible for drawing, distributing and recording of all stores required by his section, as well as any tools and testing instruments.
6. Before returning the job card in token of having completed the work, he will satisfy himself that all work has been done satisfactorily. To ensure this, he will make frequent checks while the work is in progress.
7. He will ensure necessary co-ordination with other sections as well as with PPO.
8. To guide and instruct supervisors and men under him in the correct methods and schedules laid down for maintenance and repairs.
9. To keep a close watch on maintenance so as to reduce the unscheduled withdrawal of locos to the minimum and to watch the performance of equipment involved in frequent troubles.
10. To initiate appropriate steps for recommissioning locos out of service.
11. Execution of various approved modifications and to maintain locos and the loco shed in a clean condition.
12. To keep a watch on the availability of stores for maintenance and modifications and to initiate appropriate steps for timely recoupment.
13. To ensure efficient maintenance of the shed (section) plant and machinery and ancillary services.
14. To coordinate with PPO regarding withdrawal of locos for attention,
15. To plan and arrange Initial/ promotional/ Refresher training to all the staff working in his section. To arrange training on new equipment by OEM and to coordinate with the Training School regarding relief of staff for training and refresher courses.
16. He will be the stock holder of all equipments on locos, assemblies and sub assemblies and unit exchange spares. To maintain the census such as make, Date of manufacture, commissions, warranty period, serial numbers etc.,
17. To discuss the failures/maintenance lapses with all supervisors and staff and to frame the corrective measures to overcome the failures.

30204 Distribution of Work Load in the Shed

The classification of section in different Railways varies. It shall be ensured that the work load distribution among the sections is done as per their maintenance convenience based on local conditions and type of locos.

Even though the classification of section in different Railways varies, the work load arrangement is typically as under:

E1: a. To carry out preventive maintenance schedule inspections and overhauling schedules on battery charger, rectifier blocks.
b. Trouble shooting and investigations of Unusual Occurrence Reports (UOR) withdrawal and failures of Electric Locos/EMUs.
c. To oversee checking and complete testing of Elect, locomotives nominated for VIP / Superfast trains and special trains.
d. To oversee checking and complete testing of the nominated locos /EMUs by PPO.

E1 section shall have a Quality Assurance Group consisting of competent supervisors and artisan staff who will carry out superchecking on nominated scheduled/unscheduled locos.

E2: a. Test before and test after of all schedule inspection.
b. Electrical inspection and repairs (minor) of parts noticed defective during inspections i.e. head lights, flasher lights, electrical equipments in BA panels, TFP, RPS, SL, Programme switches, MP. EMC, DBR. SMGR. CGR, tap changer, cables, cable sockets and cable connections.

E3: a. To carry out scheduled inspection, unscheduled repairs, modifications, overhauling of traction motors.
b. Connection and disconnection of traction motors before lifting and after lowering.
c. To carry out scheduled inspection and unscheduled repairs, modifications and overhauling schedule of auxiliary motors.
d. To disconnect and connect auxiliary motors while removing / refitting during overhauling scheduled and unscheduled repairs.

E4: a. To carry out scheduled inspections, unscheduled repairs, modifications and overhauling schedule oi i all delicate and precision electrical equipment like relays, speedometers, ammeters, voltmeters and circuit breakers etc.
b. To disconnect and connect speedometer connections /DJ connections during unscheduled repair.

E5: Major repairs and overhauling of EP and EM contactors, smoothing reactor. RPS. flasher light. MP. TFP oil filtration, CGR, SMGR and tap changer (during IOH schedule/unscheduled visits) and modifications.

E6: a. Removal and fitment of EMCs, EPCs, RPS. DBR during AOH schedule.
b. Removal and fitment of SL, SMGR, Tap-changer during IOH schedule.
c. Overhauling of BA panel, head light, TK panel, SB Panels, rotary switch board and switches during AOH/IOH schedule.
d. Cleaning of cable junction boxes and cables during overhauling.
e. Overhauling of SMGR and GR during AOH schedule.

E7: Recabling work, partial or full. E8: Electronic labs and PCBs etc.

M1: a. Inspection and running repairs of mechanical parts, under frame, brake gear, wheels and axles, buffing gear, body doors and windows, locks, side glasses, look out glasses etc.
b. Special checks.

c. Carry out pre-summer, pre-winter and pre-monsoon checks.

M2: AOH/IOH schedule work on i.e. centre pivot, side bearers, roof, buffing gear, cattle guard, rail guard, side glasses, look out glasses, doors, windows and locks.

M3: Inspection, repairs and overhauling of pantograph. M4: a) To supervise the work of machine shop.

M4: a. To supervise proper functioning of Tool Room and its upkeep.

b. To supervise and execute the re-profiling of wheel sets of electric locomotives on the pit wheel lathe and its preventive maintenance.

M5: a. To carry out scheduled inspections and overhauling schedules on all pneumatic equipment except compressors and exhausters.

b. Testing of all pneumatic equipments on test bench after overhauling.

c. To carry out scheduled inspections, unschedule repairs, modifications and overhauling of compressors, exhausters and auxiliary compressors.

d. Removal and fitment of compressors, exhausters and auxiliary compressors during overhauling, scheduled/ unscheduled visits.

M6: a. Mechanical disconnection and connection, lifting and lowering of locomotives.

b. Heavy repairs and overhauling of bogies and other mechanical components like wheel sets, springs, axles boxes etc.

c. Traction motors assembly and dis-assembly.

M7: Remetalling of suspension bearings.

PPO: a. Receipt and dispatch of locomotives/ EMUs for their scheduled and unscheduled visits,

b. Planning of scheduled and unscheduled repairs of locomotives / EMUs.

c. Monitoring the performance of developmental equipment.

d. Maintenance of history books, history cards of equipment fitted.

e. Keeping liaison with RSO regarding calling of locomotives/EMUs for scheduled/unscheduled work.

f. To keep record of wheel wear and to programme re-profiling.

g. To scrutinize Electric Loco/EMUs log books on arrival of locomotives and issuing all job cards to the section supervisor for proper attention to the defects and to ensure that the work is done when the job cards are returned.

S1: All works pertaining to procurement of stores and liaison with HQ for timely procurement of stores and upkeep of custody stores for non-stock items.

S2: Specification updating section. S3: Tests and Trial Sections.

G: a. Electric and mechanical millwright sections.

b. Maintenance of cranes and M&P items.

c. General upkeep of shed.

d. Road Transport.

Technical Section

All technical correspondence of the shed i.e. outside and within shed, updating and feeding of technical data in computer etc

Laboratory

Physical and chemical testing of all items including ultrasonic testing of axles and shafts. Drawing office

All drawing work, preparation of office estimates etc. Computer Section

Operation of computer - collection of data and processing.

30205 Technical Section

The chief responsibility will be:

1. Keeping track of every failure of components/ equipment. The failure should be analyzed in detail on the basis of which should emerge the analysis of the causes of failure, suggestions for improvements, modifications etc.
2. Documentation of all technical information.
3. Keeping a watch that the maintenance instructions issued to the shed staff are up-to-date and ensuring that the instructions are explained to the concerned staff.

30206 Specification Updating Section

This section will be responsible with the drawing office, to update list of specifications and drawings against which different items are to be ordered and for issuing stocking advices to Stores Department. It should also keep records regarding consumable stores so as to pin-point any abnormal consumption for effective investigation.

30207 Test and Trials

The observations regarding tests and trials should be carefully documented for the benefit of improving specifications or modifications to inspection schedules. The necessary documents should be centralized and kept in the PPO.

30208 Materials Management

1. This subject is dealt in detail in Volume I. A few relevant items are being mentioned here.

a. The various components - sub-assemblies and spare parts shall be purchased from the original/ approved supplier of equipment. Railway may however make out a compendium of approved suppliers for each item/equipment, based on RDSO's/production unit's list. Any variation from the same shall only be permitted personally by Chief Electrical Engineer.

b. For bringing in new suppliers in the compendium of approved suppliers, CEE may personally authorise use of untried and untested equipment for field trials. Special care is needed while approving any new make and type of brushes for traction motors.

c. Storage of Rubber Components

Most rubbers change in physical properties during storage and ultimately become unserviceable, due to excessive hardening, softening, cracking, crazing or other surface degradation. These changes may be the result of one particular factor or a combination of factors, such as the action of oxygen, ozone, light, heat, humidity or oils and solvents. The deleterious effects of these factors may, however, be minimized by careful choice of storage conditions. To optimize or reduce the deterioration to minimum possible rate following storage conditions are recommended by CAMTECH vide Handbook on Up-keeping of Rubber items of Pn. Valves of Electric locomotives – CAMTECH/E/13-14/Rubber item/1.0, Nov'13

i. The rubber components should be stored in a cool place and packed condition as far as practicable, preferably below 25°C (preferably between 15°C to 25°C).

ii. Rubbers should be protected from light, in particular direct sunlight and strong artificial light with a high ultra-violet content. It is advisable to cover windows of storage rooms with a red or orange coating or screen.

iii. Humidity The relative humidity of the storage condition should not be more than 70% so that condensation of moisture does not take place on the surface of the components. Very moist or very dry conditions should be avoided. Where ventilation is necessary it should be kept to a minimum.

iv. Oxygen & Ozone Where possible, rubber should be protected from circulating air by wrapping, storage in airtight containers or by other suitable means. In the vicinity of rubber components, any loose electrical connections should be avoided, as the arcing due to loose connections causes production of ozone.

v. Contact with metals They should be stored away from contact with certain metals and their alloys containing copper and manganese or materials impregnated with their compounds (except when bonded to them) which act as poisoning agents resulting in their faster degradation. They shall be protected by wrapping or by separation with a layer of suitable material for example paper or polyethylene.

vi. Deformation Under no circumstances rubber components should be stressed during storage. The portions under stress undergo deformations with permanent set and leading to degradation. Large O-rings and seals shall not be suspended on pegs as this will lead to severe deterioration.

vii. Contact with liquid or semi solid materials: Any contact with grease or oil should be avoided as these cause swelling, softening and deterioration of rubbers. Even people handling rubber should ensure that their hands are oil/grease free.

viii. Contact with dusting powder A small amount of French chalk or soapstone or mica may be applied on the surface of rubber components for the packaging in order to prevent blocking. In such instances the minimum quantity of powder to prevent adhesion shall be used. Contact between different rubber Contact between rubbers of different composition and colour shall be avoided.

Article with rubber to metal bonds the metal parts of bonded metal items shall not come into contact with the rubber of others articles. Rotation of stocks Great care is to be exercised so that the material is used in the order of their receipt in the stores i.e. first-in-first-out basis (FIFO).

d. Storage of Lubricants/ Greases:

Lubricants/ grease are the most important products for reliable and safe operations of various types of bearings used in rolling stocks. To achieve desired performance of these bearings, besides lubricating/ greasing them periodically, equal importance and care need to be taken right from manufacturing, transportation, storage, handling and point of usage.

After detailed study and consultations with Oil Companies, manufacturing lubricants for Railways applications, RDSO issued Technical circular no. RDSO/2010/EL/TC/0104 Rev '0' dt. 22.07.2010.

i. All barrels must be stored, preferably indoors; away from extreme heat/cold, dust, acidic fumes and moist atmospheric conditions.

ii. Lubricating oil barrels should be stored horizontally preferably on wooden rails dunnage to avoid contact with ground. The barrel bungs should be in the clock position at 3 & 9.

iii. Grease barrels must be stored vertically preferably covered with tarpaulin, if not stored indoors.

iv. Technical circular No. RDSO/2010/EL/TC/0104 (Rev.0) should be followed for storage & handling of lubricant/greases used for Electric Locomotives.

e. Storage of Bearings

RDSO after conducting Technical Audis of various sheds (LGD, AQ, HWH, GZB, CLW & KPA shops etc.,) recommended the following guidelines for proper storage of bearings vide Technical Audit Report No. RDSO/2016/EL/TAR/001 Rev. '0' dt. 01.03.16, 002, 003 & 004 dt.

29.03.16, 005 dt. 30.03.16 and 008 dt. 13.07.16.

i. Air-conditioned storage ward may be developed for storage of bearings, varnishes, rubber components etc. Arrangements to be made for 24 hour working of air conditioners of AC Storage ward. Fridge/Deep freezer of adequate capacity needs to be used for storage of varnishes which are to be stored at less than 100C. Temperature and humidity indicators to be provided at the far end of AC Storage ward.
ii. Bearings should be kept in clean room separate from other components.
iii. Keep the bearings little away from walls to avoid ingress of water/moisture in a stack of not more than 5 bearings.
iv. Large size bearings should be stored in horizontal condition only.
v. Bearings should also not be stored directly on floor.
vi. First-In-First-Out (FIFO) system should be followed to avoid prolonged storage of bearings.

30209 Demarcation of Responsibility between Sr. DEE (RS), DEE and ADEs

The DEE / ADE will be responsible for day to day activities in the shed including unscheduled attentions and scheduled inspections. He will be particularly responsible for induction of any new type of equipment/ stock in the shed and ensure that the maintenance schedule for such equipment/ stock is finalized in the shortest possible time.

He/She will do Periodical inspections, Technical audit of the sections under his control to ensure that schedules, overhauling of various equipment are done as per the prescribed schedule charts. He will ensure the implementation of RDSO modifications/special maintenance instructions, Technical circulars, Fire preventive measures and Reliability Action Plan etc., He/She will monitor the progress of initial, periodical refresher training to be imparted to supervisors/staff and plan the training on new equipment/stock etc., He/She will ensure all the M& P, T& P items, jigs, fixtures, Test benches are in working order and arrange periodical calibration to the Gauges, meters etc.,as per the supplier's manual/guidelines.

The Sr. DEE will in addition concern himself with the broader aspects of work and forward planning such as watch-out for organizational shortcomings, indenting and progressing the procurement of forward delivery spares, maintaining a close watch on the functioning of the PPO and above all, exercising vigilant technical control over unusual occurrences, recurring failures and unscheduled booking of locos to the shed and shall be in close liaison with Sr DEE (OP).

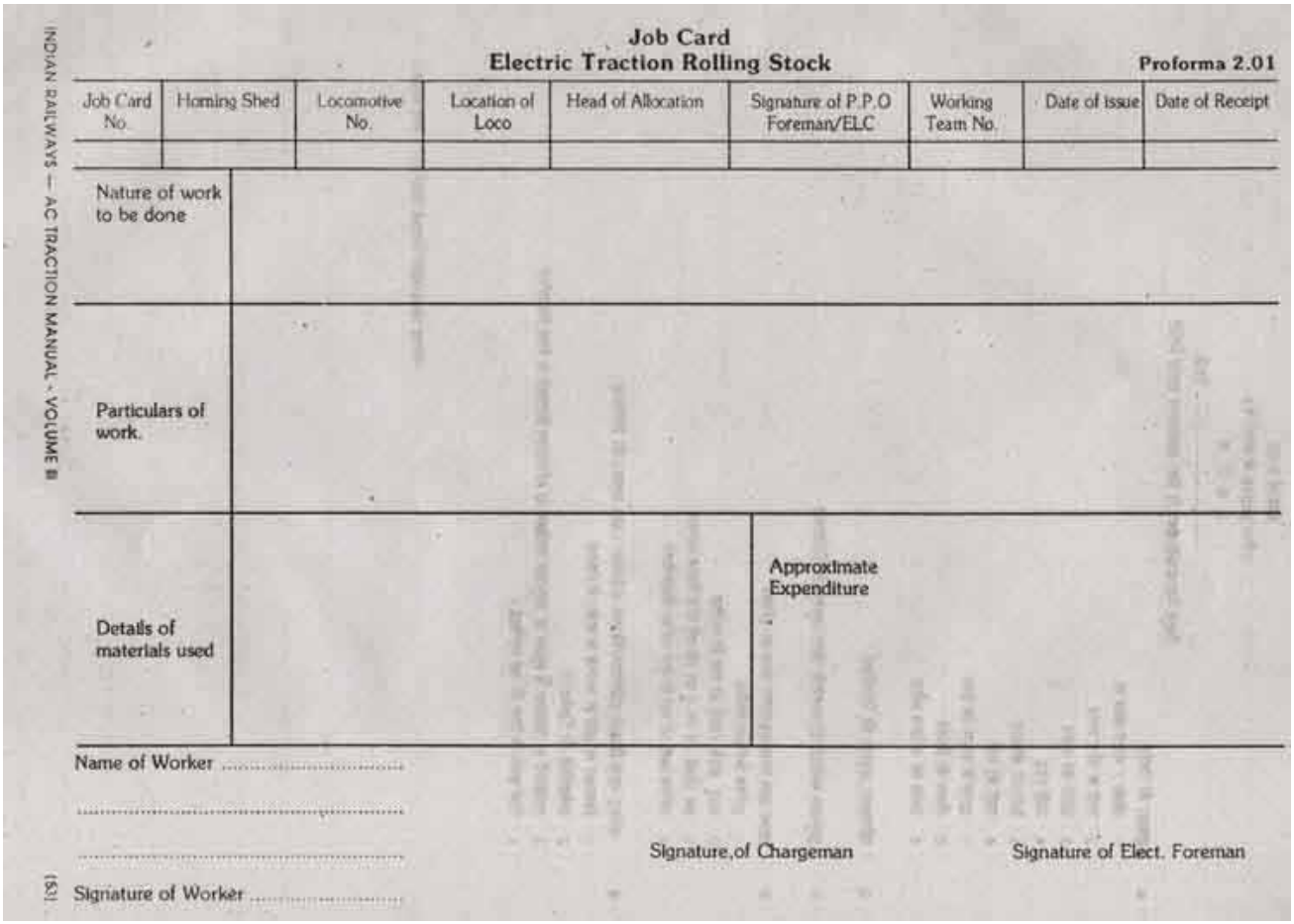
30210 Job Cards

For each loco/EMU received in a shed for scheduled or unscheduled attention, the PPO will issue a job card in proforma 2.01 to each section incorporating the following:

1. The nature of inspection (IA, IB etc.). Refer to chapters III and IV.
2. Additional items of work to be carried out on the loco/EMU by the section, based on booked defects, pre-inspection of the loco or planned modification.
3. The time by which the loco/EMU is required to be released.

Based on his own inspection, if the Section supervisor (SSE/JE) finds that any items in addition to those mentioned by PPO are required to be attended to, he will get such work approved by the Section

Incharge and get the additional items also entered in the job card by PPO. The job card will thus contain a complete record of all work done on a loco during its visit to the shed. When the work is completed, the Section supervisor will sign the job card indicating the attention particulars, important parameters, & observations, time of completion of the work and the names of the workers, who have attended. The loco /EMU should be offered by the PPO for final inspection by El only after job cards from all sections have been received back duly signed by the respective supervisor.



Job Card
Electric Traction Rolling Stock

Proforma 2.01

Job Card No.	Homing Shed	Locomotive No.	Location of Loco	Head of Allocation	Signature of P.P.O Foreman/ELC	Working Team No.	Date of issue	Date of Receipt

Nature of work to be done

Particulars of work.

Details of materials used

Approximate Expenditure

Name of Worker .....

.....

.....

Signature of Worker .....

Signature of Chargeman

Signature of Elect. Foreman

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proforma 2.01

30211 Shed Facilities

Machinery and plant for Loco Sheds

The list of machinery and plant recommended for a loco shed to cater for inspection, maintenance, overhaul and repairs including major schedule of locomotives as per RDSO Technical Circular No. 121 is indicated here under.

COMMON LIST OF MACHINE TOOLS, INSTRUMENTS, LIFTING, HANDLING, COMMUNICATION, TEST EQUIPMENT, TRANSPORT FACILITIES, AUTOMATED/ REMOTE DIAGNOSTIC & MONITORING EQUIPMENT FOR SHED WITH 200 CONVENTIONAL/THREE PHASE LOCOMOTIVES

LIST 1 - MACHINE TOOLS (GENERAL PURPOSE MACHINES)		**Shed Holding**
		For 200 locos
A- Machine Shop		
1	Lathe 250 mm swing x 1500 mm between centers	1
2	Lathe 150 mm swing x 1000 mm between centers	1
3	Radial drilling machine	1
4	Universal milling machine 900 mm x 300 mm table With indexing attachment	1
5	Shaping machine, 600 mm stroke	1
6	Power drill (40 mm hole in M.S.)	1
7	Power Hacksaw to cut 150 mm dia M.S.	1
8	Pipe Threading machine	1
9	Pipe Threading die sets	2
10	Pipe bending machine	2
11	Marking table	1
12	1.5 KVA portable generating sets	4
	Shearing machine sheet cutting M/c table type/ Power press.	1
14	Heavy duty shaping machine	1
15	Winch machine 03 Ton. Cap.	5
16	Pipe Swaging machine for SS pipes	2
17	Sensitive drill (20 mm hole in M.S.)	2
18	Watchmaker`s lathe	2
19	Portable welding set 600 A dc	6
20	Portable transformer welding plant 350 A	6
21	Oxyacetylene welding and cutting set with 25 sets of cylinders for oxygen and acetylene.	5
22	Eutectic weld deposit torch set	2
23	Inverter based multipoint welding m/c	4
24	Smith Hearth	1
25	Gauging facility for cutting and making grooves	3
26	Spray guns portable Compression unit and reservoir with 2 spray guns.	3
27	Portable electric tools (grinder, drills, wrenches) set	12
28	Torque wrenches (Pneumatic/electrically operated)	12
29	½” Sq. Drive industrial socket set (Taparia)	60
30	¾” Sq. Drive industrial socket set (Taparia)	60
31	Pneumatic impact wrenches ½”	10
32	Pneumatic impact wrenches ¾”	6

33	Pneumatic impact wrenches 1”	4
34	Air compressor-complete with air drier filter after cooler, reservoir, outlet valves 250 cfm.-9 kg/cm sq.	3
35	Distributed compressor sets to be provided with pipelines at far away locations for better energy efficiency	6
36	Portable vacuum plant	4
37	Filter cleaning plant	2
38	Pit dewatering portable electric pump	5
39	Booster pump for washing lines	3
40	Sand drying and sieving plant	2
41	Submersible pump fitted in each pit	As per No. of pits
42	Battery charger	3
43	Portable battery charger	4
44	Loading resistor for battery	3
45	Distilled water plant (Electrical)	3
46	Oil centrifuging and filtering plant 3000 LPH capacity(VPI)	4
47	Pneumatic crimping tool for power cable	3
48	Hand crimping tool for control cables	10
49	Panto assembly fixture	2
50	Special crimping tool for sub ‘D’ connector	5
51	Special crimping bayonet connector	4
52	Anti static soldering & De-soldering plan	1
53	Anti static vacuum cleaner	2
54	Ionizing blowers	2
55	Set of anti static tools	2
56	Anti static storage transportation box facility	1 set
57	Contactless thermometer	10
58	Thermo vision camera	1
59	Q meter	2
60	Panto TF measuring fixture	1
61	Spring scale (cap. Above 30 kg) for measuring housing force of pantograph	4
62	AM12 Servometer overhauling fixture	3
63	AM92 Servometer (old version) overhauling fixture	2
64	Magnifying scale	2
65	Portable grease gun & lubricating equipment	3

LIST 2 - SPECIAL PURPOSE MACHINE TOOLS		
A- Bogie and Wheel Sets(Including Repairing, Rediscing & MSU repairing)		
1.	Bogie washing and jet cleaning plant	2
2.	Pit type wheel lathe (with mechanical scrap removal and disposal)	2
3.	Horizontal boring machine 1000 mm x 1000 mm table.	1
4.	Hack's burners	2
5.	Bogie squaring Jig	1
6.	Wheel profiling set (tool room)	2
7.	Grease guns and lubricating equipment (One set for each type of oil or grease)	8
8.	Lifting beam for locomotive body with stand	4
9.	Lifting tackle for bogie	8
10.	Spring testing equipment	2
11.	Shock absorbers snubbers testing jig	2
12.	Hydraulic Dampers testing and Calibration Machine	2
13.	Motorized drop pit with wheel dropping arrangement for removing of axle without lifting loco.	1
14.	AJTB Machine	1
15.	VTL Machine	1
16.	Axle turning machine	1
17.	Press machine 400 t	1
18.	Bogie manipulator for welding of bogie frames	1
19.	CNC Surface wheel lathe	1
20.	Axle turning lathe, CNC(indigeneous)	1
21.	Vertical turret lathe, CNC	1
22.	Axle grinding machine, CNC	1
23.	AJTB lathe	1
24.	Wheel press, 500 Ton	1
25.	EOT crane 15 t	1
26.	Ultrasonic flaw detector	1
27.	Induction heaters	3
28.	Bearing extractor, motorized	2
29.	Drilling & tapping machine	2
30.	5T fork lift	1
31.	Welding for axle box (inverter based)	1
B- Traction Motor Shop		
1	Pinion extractor	2
2	Pinion heating oil bath or induction heater	3
3	Autotransformer-rectifier unit 100 V x150 A dc	2
4	Commutator turning, Mica undercutting and chamfering and armature banding lathe	2
5A	Dynamic balancing machine for Armature (1 tonne)	1
5B	Dynamic balancing machine for impellers (200 kg)	1
5C	Portable balancer for balancing of rotors and impellers of auxiliary machine in position (500-6000 r.p.m. range)	2
6	Vacuum impregnating plant	1
7	Baking oven 2000 C with trolley	3
8	Brazing tongs with transformer	2
9	Bearing extractor set	3
10	Hand 5operated shearing machine for insulation	2

11	Traction Motor assembly fixture set (shop made), One set for each type of motor.	2
12	Electric motor Checker 5type EMC-22 (SMI/163) for checking rotor bar cracks in the rotors of auxiliary machine & Arno	3
13	TM stator cleaning plant	1
14	Axle racer puller	2
15	Run test machine for TM	2
16	Run test machine for assembled wheel sets	2

LIST 3 – TESTING, MEASURING INSTRUMENTS AND PANELS		
A - Testing Panels		
1.	Test and calibration panel with meters for each type of relay	2
2.	Test and calibration panel with meter for speedometer	2
3.	Test panel with meters for auxiliary machines	2
4.	Loading dynamometer with test bed for auxiliaries	2
5.	Test panel with meters for contactors circuit breakers	2
6.	Brake and pneumatic equipment test panel including air compressor 500 liters per min 15 kg/cm sq	2
7.	Air brake pneumatic testing rig	2
8.	Test panel for testing of SMGR	1
9.	Variable Auto Transformer Rectifier Unit Out Put 0-135V,100A.	2
10.	3 Phase 415V, 50Hz variable Auto transformer rectifier unit for high cap. DC Motor testing.	2
11.	Relay test bench for Air flow relay testing.	1
12.	Test bench for Pressure switch relay testing.	1
13.	Test bench for Electro Pneumatic valve.	2
14.	Test bench for Reverser/ CTF.	2
15.	Three tank portable work station for cleaning Sinter Bronze capsule of Pneumatic circuit of AC Locomotive.	2
16.	Angle Indicator test kit for Digital notch Indicator.	1
17.	Set of Test Unit for SMGR/GR & CGR.	1
18.	Constant current/ Constant voltage Battery Charge/ Discharge Panel.	2
19.	Battery impedance test equipment bite 3, 230 V AC, 50 Hz, CE Marked including Accessories & operating manual & printer battery operated 220 V AC.	1
20.	LCD Multimedia projector.	1
21.	Static converter (SIV) analyzer with printer & memory reader unit.	1
22.	Hydraulic puller of capacity – 15 ton with spread – 280mm, reach – 229mm stroke – 82mm.	2
23.	TFP oil circulation pump MPH test Bench.	1
24.	TFP oil circulation pump Radiator test Bench.	1
25.	Testing panel for Air Dryers.	1
26.	Testing panel for circuit breaker.	1
27.	Testing panel for ARNO Converter.	1
28.	3 Phase testing panel with Amp. Meter for testing 3 CPs.	1
29.	Air dryer test ring with stand & Dew-point meter	1
30.	Thermal imaging equipment	2
31.	Provision of testing facilities for testing of MPCS & SIVs of conventional locomotive on the line of test jig of electronic cards developed by M/s MEL system Chennai.	As per requirement

B- Testing and Measuring Instruments		
1A	Megger 2500 V	8
1B	Megger 1000 V	10
2	Megger 500 V	8
3	Universal multimeter	10
4	Portable voltmeter dc	5
5	Portable voltmeter ac	5
6	Portable ammeter dc	5
7	Portable ammeter ac	5
8	Current transformer set 20 to 2000 A	3
9	Ammeter shunts 75 m V 2000 A	2
10	Millivoltmeter 0-75 mV	3
11	Storage type Oscilloscope with current & voltage probes	4
12	High voltage tester 0-15 kV	2
13	High voltage tester 0-75 kV	2
14	Oil tester 0-50 kV	3
15	Current injection set 2000 A 3 V dc	1
16	Silicon diode tester	3
17	Electro- plating thickness measuring equipment	2
18	Contact pyrometer (0 – 200 0C)	5
19A	Ultrasonic crack detector for testing white metal bonding in suspension bearing	1
19B	Ultrasonic crack detector for Axles and traction motor shafts	4
20	Zyglo ultraviolet light crack detector	2
21	Brinell hardness tester	2
22	Shore hardness tester	2
23	Spring balance (0-1 kg)	3
24	Spring balance (0-3 kg)	3
25	Spring balance (0-5 kg)	3
26	Spring tester	2
27	Recording ammeter	2
28	Recording voltmeter	2
29	Aneomometer	6
30	Manometer	2
31	Vibration meter	3
32	Capacitance and induction bridge	2
33	Clip on ammeter 0-5-10-25-50-100-250 A	8
34	Dial gauge, Cernier valiper, micrometer and feeler gauge (1 set each)	7
35	Revolution counters	5
36	KWHr meter with accessories for mounting on loco	3
37	Electric coil tester	2
38	Electric timer	2
39	Portable relay testing kit	1
40	Commutator profile recorder	2
41	Stop watch	3
42	Illumination meter	2
43	Wheat stone bridge	2
44	Distilled water tester	2
45	Stroboscope/8Tachometer	2
46	Gear teeth micrometer	2

47	Capacitance & Tan-delta measuring instrument	1
48	Ultrasonic hardness tester	2
49	Dissolved gas analysis apparatus	2
50	Universal tensile testing machine (40 tonne)	2
51	VCB overhauling & testing tool	2
52	Surge comparison tester	3
53	Shock pulse meter for bearing	4
54	Bearing room with ultrasonic cleaning facility	2
55	Induction heater for mounting/ dismounting of bearing	2
56	Micro ohm resistance meter for bar to test of armature.	2
57	Resistivity meter (Model-I.R.T.).	1
58	Microprocessor based Moisture tester (Vigio matic-III).	1
59	Surface & interfacial tension meter.	1
60	Pensky-Marten (closed) Flash point apparatus.	1
61	Electric & Battery operated single pan balance.	1
62	Reference block type – VI (IIW).	1
63	Flexible oven illuminated magnifier.	1
64	Welding resistance meter	2
65	Electrode heating oven 3500 C	6
66	Testing kit for Furan analysis	1
67	Transformer ratio tester	1
68	Vacuum drying plant	1
69	Dew point meter	1
70	Micro ohm meter for measuring of RF/RPS & RS resistance	1
71	Delay time for EMC	2
72	Air flow meter	4
73	Thermovision camera	1
74	High speed camera (for taking photo of equipment failures)	1
75	Ultrasonic air leakage detector	1
76	Wheel profile recorder	1
77	Lubricating grease metal particle analyzer	1

Note: 1. All electronic equipment maintenance sections, Relay maintenance, SMGR overhauling section and bearing overhauling section to be air conditioned.

2. All electronic equipment maintenance sections should have anti-static flooring.

LIST 4 – LIFTING, HANDLING AND TRANSPORT EQUIPMENT		
A - Lifting and Handling Equipment		
1	65 tonne Electric overhead travelling crane with 10 ton Auxiliary hoist for heavy lifting bay.	4
2	35 tonne crane for medium, TM & Aux lifting bay.	4
3	25 tonne EOT crane with 6 t auxiliary hoist	2
4	15 tonne EOT crane	4
5	Lifting tackles for transformer, traction motor, armature loco underframe, roof sections, bogie, wheel set, loco body etc.	4
6	2 tonne chain pulley hoist	6
7	Capstan units 3 tonnes	6
8	Tirfors 3 tonnes	5
9	35 tonne screw jack electrically operated with traversing bases (4 numbers a set)	2
10	20 tonne high lift hydraulic jack (4 numbers a set)	4

11	Accommodation bogies for each type of loco (loco set)	4
B. Transport Facilities		
1	2 tonne fork lift battery truck	4
1A	5 tonne fork lifter	4
2	1 tonne pallet battery truck	2
3	1 tonne material hand trolley platform type (rubber tyres)	5
4	1 tonne hand pallet trolley	5
4A	2.5 tonne hydraulic pallet trolley	6
5	7.5 tonne trolley on rail (for traction motors)	3
6	10 tonne truck	2
7	Jeep with trailer	2
8	Departmental wagon	1
9	Material handling van fitted with crane	2
10	Breakdown vehicle	2
10A	Rail cum Road Vehicle	1
11	Battery driven trolley with rubberized wheel of 3 ton cap.	2
12	Fork lifter having multi stacking features.	3
C. Weighing Machine/Scales		
1	Weighing machine 1 tonne (Stores Depot)	2
2	Weighing machine 50 kg (Stores Depot)	2
3	Weighing machine (Electronic 0-300kg)	2

LIST 5 – COMMUNICATION FACILITIES		
1	Fax machine	2
2A	Telecom facility (with electronic exchange of 100 lines)	1
2B	Linkage of shed Computer network with Zonal head Quarter and Divisional HQs	As per requirement
2C	V.H.F. sets (Walkie- Talkie)	40
3	Laptop & P.C.s with associated hard ware.	Adequate nos
4	PC based computer system with tape drive printer etc and linked with stores computer	2
5	LAN connection with server unit having PC in each section/Sr. Supervisor and 4 PCs in SrDEE's Technical section with railnet/internet facility.	1
6	FOIS/COIS -terminal	2
7	Software Tools for maintenance magnet, failure analysis, inventory magnet and establishment.	As per requirement
8	Railnet & Intranet	10
9	CUG connections	100
LIST 6 – GENERAL PURPOSE MACHINES		
1	Rain water leakage testing shed	1
2	Facility for mechanised washing of loco body for coaching locos	2
3	Floor scrubber	6
4	Portable compressed Air system for blowing out the pipelines in IOH/POH in situ	2
5	Industrial vacuum cleaner for cleaning inside the loco	8
6	500 KVA DG Set.	2
7	Water cooler with water purifier (R/O)	10
8	Deep freezer (675lt. capacity).	2
9	Multi split air conditioner for lab upto 3 ton. Capacity.	4
10	33/0.44 kV sub station TFP of 500 KVA.	2

LIST 7 – WORK BENCHES , LOCKERS Etc.		
1	Stores	Adequate quantity to be provided as per requirement
1A	Workmen's tables, Battery charging Benches, Armature Trestles	
2	Bench vices	
3	Individual fitters tools	
4	Steel lockers for workmen	
5	Steel almirahs and stores racks	
6	Steel tables and chairs, cardex boards, filling cabinets, index cards cabinets, Printers, PC for PPO`s office.	
7	Tables, chairs for officers and supervisors, almirahs, filing racks, cabinets, Printers, duplicator, drawing office and ferro printing equipment.	
8	Time office equipment, Time clock, ticket filing racks, tables and chairs.	
9	Optimiser/File keeping racks	
10	Multi level stacking facility for storage of material on shop floor	
11	Stool with 8" back support for micro-processor/ electronic equipments repair for staff	

LIST 8 – Training & staff welfare facilities		
S.No		**Items**
1	Basic Training school(BTC) with Hostel/rest room having 2 class rooms with LCD projector, one small meeting room and one model room	1
2	Well furnished Library having all the facilities viz. adequate technical books, PC with internet connection, printer, photo copier	1
3	Lunch / Tiffin room	1
4	Staff Canteen	1
5	Cycle/motor cycle stand	1
6	Digital Camera	2
7	Micro processor based training module for conventional / 3 phase loco	1

LIST 9 – Other facilities		
S.No.		**Items**
1	Water Harvesting arrangement	1
2	Fire fighting arrangement	1
3	General electrification with provision of all electrical fitting light & power socket point.	1
4	Heavy Duty Digital copier machine	1
5	Audio conferencing system for meeting room.	1
6	Provision of CCTV	As per requirement
7	Borewell with pump	As per requirement
8	Provision of motorized points to expedite shunting and avoid the need for points men	
9	Provision of ESD free lab	
10	Provision of effluent treatment plant	
11	Provision of security chowkie at main gate	

LIST 10–Testing Facilities to be made available at Chemical & Metallurgical Lab

1. Facilities available for Insulating oil Testing
   a. Dissolved Gas Analyser/Chromatograph – 2 Nos.
   b. Tan Delta and Specific Resistance tester – 1 No.
   c. Moisture tester – 1 No.
   d. Flash Point Apparatus – 1 No.
   e. Visgauge for Viscosity Testing – 2 No.
   f. Interfacial Tensiometer – 1 No.
   g. Acidity test kit – 1 No.
   h. Testing kit for testing carbonization of battery electrolyte in Ni-Cd batteries
2. Ultrasonic Flaw Detector to check internal crack of Loco Axle, Armature Shaft, Wheel disc, Looseness of racer etc. – 02 Nos.
3. Universal Tensile Tester for Rubber, Cork etc. – 01 No.
4. Spectrometer to check metallurgical composition of various loco components – 01 No.
5. Rockwell cum Brinnell Hardness Tester to test metallic component hardness – 1 No.
6. Poldi Hardness tester to test metallic component hardness – 1 No.
7. Shore Hardness tester to test rubber, cork hardness – 01 No.
8. Grease Penetrometer to check consistency of grease – 1 No.
9. Magnetic crack detector AC/DC 230 V to check surface crack of Ferrous components - 1 No.
10. Permanent pole Magnet to check surface and sub surface crack of ferrous component - 1 No.
11. Other Mandatory Lab equipments
    a. Magnetic stirrer cum heater – 02 Nos.
    b. Mono Pan Balace – 01 No.
    c. Muffle Furnace – 1 No.
    d. Hot air oveb – 01 No.
    e. Dial Thickness gauge – 1 No.
    f. Integrated Portable Hardness tester – 1 No.
    g. Conductivity meter of Battery water – 1 No.
    h. Refrigerator – 1 No.
    i. Gas cylinders for DGA – 02 each of Hydrogen, Oxygen and Nitrogen
    j. Distillation plant – 1 No.
    k. Metallurgical Microscope – 01 No.
    l. Voltage Stabilizer – 01 No.
    m. Set of Laboratory Glass wares
    n. Argon gas Cylinder – 2 Nos.
    o. Set of Laboratory chemicals
    p. DPT test kit
    q. Magnetic powder for MPT
    r. Contactless Thermometer
    s. Gas generator for DGA

Other Facilities:

1. Fuming Gas Chamber
2. 02 Desktop computers with UPS and Laser Printer

LIST 11 - Computerized Network data base system of maintenance of locomotives and equipment in electric loco sheds.

1. Computer Room — 2 No.
2. Split AC — 4 Nos.
3. Computer Table — 50 Nos.
4. Computer Chairs — 50 Nos.
5. PCs — 50 Nos.
6. Server — 05 Nos.
7. Printer — 25 Nos.
8. All hardware & software required for LAN
9. Development of a uniform Shed management Software to monitor the position/status of overhauling/repair/inspection/failure of equipment and locomotives, status of availability of spares/equipment in stores, Status of implementation of modifications suggested by RDSO etc. to be connected through LAN and used by all the officers and staff of shed.
10. Development of a comprehensive Loco Management Software like FOIS, through reputed organisations like CRIS connecting sheds, Zonal Railways, Railway Board, RDSO, CLW and other units for monitoring the position of locomotives and carrying out failure analysis for the same.

List 12 – Advanced automated maintenance & condition monitoring system for on line health monitoring of electric locomotive and Real-time preventive maintenance support system for Electric rolling stock:

Automatic maintenance system plays an important role as a solution to the problem of handling down maintenance techniques to younger generations, due to the ageing society and reduction of man power, because the system always yields stable measurement/maintenance results without depending on personal skills. Industries have developed many automatically measuring & maintenance equipments which can provide maintenance solutions in conditions where dangerous, hard and dirty tasks are inevitable and for reducing the work load of maintenance operators. The following is an indicative & in-exhaustive list where automated system could be considered for use by sheds:

SN	Description	Remarks
1.	Pantograph contact measuring system	The thickness or abnormal wear of pantograph contacts are measured by the ultrasonic method and image processing method.
2.	Monitoring system for loco roof tops	Still picture of the pantographs and AC devices and the moving images of the entire roof top condition are recorded.
3.	Wheel profile measuring system	Dimensions of different sections of a wheel are measured by laser and camera.
4.	Brake wear measurement unit	Dimensions of the brake shoe and brake lining are measured by a camera and their replacement periods are estimated.
5.	Wheel flat detection device	Flats on the wheel treads are detected by acoustic sensors and camera images.

6.	Axle flaw auto detector	Flaws in axles are automatically detected by ultrasonic echo analysis
7.	Paint peeler	Higher pressure water jet shall be used to peel off the paint , instead of solvent which has higher environmental impact
8.	Loco body dirt auto detector	The degree of dirt accumulated on the surface of loco body and inside loco is judged by image processing technique for improved efficiency of the following chemical cleaning process
9.	Blower for under frame equipment	Air blowing of under frame devices is automatically performed.
10.	Simulator for malfunction recovery training	Procedures for counter measures taken by Railway man in the event of problems during train operation are outlined on a PC.
11.	Infrared Thermograph	An inexpensive way to embark on condition monitoring is through the use of infrared imaging. The temperature of conductors, bus, switches, transformer tanks, motors and bushings are a direct function of the level of loading of the components, infrared techniques provide value by reviewing temperature differences. The magnitude of difference in temperatures can assist in determining whether the repair should occur immediately or if the problem can be addressed during scheduled routine maintenance.
12.	Ultrasonic and Vibration Detector	Ultrasonic detection techniques are based upon analysis of sounds that the ear can't normally detect. Electrical arcing and corona discharge and pressure or vacuum leaks can be pin-pointed with the aid of detecting devices. Electrical discharges are heard as a frying or buzzing sound whereas a pressure or vacuum leak is heard as a rushing sound or noted on a ballistic meter. The device can be used to test switchgear, transformers, circuit breakers, relays, junction boxes, insulators, bushings, arresters and other electrical gear.
13.	Oil Analysis equipments	Beside gas chromatography; which requires drawing of oil routinely to assess & 17nalyse the levels of various gases. The on-line system designs will improve upon the semi-annual or yearly DGA sampling cycle. The system detects four key gases through tiny semiconductor sensors immersed directly in the transformer oil at the end of a sensor probe. Hydrogen, carbon monoxide, ethylene and acetylene concentrations are continuously monitored for detection of corona or partial discharge, cellulose overheating, pyrolysis, oil overheating and arcing, respectively. Fault gas readings are displayed on-site via a microprocessor unit or are accessed via a computer, on-site or remotely. Transformer maintenance can be better managed based on information obtained through the monitoring system. One such system, developed by Micromonitors, Inc., Bend, Oregon, U.S .
14.	On-line monitoring system for transformers	On-line monitoring system that can be retrofit to existing transformers or supplied with new transformers. The system is based on a condition monitoring package that performs gas-in-oil and partial discharge analysis. It also uses an acoustic method to monitor vibrations of transformers with load tap changers. Load current and oil temperature are also monitored.

15.	Breaker Maintenance & Diagnostics tools	On line Breaker condition monitoring system captures information on the condition of the breaker every time it operates. Trip and close coil currents, open and close of contacts, fault current values and station battery voltage dips. The device provides output alarms for operate times, coil currents and contact duty. The system can also accept inputs from various types of transducers.
16.	Automatic locomotive Washing Plant	Required for fast and automatic cleaning and washing of locomotive body
17.	CNC M/Cs	For Machine shop activities
18.	TPWS/ACD/TCAS/DPWCS Test stand of associated equipment	Required to check the functionality of each equipment.
19.	E-70/CCB Brake equipment (full simulation) test and diagnostic console	Required to check the functionality of brake system on 3 phase locomotives
20.	Automated Vertical Storage and Retrieval System(AVSRS)	Provides easy storage and retrieval of equipment/components with multilevel stacking facility within available space

Note: The above list is indicative & in-exhaustive and the same can be expanded depending on the development and availability of more automated tools to assist maintenance of locomotives and its equipment.

B. Real-time preventive maintenance support system for Electric rolling stock:

1. Introduction

With hundreds of components onboard, it is not possible to know the extent of utilization of each component within a rolling stock by any off line methods or analysis. However, by providing suitable onboard monitoring systems, the utilization of many vital components can be precisely monitored and reported to base station on a real time basis. At the base station, a large repository of such data for all the assets can be created, which will provide timely alerts when an asset is due for a preventive check. Such a repository can be connected to all the custodians of assets simultaneously using internet technology. Using this method, centralized expert advice can also be sought.

Upon receiving such alerts of an expected failure or component replacement request from the system, the depot can mobilize a quick response team to the site with necessary materials which would avoid a line failure and major catastrophe. This is the trend now in developed Railway Systems and comes under the umbrella of ***Remote Diagnostics & Remote Monitoring.***

2. Infrastructure Requirement

2.1 Onboard Hardware

To start with, this system can be targeted in 3-phase locomotives and tap changer locomotives. Three phase locomotive has already microprocessor based system and hence the status of almost all items are available in real time on board. This only has to be suitably brought to a base station repository. In tap-changer locomotives provided with microprocessor based systems, some level of augmentation can provide additional hardware and sensors to capture the required details.

2.2 Base Station

The base station will contain one or more large data servers, loaded with various application programs to analyse the raw data received from various rolling all over India. It will have access to registered users. The system itself will make alerts to the custodians about the failure trend, expected time for preventive check, replacement of a components etc.

2.3 Data Network

The most important aspect for success of this scheme is to have a seamless coverage of a wireless data network in the entire Indian Railways electrified section. Even though private operators like Reliance & Airtel as well as state owned BSNL provide wireless coverage in many parts of the country, these are mainly for voice applications and for public use. These networks will not provide facility for huge data transfer, and even if it is available in future with 3G spectrum, such operators would not be able to guarantee uninterrupted data transfer and foot print across the electrified track. Hence, as part of this project, it would be needed to set up a pan India (covering electrified tracks to begin with) broad band wireless network. Alternatively, some network operators who would be getting the 3G spectrum and in future can be asked to provide this facility with an exclusive arrangement.

ADDITIONAL MACHINERY & PLANT (M & P),TOOLS & PLANTS(T&P) AND TRAINING, TESTING AND REPAIR FACILITIES FOR ELECTRONIC EQUIPMENT SPECIALLY REQUIRED FOR HOMING 100/200 3-PHASE LOCOMOTIVES IN SHEDS

LIST- 1 MACHINE TOOLS (GENERAL PURPOSE MACHINES)		**Shed Holding**	
		100 locos	**200 locos**
1	Diagnostic Tool (Mark-BT)	8	16
2	Valve set Trolley Drg. No. TRS/GMO/WAG9/003 & TRS/ GMO/WAG9/002	6	12
3	Test loops boxes (sets)	3	6
4	Converter lifting tackle (sets)	3	4
5	LCR Meter (Make: Philips fluke)	3	6
6	GTO Fire Box (Make: BT)	2	3
7	Oscilloscope with probe (Model: DL 1740) (Make: Gould / England)	2	3
8	Gate Unit Transmitter and Receiver	2	3
9	Fibre optic test equipment (Make: BT)	4	8
10	MIG Welding Plant (Aluminium Welding Plant)	3	6
11	Converter Oil Filtration Unit	2	2
12	Oil filling plant with flow control for transformer	2	4
13	Oil filling plant with flow control for Power converter	3	6
14	Hydraulic Lifting Platform / trolley for TFP	2	2

LIST- 1 MACHINE TOOLS (GENERAL PURPOSE MACHINES)		Shed Holding	
		100 locos	200 locos
15	High pressure steam cleaners including cleaning grill	3	6
16	Traction rod bush assly. Fixture (RRH3010 mof Enerpac	2	2
17	Rubber bush extracting plant for spheriblock (Make: Enerpac)	2	2
18	Hydraulic Press with Accessories	2	2
19	Test Rigs for E70 brake equipment	2	2
20	Pinion extraction tool (Hipress)	3	4
21	Gantry Crane (SWIL-3T)	3	4
22	PCB Handling facility	As per Requirement	As per Requirement
23	Battery Charger (250 A, 150V)	3	4
24	Universal Programmer	2	2
25	Inverter	3	4
26	UPS	4	8
27	Hurth Coupling removal pump (Make: Enerpac)	2	2
28	Towing Equipment as per RDSO Drawing No. SKVL-215, 216, 217 & 218 for WAG9 locomotive.	1 set	2 sets
29	Supply of SAB WABCO make special tool kit for BFC/F TBU of WAG9.	1	2
30	Variable voltage, Variable frequency converter power system 3 phase, 380 volts, 45 kw alongwith suitable control panel.	1	1
31	EPROM Programme Kit & 03 set card handling boxes.	1	1
32	Light load run test facilities for traction motor of WAG9 loco as per specification attached.	1	1
33	Testing unit for Angle Transmitter (Master controller) for WAG9 loco as details given below:- Supply: 230V AC,50 Hz Input:- a. Analog resistance input signal from angle transmitter b. Digital contact.	1	1
34	Electronic card handling/storage room.	1	1
35	Mounting & Dis-mounting arrangement for axle box bearing	1	2
36	Traction rod bush assly. fixture (RRH 3010 of Enerpac)	2	4
37	Knorr make special tool kit for BFC/F TBU	1	2
38	Pinion extraction hydraulic machine	1	1
39	LEM System Unit	1	2
40	Transient recorder	1	1
41	Power Quality analyser	--	1
42	Integrated charge discharge regenerative type unit	--	1

LIST 2- ADDITIONAL TOOL & PLANT (T & P) ITEM SPECIFICALLY REQUIRED FOR HOMING 100/200 3-PHASE LOCOMOTIVES IN SHEDS

S. No.	Description	Shed Holding	
		100 locos	200 locos
1	Vertical balancing machine	1	1
2*	Industrial vacuum cleaner	6	8
3*	½" Sq. Drive industrial socket set (Taparia)	30	60
4*	¾" Sq. Drive industrial socket set (Taparia)	30	60
5*	Torque wrench (72-340 NM) (Make: Trip Torque)	6	12
6*	Torque wrench (475-1015 NM) (Make: Trip Torque)	6	12
7*	Torque wrench (1015-1900 NM) (Make: Trip Torque)	6	12
8*	Hydraulic Pellet Trolley (2.5T)	3	6
9	Pinion pushing jack Enerpack (20T) with oil pump	3	6
10	Hydraulic jack (2.5T)	3	6
11	Disc Micrometer (75-100mm, 0.01mm) Disc Micrometer (250-275mm, 0.01mm) Make: Mitotoyo / Japan	2 2	4
12*	Digital clamp meter Metra clip - 5110	4	8
13	VARIAC (0-220 V, 50 Hz)	2	3
14*	Milliohm Meter	6	12
15*	Multi Meter	4	8
16	Contactless (Infrared) Thermometer	2	4
17	Sensor checking unit	2	4
18	Pressure Calibrator	2	2
19	10.5 V 10 amp. Ac source with voltage and current indicator	2	4
20	Grease gun with air dryer	3	6
21	Centre pivot housing pushing and pulling double acting jack cap.-30t and pump 700 bar with all accessories	2	4
22	LCR meter (range-1 MH/F/ohm to 100 MH/F/ohm)	1	1
23	SR rack power supply load test jig	1	1
24	BUR rack power supply load test jig	1	1
25	Reed relay test jig for UFB 5 1 2 D 1 5 & URB 1 7 7 DIS card	1	1
26	DB loss test jig for UFB660 A01 and AFB 635 B08 LWL card	1	1
27	WRE gate drive card test jig	1	1
28	SR gate unit test jig	1	1
29	GG module pulse transformer test jig	1	1
30	SAP card test jig	1	1
31	FDU testing jig	1	1
32	Card testing jig for testing of PCBs at compo. level	1	1
33	GTO stacking arrangement	1	1
34	Continuous pulse testing of gate unit	1	1
35	Multi channel oscillograph (portable)	1	1
36	Function generator	1	1
37	Tools for Knorr compressor	1 set	1 set
38	Current signature analyzer for TM & Aux. motors	1	1
39	Surge comparison tester for condition monitoring of TM & Aux. motor	1	1
40	Damper testing machine	1	1

Note: *marked items are common to conventional and 3 phase electric locomotives. Therefore, their actual requirement in a shed should be worked out depending on the types and numbers of locomotives available in the shed.

LIST 3- Requirement for testing, maintenance and repair facilities of electronic cards/modules used in 3-phase locomotives

A. Requirement for Electronic Testing Lab (As per CLW specification No. ES/3/534):
   1. Functional Tests of the cards to determine Whether the card is faulty and identification of suspect component list
   2. In circuit diagnostic test of the PCB cards up to Component level
   3. Through Hole and Surface Mounted Device (SMD)PCB Remote stations
   4. Conformal coating Removal Equipment
   5. Video Microscope Based PCB Remote Inspection System
   6. ESD Work Tables
   7. Software Requirement for 1 and 2 above -
   8. Power Supply Requirement 230 V, 1 phase, with Max count of 64A
   9. ESD Flooring

B. Test set ups for testing of locos with GTO based convertors
   1. RDSO's SMI 252 Testing of speed sensors
   2. RDSO's SMI 256 Testing of WRE gate units
   3. RDSO's SMI 260 Testing set up for signal conditioning cards and sensors
   4. RDSO's SMI 261 Repairing of WRE Gate unit
   5. RDSO's SMI 265 Repairing of Valve set

C. Other Requirements
   1. Reed Relay test jig for URB 512 D15 & URB 177D15 card
   2. GG Module pulse transformer jig
   3. FDU Testing jig
   4. Multi channel oscillograph (Portable)
   5. Function Generator

D. Training facilities required in shed
   1. 02 Class rooms equipped with Benches for 40 trainees
   2. Working Model for WAG-7/WAG-9 & WAP-4/P7/P5 locomotive in Hall
   3. Cut models of Compressor, Pneumatic valves of conventional/three phase locomotive.
   4. Details of various bearings used in Locomotives
   5. Trouble shooting Circuit model for conventional/three phase locomotive
   6. Working model of Bogie of conventional/three phase locomotive.
   7. Model for various equipments of conventional/three phase locomotive
   8. Digital still camera – 01 No.
   9. Audio Video set for display of various educational films on maintenance, safety, fire etc.
   10. Overhead Projector – 01 No.
   11. Video camera – 01 No.

Maintenance of Electric locomotives in Diesel sheds (TC-138)

To cater the growing demand of traffic & freight on Indian Railways Electric and diesel Traction have been streamlined. Presently, electric locomotives are being maintained in Electric Loco Sheds/ Diesel locomotives at satellite Diesel Loco Shed/ Diesel Loco Sheds.

With a view for optimal utilization of resources available at electric loco sheds & Diesel loco sheds and facilitate seamless operation. RDSO issued a Technical Circular No.

RDSO/2017/EL/TC/0138(Rev'0') Dated: 22.09.2017 covering

1. Infrastructural and layout requirement of Diesel loco sheds for maintaining Electric Locos and vice versa.

2. Up-gradation and additional M&P required for maintenance of electric locos in Diesel sheds and vice versa.

30212 Modification of Designs for Rolling Stock

Railways should not adopt any new design or modify the existing approved designs except for trials, without the prior approval of RDSO.

Procedure for Initiating and Progressing Modifications

1. One shed which has the bulk of the holdings of a particular class of loco/EMU will be nominated by the RDSO, in consultation with the Railway, as the parent shed for that class of loco/EMU.
2. Each Railway will continue to tackle operating and maintenance problems as hitherto, but will also furnish complete particulars of all problems and failures on each class of loco/EMU to the corresponding parent shed and RDSO together with the modifications evolved by it and further suggestions, if any.
3. The nominated parent shed will then collate all the information in regard to each type of failure, study the merits of the different improvements suggested from all angles and submit recommendations to the PCEE of the Railways, giving, full particulars of the most satisfactory improvements / modifications after they have been actually tried out in service and found feasible. When any defect is found to be intractable and expert investigation is necessary, a comprehensive note on the subject should be prepared and submitted by the parent shed to the Headquarters Office. PCEE will arrange to forward the considered recommendations to RDSO.
4. The recommendations received from the parent Railway will be subjected to a further scrutiny and analysis by the different wings of the RDSO after which final instructions regarding the standard approved method of modification / improvement will be issued to all concerned, giving an identification serial number to each with full details and drawings required for carrying it out.
5. On receipt of the instructions from RDSO, each user Railway will arrange to carry out the modifications on priority on locomotives / EMUs until the work is completed in all locomotives/ EMUs. Progress of implementation of the modifications will be regularly sent to PCEE's office by each shed and PCEE's office in turn will send a quarterly report of progress to RDSO.

30213 Records and Register to be Maintained in Loco/EMU Sheds

Particulars of some of the basic records to be maintained by sheds are given below:

1. History Book - For each electric locomotive/motor coach, a History Book should be maintained in the loco/EMU shed by the Planning and Progress Office, (PPO). The History Book should have separate pages allotted for recording the items listed below in the proforma shown against each
   a. Pre-commissioning details.
      i. Contract or order number against which received.
      ii. Date of despatch/shipment & name of the supplier.
      iii. Date of receipt by the Railway.
      iv. Date put into service.
      v. Particulars of tests and trials carried out and reference to reports on these
      vi. Particulars and serial number of major equipment initially provided
      vii. Particulars of any major defects rectified or modifications carried out prior to commissioning.
      viii. Particulars of Guarantee clause / period.
   b. Defects and failures during the Guarantee period:

c. Centre for Railways Information system (CRIS), New Delhi is developing Software for Loco Asset Management System (SLAM). After development, data is to be maintained accordingly.

Sl. No.	Date	Nature of defect	Action taken to rectify	Reference to reports Manufacturers/ Loco Unit/RDSO etc.

c) *Statistical failures*

Sl. No	Date	Brief details of failure	Repercussions on traffic	Action taken	Reference to detailed reports.

d) *Non statistical failures*

The same proforma should be followed as for (c).

e) *Progressive record of kilometres earned:*

Month and year	Kilometres earned during the month	Cumulative kilometres earned upto end of month	Remarks

f) *Availability for traffic:*

Month and year	No. of hours available for traffic.	Percentage availability	Remarks

g) *Modifications (Electrical):*

Sl.	Description of modification	Authority	Date of completion on this loco/motor coach

h) *Modifications (Mechanical):*

This should be as maintained in the same proforma as for (g).

i) *Inspections, Overhauls and Unscheduled Repairs.*

Schedule	Time in	Time out	Particulars of special work carried out, if any.

d. Changes in Main Equipments:

PPO should record particulars of replacement of complete units of main equipment such as Traction Motors, Transformer, Rectifier, Pantograph, Traction Converter, Auxiliary Converter, Vehicle control unit etc., together with serial numbers of the original and substituted items and reasons for replacement.

e. Record of mechanical clearances with bearing on safety.

This History Book or extracts of history book should be sent along with the loco/EMU to the workshop when the loco/EMU is booked for POH for heavy repairs and should be received back with the loco/EMU. The workshop should enter details of work done and modifications, if any carried out.

2. Equipment Cards: In the case of major items such as traction motors, transformers, rectifiers, circuit breakers, pantographs, tap-changers, auxiliary machines, bogies, wheels, Traction converters, Auxiliary converters, Vehicle control unit etc. 'Equipment Card' should be maintained in the shed by the PPO so as to have for ready reference the history of the equipment. Individual Cards should be maintained for each unit of major equipment and the individual cards may be stored grouping them either equipment wise or loco-wise as convenient. The Equipment Cards should contain details as shown below:

EQUIPMENT CARD NO.....

Description of Equipment:
Date of commissioning:

Serial No.
Loco/Motor Coach
No. in which initially installed.

EQUIPMENT MOVEMENTS

Date	Serial No. of Loco / EMU In	Out	Reasons for movement

HISTORY OF OVERHAULS

Date removed for overhaul	Date overhaul completed	Particulars of work

HISTORY OF SPECIAL REPAIRS

Date removed for repairs	Date repairs completed	Nature of repairs

30214 Unusual Occurrence Reports

A report indicating failure, withdrawal and any other technical abnormality in locomotive/EMU observed on line is called Unusual Occurrence Report (UOR). This should be made after carrying out thorough investigation in each case recording in full detail as to what has actually happened and what steps should be taken in future to avoid recurrence.

While suitable proforma may be laid down by each Railway to suit local requirements, the UORs should basically contain the following details:

1. Report of Driver detailing all his observations, together with remarks of TLC/CCC and Officers incharge of operation.
2. Observations made by Maintenance Organization i.e. Technical Investigation Section, concerned section Incharges and ADEE/DEE (RS). A sample proforma is appended (Proforma 2.02).

UORs should be serially numbered for each calendar year to identify the homing shed, class of loco and serial number of the occurrence for the class of loco /EMU during the year e.g. TATA/WAG4/3/90. A copy of all UORs duly signed by Sr.DEE should be forwarded to PCEE's office periodically.

30215 Periodical Review Information

Each homing shed should maintain requisite records and compile the following statistical information for each month. While the report on availability and reliability of the locomotive should be submitted to PCEE every month, the report on the cost of repairs and maintenance should be submitted quarterly.

I Availability and Reliability Locomotives

1. Average authorized stock (on allotment basis)
2. Average total number on line (on allotment basis)
3. Average number under or awaiting repairs (on allotment basis)
4. Average number effective (fit for use) (on allotment basis)
5. Actual number in good repair stored (on allotmentbasis)

5a. 5a.Average number available for use (on allotmen basis)

6. Average number in use
7. Average number of engines on the line for operation
8. Percentage of total engine hours spent
9. Engine km per day per engine in use on individual services
10. Engine km per day per engine on line on individual services
11. Engine km per day per engine in use on all services
12. Engine km per day per engine in use on line (on allotment basis)
13. Engine failure

EMUs

1. Average authorized stock (on allotment basis)
2. Average total number on line (on allotment basis)
3. Average number under or awaiting repairs (on allotment basis)
4. Average number effective (fit for use) (on allotment basis)
5. Actual number in good repair stored (on allotment basis)

5a. Average number available for use (on allotment basis)

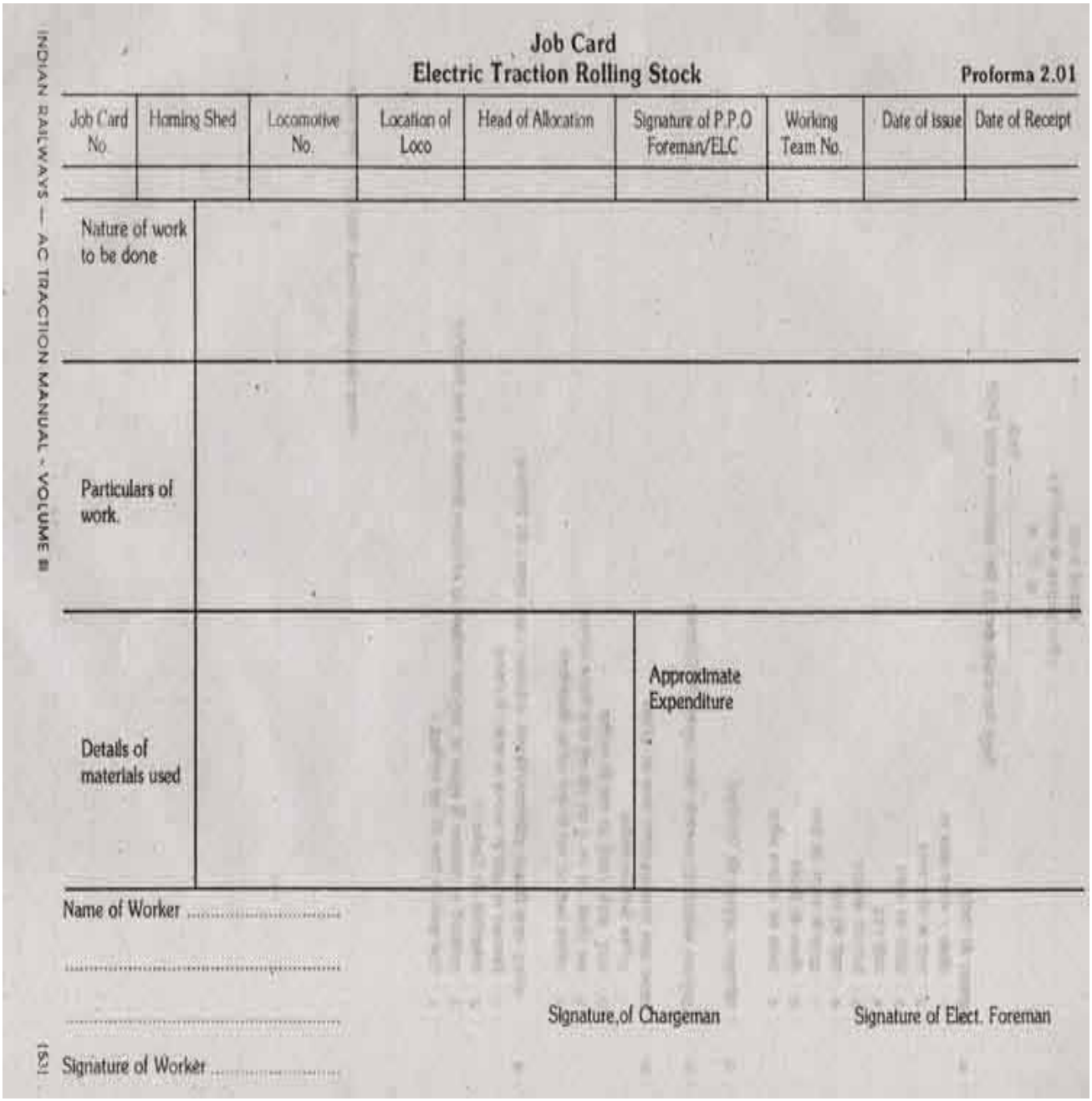
6. Average number in use
7. Train km, passenger
8. Hours
9. Vehicle km (in units)
10. Train Usage
11. Vehicle used
12. Motor coach failures
13. Gross tonne km
14. Power used

II Cost of Repairs and Maintenance

1. Engine km
2. Cost of repairs and maintenance per Engine km)
3. Cost of repairs and maintenance per EMU stock (in units)

30216 Daily Loco/EMU Position

1. The Daily Loco/EMU position at 00.00 Hr, will be put up to PCEE next morning. Over the years various Railways have evolved their own proforma depending upon the local operating conditions.
2. The proforma as used on SC Railway indicating the Daily Loco position is enclosed (2.03).
3. The proforma as used by Eastern Railway indicating the EMU position is also enclosed (2 04).
4. Railway may evolve their own proforma based on these proformae



INDIAN RAILWAYS — AC TRACTION MANUAL - VOLUME II

Job Card
Electric Traction Rolling Stock

Proforma 2.01

Job Card No.	Homing Shed	Locomotive No.	Location of Loco	Head of Allocation	Signature of P.P.O Foreman/ELC	Working Team No.	Date of issue	Date of Receipt

Nature of work to be done

Particulars of work.

Details of materials used

Approximate Expenditure

Name of Worker .....

.....

.....

Signature of Worker .....

Signature of Chargeman

Signature of Elect. Foreman

(53)

PROFORMA2.02

UOR NO.....

.....RAILWAY

UNUSUAL OCCURRENCE REPORT FOR ELECTRIC LOCOS/EMUs Date.....

A. Driver's Report
   1. Loco No./ Type / Homing Shed.
   2. Train No. and Date/Time
   3. Place of occurrence(Section / Division / Railway)
   4. Train Load
   5. Catenary Voltage
   6. Speed of train
   7. Gradient at the place of occurrence
   8. Weather conditions
   9. Loco pilot/ Base / Grade
   10. Nominated Loco Inspector Name
   11. Movement (Dead/ Light Engine/Working Train)
   12. Detention (Minutes)
   13. Brief Description of occurrence

B. Observations of Operating Section

C. Observations of Maintenance Staff / Technical Investigation Section.

D. History of Locomotive
   1. Last minor inspection/ date:
   2. Commissioning / TOH /IOH/POH date:
   3. Any special repair carried out on this loco:
   4. No. of days / Kilometres earned after last major schedule:
   5. Last Trip Inspection done at/ Date
   6. Equipment Name/ Make/ Sl. No./DOC/LOH
   7. Name of the failed component / Sub-assembly

E. Remarks of Sr DEE / DEE (RS)
   1. Findings regarding causes of failure or damage:
   2. Responsibility (of staff/Shop /Manufacturer /Design):
   3. Recommendations for modifications or improvement to equipment or maintenance schedule or operating instructions or required training to staff:
   4. Status of implementation of Modification / Special maintenance Instruction / Technical Circular / reliability Action Plan already issued by RDSO/ OEM/ Railway, if any.
   5. Action taken for rectification:

Sr DEE / DEE (RS)

REVIEW OF ELECTRIC LOCO PERFORMANCE (SHED-WISE) **PROFORMA - 2.03**

DATE

	TATA	BNDM	BIA	M/L TOTAL	WAT	OVERALL
1. NET HOLDING						
2. AV. AVAILABILITY (PRE. DAY)						
(a) GOODS						
(b) COACHING						
(c) MU† CON						
3. AVERAGE TR*						
4. AVAILABILITY AT 4.0 Hrs.						
(a) GOODS						
(b) COACHING						
5. NO. OF LOCOS TR						
(a) TOTAL						
(b) SCH. REPAIRS						
(c) UN-SCH. REPAIRS						
6. LOCO FAILURE (During Day)						
(a) STAT						
(b) OTHER LOCO (OL)						
(c) TOTAL						
(d) MID-SEC. STAT						
(e) MID-SEC. OL						
(f) COACHING STAT						
(g) COACHING OTHER						
7. NO. OF LOCOS TURNED OUT						
(a) OWN LOCOS						
(b) OTHER SHEDS LOCOS						
8. SCH. INSP. PRE. DAY/CUM						
I A						
I B						
I C						
9. TR AT OTHER SHEDS						
AT BIA						
AT TATA						
AT BNDM						
10. OUT STN. TR LOCOS						

* TR - Withdrawn from Traffic † MU - Multiple Units

A. ELECTRIC LOCO AVAILABILITY

Proforma 2.03/A

GOODS

Minm ..... At ..... Hrs .....
Maxm ..... At ..... Hrs .....

Loading .....
Current ..... Date .....
Progressive .....

HOURS	LOCOS UNDER TR/SCIL								COACHING SERVICE MAIN LINE				AVAILABILITY GOODS MAIN LINE			DIVISION WISE AVAILABILITY				MU/CONSISTS AVAILABILITY				K K LINE TR G 5 B	K K LINE AVAILABILITY			
	TATA				BNDM	BIA																					
	G1	M4	GSA	GSE	M4	M4	GSA&E	MAIN LINE TR	TATA	BIN	BIA	TOTAL	WKG	SP	TOTAL	ADA	BSP	DKP	KGP	TATA	BNDM	BIA	TOTAL		GOODS	PASS	TOTAL	Con-sists
00/-																											
04/-																											
08/-																											
12/-																											
16/-																											
20/-																											

B. SERVICE-WISE LOCO UTILISATION (GOODS)

DIVISION	I. THROUGH SERVICE						II. INFERIOR					III. OVERALL (I & II)				
	LE	TOTAL EKM	HOLDING		KM/DAY/ IN USE		TOTAL EKM	HOLDING		KM/DAY/ IN USE		TOTAL EKM	HOLDING		KM/DAY/ IN USE	
			Target	Actual	Target	Actual		Target	Actual	Target	Actual		Target	Actual	Target	Actual
ADA																
BSP																
CKG																
KGP																
SER MAIN LINE																
WAT																
ER LOCO OVER SER VIA ADA																
ER LOCO OVER SER VIA KGP																
TOTAL ER ON SER																
OVERALL TERRITORIAL																
SER LOCO ON ER VIA ADA																
SER LOCO ON ER VIA KGP																
TOTAL SER ON ER																

C. TRIP INSPECTIONS

Engg. Exam Points	Target	Actual	Progressive
ANR			
ADA			
BURN			
BNDM			
DPS			
TATA			
BIA			
BSP			
KGP			
TOTAL			

D. PROGRESSIVE UTILISATION

BREAK-UP	EKM	EKM/DAY/IN USE
MAIN LINE		
K K LINE		
TOTAL		

E. MIDNIGHT LOCO DISPOSITION

BREAK-UP	VIA ADA	VIA KGP	TOTAL
SER/ER			
ER/SER			

A. ELECTRIC LOCO INCIDENCES

Proforma 2.03/B

SHEDWISE FAILURE:- TATA BIA BNDM WAT TOTAL MID SEC

DATE:-

STAT -
OL -

Date	Loco No.	Base Shed	Tr.No.	Driver	Hd.Qr.	Site & Time	Nature of Trouble	Detn	Last Sch.	Remarks

B. COACHING PUNCTUALITY

(a) MAIL / EXP. (b) PASSENGER (c) EMU

NO. OF MAIL / EXP LOST	NO. OF PASS. LOST -	TOTAL EMU LOST UP - DN -
		LOST ON ELEC. A/c UP - DN -
LOST ON ELEC. A/C	LOST ON ELEC. A/c	EMU - FAILURE PR. DAY - CUM -

PROFORMA 2.04

DAILY POSITION OF EMU COACHES

DATE

Availability		**HWH**	**SDAH**	**Punctuality**		**HWH**	**SDAH**
i)	No. of units in service			i)	Overall		
ii)	No. of units under repair			ii)	Progressive		
iii)	No. of M/Cs sent to KPA						
iv)	No. of T/Cs sent to KPA						
v)	% ineffective M/C						
vi)	% ineffective T/C						
vii)	No. of M/C's with TM isolation & reasons.						

CTLC/TLC's Signature

ELECTRIC LOCOMOTIVE OUTAGE

Statistics of Freight locos such as outage, KMs earned, utilization etc., can be taken from Freight Operation Information System (FOIS).

WEBSITE ADDRESS: www.fois.indianrail.gov.in

Statistics of Coaching locos such as Outage Territorial & Ownership, GOP etc., can be taken from Coaching Operation Information System (COIS).

WEBSITE ADDRESS: www. icmstrng.indianrail.gov.in

Format For AC Loco Holding Daily Position at Zonal Head Quarters

AC LOCO HOLDING POSITION AT						00.00 hrs			hrs		
									Date:		xx.xx.xx
Shed / Type	BZA (Holding)					LGD(Holding)			KZJ (Holding)		TOTAL
	M4	G5 P	P4	G5 TH	G7	P4	P7	G9	G7	G9	
Effective holding											
Sch. Rep											
Un.Sch Rep in shed											
On line Ineff in SCR											
On line Ineff on FR											
Total Rep											
On Line Chg.											
Total Chg Locos											
Chg Link Locos required											
Goods Locos											
On Line Goods											
Under Accident											
New allotment											
Yet to leave CLW*											
Under transit**											
Under commis***											
Commissioned											
Due for transfer											
Total Locos											
Shed / Type	BZA (Holding)					LGD (Holding)			KZJ (Holding)		TOTAL
	M4	G5P	P4	G5TH	G7	P4	P7	G9	G7	G9	
Goods Target											
Actual Outage											
Shed ineffective											
On line ineffective											
Status Change											
Total											

Format for Electric Loco Incidences & Punctuality Loss

LOCO INFORMATION

Date	xx.xx.xx

I. Loco Asset Failures

	On Date	Cum. For the month	Cum. For the year 2017-18	Corresponding month of 2016-17 (ie DEC 2016 full month)	Cum. For the year 2016-17 (1st APR 2016 to 31st DEC 2016)
SCR ON SCR					
SCR ON FR					
FR ON SCR					
Teritorial					
II. Punctuality					
Loss of punctuality cases due to Loco (No.of trains)					
SCR ON SCR					
SCR ON FR					
FR ON SCR					
Owner ship					
Teritorial					
Incidences resulting in Locos of punctuality to trains					
SCR ON SCR					
SCR ON FR					
FR ON SCR					
Owner ship					
Teritorial					
Loss of punctuality cases due to GEN CHG (No.of trains)					
SCR ON SCR					
SCR ON FR					
FR ON SCR					
Owner ship					
Teritorial					
Incidences resulting in GEN CHG of punctuality to trains					
SCR ON SCR					
SCR ON FR					
FR ON SCR					
Owner ship					
Teritorial					
Loss of punctuality cases due to others (No.of incidences)					
TRD					
EMU/MEMU					
GEN POWER					
Loss of punctuality cases due to others (No.of Trains)					
TRD					
EMU/MEMU					
GEN POWER					

Reconciled figures of Ownership Equipment failures / Punctuality				
	2017-18 (Up to OCT)	2016-17	2015-16	2014-15
Equipment failures				
Punctuality(Trains)				
Punctuality incidences				

Format for Electric Loco Outage and Utilization

Total Outage					
Division	Net Territorial Outage			Utilization	
	Target	On Date	Avg. for Month	On Date	Avg. for Month
SC					
BZA					
GTL					
GNT					
Total					

Ownership Outage: 436.7						Target:	
Shed	On Date				Cum. For the Month		
Goods Loco Holding							
Board Target							
5% above board target							
target							
Actual Goods Outage							
Shed Ineffective							
On Line Ineffective							
Status change							
Total Goods Locos							

U/R at M/N in shed	Goods							
	Chg.							

IV. Break up:

	On Date			Cum. For the Month	
Outage	Total	SCR On SCR	SCR on FR / FR on SCR	SCR On SCR	SCR on FR / FR on SCR
Ownership					
Territorial					

MAJOR YARD DETENTION ON DATE						
Div	Yard	On date			For the Month	
		No. of Locos	Total Hours	Avg.Detn / Loco	Avg. No. of Locos	Avg.Detn / Loco (HH.MM)
SC	SNF					
	KZJ					
	RDM					
	TOTAL					
BZA	BZA					
	GDR					
	RJY					
	BTTR					
	TOTAL					
GTL	RU					
	NRE					
	GY					
	TOTAL					
SCR						

*****

CHAPTER-3
MAINTENANCE AND OVERHAUL SCHEDULES OF LOCOMOTIVES

30300 Maintenance and Overhaul Schedules of Locomotives

Indian Railways have gained considerable experience with the maintenance of electric locomotives since 1960. Based upon the safety requirements, various checks have been introduced and already standardized. Also, based upon investigations into failures instructions (Special Maintenance Instructions, Technical Circulars, Compendium of Instructions, Technical Audit Reports etc.,) are issued by RDSO. Even, for new type of locomotives, standard equipment like pantographs, circuit breakers etc., continue to be used and established maintenance practices for such equipment, are therefore applicable.

The scope of maintenance work to be followed in each maintenance schedule is arrived at based upon the following:-

1. Maintenance Instructions supplied by locomotive manufacturer for a new type of rolling stock. Copies of these manuals will be made available for reference of maintenance staff.
2. Maintenance Instructions that are evolved on Zonal Railways for various equipment.
3. Specific instructions already laid down regarding safety / fire prevention requirements etc. of the rolling stock.
4. Experience on the system taking into account environmental conditions in which electric locomotives are expected to perform satisfactorily like temperature, humidity, dust, etc.

On the above lines, maintenance schedules for electric rolling stock of different classes and types already in service have reached an optimum level. However, there may be necessity for marginal changes as dictated by further service experience.

As far as new types of electric locomotives and their sub-assemblies that may be introduced from time to time, the principles enumerated above are to be followed for arriving at optimum scope of work consistent with periodicity of prescribed schedules

30301 Alterations in Maintenance Schedules

Presently individual Railways might have made some alterations in the schedules based upon their own experience. Today electric locomotives of one Railway are running in other Railways (seamless operation). Thus alterations in schedules based upon local experience would have to give way to standardization of schedules so that the locomotives of one Railway would perform satisfactorily when operate in other Railways.

In the light of experience and improvements based upon trials of modifications, it may become advantageous either to reduce the scope of maintenance work or the periodicity already prescribed and standardized. The following procedure -should be adopted for effecting such changes.

1. Those which are connected with safety requirements, a comprehensive proposal indicating the actual experience of the Railways, the benefits that are likely to accrue due to proposed changes and the particular reasons for suggesting the change will be sent to RDSO with the approval of the Principal Chief Electrical Engineer. Such modifications to the maintenance requirements shall only be implemented after RDSO's approval.

2. Proposals other than item (i) above .- A similar procedure must be adopted excepting that the Principal Chief Electrical Engineer may authorise provisionally the introduction of the change subject to post-facto approval from RDSO. In case RDSO convey an opinion to the contrary, the original schedule shall be brought back. The Railways can however continue to pursue the matter with RDSO and if the latter agrees finally, adopt the change to the extent agreed upon.

30302 Scheduled Inspections

The maintenance and overhaul schedules to be followed for AC electric locos are as under.-

Nature of Inspection/overhaul	Place where to be carried out
1. Trip Inspection, IT	Trip Shed
2. IA	Electric Loco Shed
3. IB	Electric Loco Shed
4. IC	Electric Loco Shed
5. Term overhaul(TOH)	Electric Loco shed
6. Intermediate overhaul(IOH)	Electric Loco Shed
7. Periodical overhaul POH)	Workshop

Detailed instructions for IT, IA, IB IC AOH/MOH/TOH IOH and POH are issued by PCEE for each type and each series of locomotives keeping in view inspection schedules issued by RDSO.The scope of work is broadly covered in

Annexure- 3.01 Inspection of Electric locos.

Annexure- 3.01 A: for Conventional locos

Annexure- 3.01 B: for 3 phase locomotives.

Inspections as detailed above may need revision based on experience accrued on new types of locomotives.

30303 Technical Instructions

A set of the technical instructions relevant to the work of each section should be made available so that they may carry out their work correctly. These can be classified under the following heads :-

1. Inspection Books
2. Inspection Charts
3. Trouble shooting Charts
4. Technical Charts

1. **Inspection Books:** These give the scope of work of the various scheduled inspections viz. IT, 1A, IB. IC etc. itemizing the works and the order in which they are to be carried out, arranged section-wise. The responsibility of each section supervisor is defined.
2. **Inspection Charts:** These charts are prepared for each component individually. These cover a comprehensive list of all the points to be checked, the observations to be made, clearances to be ensured, specifying the conditions under which such verification should be made and the measuring equipment to be used for the purpose.
3. **Trouble shooting Charts:** Clear instructions should be issued in the form of trouble-shooting charts for major defect, related with fire, safety and type defects which detail the checks to be made and the order in which they are to be made. Before the locomotive is given back to service, a competent supervisor should satisfy himself regarding the correctness of the investigations and the

rectifications made. In trouble shooting, the investigating team quite often discovers a pattern of failure on the basis of which modifications and improvements to designs may have to be initiated.

4. **Technical Charts:** These cover full details of all repairs, major adjustments and refitting of equipment which are to be carried out. Where such repairs are not possible, the item will have to be replaced by a new component. In the technical charts the detailed description of the material, the tools to be used and the procedure to be followed and the defects to be checked after completion of work are detailed.
5. The PCEE's office is responsible for ensuring that (a) the instructions received from RDSO are forwarded to the Loco sheds and (b) the superseded instructions are cancelled, withdrawn, preserving one copy only for future reference. Instructions received from RDSO require constant review and a system of generating feedback information on the implementation of these instructions will be followed. Any modifications required in RDSO's instructions should be carried out only after approval from RDSO.

   These instructions require constant review in the light of experience. If any modifications become necessary, Sr. DEE(RS) may introduce changes provisionally with the approval of PCEE. Such changes should, however, be advised to RDSO for scrutiny and final incorporation in the documents (see para 30301).

30304 Engine Fitness Certificate

Whenever a loco for passenger service is issued from a loco shed or outstation depot after scheduled inspection or unscheduled repairs, an "Engine Fitness Certificate" should be issued, a sample form for which is appended for Conventional and 3 Phase locos separately (proforma 3.01 Part A and 3.01 Part B).

30305 Must Change Items

Certain critical components which are subjected to wear & tear etc., need periodical replacement, otherwise such components fail at different time frames, cause loco failures and unscheduled withdrawals and adversely affect the outage. This also has the implication that for replacement of many items, loco needs to be lifted again and again. To improve the reliability, availability and to avoid unscheduled withdrawal of locomotives, it is necessary to break this vicious circle by replacing such items with new ones during major schedules. RDSO circulated the list of must change items to be replaced during various schedules for conventional and three phase locomotives. These lists are enclosed as Annexure 3.06.

30306 Fire Prevention Measures

The Fire in Electric Locomotives, even at a very small scale is a very serious incident. The fire or smoke emission cases generally lead to disruption of traffic and make the troubleshooting of locomotive more cumbersome as there is a panic among the crew, invariably. In some of the cases, the fire leads to complete damage to the electric locomotive. Therefore, there is a need for completely eliminating the origin. All the loopholes and potential fire hazards need to be taken care of and proper attention should be given.

Fire prevention measures for conventional and 3-phase Electric Locomotives circulated by RDSO are appended as Annexure. 3.03A & 3.03B.

30307 Unit Exchange Spares

For major equipment like Traction Motor, Bogies, Tap changer etc., shed require healthy spares for immediate replacement at the time of un-schedule failures of locomotives.

The availability of Healthy Unit Exchange Spares in a shed not only reduce the down time for AOH/ IOH/POH and running repairs but will also improve reliability and availability of locomotives.

Unit Exchange Spares of Electric locomotive prescribed by RDSO vide Lr. No. 2008/Elect.(TRS)/441/5 Dt: 13.05.2014 is appended as Annexure No. 3.04.

Proforma 3.01 Part A

ELECTRIC LOCO FITNESS CERTIFICATE -WAG-7/WAP-4

Date of checking Loco No date of insp.

S. N	TITLE	NAME OF THE TEST	OBSERVED
1.	BA.voltage (diff. should not be more than 3.0V)	a. Voltage with HBA on '1' position. b. Voltage with MCPA 'ON'	
2.	Function of MCPA	a. Keep ZCPA from 'O' to '1'position	Yes / No
3.	Function of Aux.	a. Are the CPs working. b. Are the CPs building up & maintaining thepessure. c. Is there any abnormal sound in the Aux.	Yes / No Yes / No Yes / No
4.	Pantograph	a. Working of PT-1 from Cab-1 &2 b. Working of PT-2 from Cab-1 &2	Yes / No
5.	Brake test in loco from both A9&SA9	a. Are the both bogie isolation cocks in normal position. b. Are the loco brakes applied with SA9& A9.	Yes / No Yes / No
6.	Brake power	a. WAG5 &7 should not move at TM current of 600A b. WAP4 should not move at TM current of 800 amps.	Yes / No Yes / No
7.	Brake released condition.	a. Ensure minimum of 10mm gap between wheel and brake block.	Yes / No
8.	Application of brakes through A9 for freight locos	a. Application time (15 to 25 sec) b. Release time. (25 to 40 sec)	Yes / No Yes / No
9.	Application of brakes through A9 for pass. locos.	a. Application time (7 to 10 sec) b. Release time (10 to 15 sec)	Yes / No Yes / No
10.	Function of SMGR.	a. SMGR wrkg with MP&EEC from both cabs. b. SMGR working manually.	Wrk/N. wrk Wrk/N.wrk

11.	DBR	a. DBR working.	Wrk/ N. wrk
12.	Oil levels	a. Compressors oil level. b. TFP oil level. c. GR oil level.	Above/below/min level Above/below min level Above/ below min level
13.	Safety items in both cabs.	a. Horns in both cabs. b. Head light in both cabs. c. Flasher light in both cabs. d. Marker lights in both cabs. e. SPMs in both cabs. f. AFL/ACP unit both cabs. g. SPMs chart / Floppy. h. Sanders working both sides. i. Cattle guard is both cabs. j. Rail guard in both cabs. k. CBC in both cabs. l. Screw coupling in both cabs. m. Fire Extinguishers in both cabs due dates. 1. 2. 3. 4.	Working /N. working Working /N. working Working /N. working Working /N. working Working /N. working Working /N. working Working /N. working Working /N. working Intact / Damaged Intact / Damaged Intact / Damaged Intact / Damaged Available/ N.A
14.	Safety Items J-1 brackets keeper pins and split pins	a. J-1 brackets keeper pins and split pin, space bolts, nose pins. b. Brake hanger pins and brake rigging. c. Availability of wooden wedges 2 nos / 4nos. d. Axle box strap bolts and split pins. e. Are equalizer snubber, suspension springs healthy? f. Gear case bolts. g. Bogie No.1 crack. h. TM covers. i. Bogie No.2 crack. j. Sanders 08/04 Nos. k. Hand brake. l. Air dryer	Intact / Damaged Deficient. Intact / Damaged Available / N. A Intact / deficient Intact / deficient Intact / deficient YES/NO Intact/loose YES/NO Working / N. working. Working / N. working. Working / N. working
15.	BP,FP leakage	BP/FP leakage checked with dummy.	Leaking /No leaking.

Signature of the loco pilot.	Signature of the supervisor
Name	Name
Desgn / Hqrts:	Home shed
Date / time	Date / Time

Proforma 3.01 Part B

ELECTRIC LOCO FITNESS CERTIFICATE -WAG-9/WAP-7

Date of checking	Loco No	Type of insp.

Sl	NATURE OF TEST	OBSERVATION
1.	Battery:- Record the battery voltage with the switch 112.1 in machine room. (VCB in tripped condition) Function of CPA (ZCPA ON)	 105volt. (in panel "A) Wkg./N Wkg
2.	Function of Auxiliaries a. Are the main compressor wkg. b. Can the main compressor build up & maintain air pressure in the locomotive. c. Is there is any abnormal sound in the Aux. d. If the answer to 2C is Yes indicate the defective Aux.	 Yes/No Yes/No Yes/No Yes/No
3.	Pantograph By PT selector switch. a. PT-1 raising from cab1 b. PT-2 raising from cab1 c. PT-1 raising from cab2 d. PT-2 raising from cab2	 Yes/No Yes/No Yes/ No Yes/No
4.	Brake test on loco:- a. Are the bogies isolating cock in normal position b. Are the brake applied normally with independent brake c. Is the Asst. Dr. emergency brake wkg.	 Yes/No Yes/No Yes/ No
5.	Conjunction working: a) Apply A-9 to full service, apply PVEF the loco brakes should be released(BC pressure should be 2.5kg/cm2)	Yes/No
6.	Parking brake. Is the parking brake working (use of BPPB)	Yes/No
7.	Safety items: a. Whistle of either cab. b. Head light of either cab. (both leading and rear) c. Marker light / cab light and machine room light d. Cattle guard e. Screw coupling Cab-1 end f. Screw coupling Cab-2 end g. Cab-1 end CBC coupler h. Cab-2 end CBC coupler i. Fire extinguisher cab-1 j. Fire extinguisher cab-2 k. Machine room Dr.1 l. Machine room Dr2 m. Brake sleeve rod/guide rod. n. TM gear case bolt o. Check the proper wkg and visibility of flasher light p. Check the frequency of flashing q. Check the Auto flasher light wkg. r. Check the flasher light glass is cleaned s. Check the additional BP and FP isolating cocks. t. Check for wkg. Of sanders u. Check for working of VCD 1. Cab-1 2. Cab-2	W/N.WKG W/N.WKG OK/N.OK

8.	Oil levels: a. Check the oil level of CP-1 b. Check the oil level of CP2 c. Check the oil level of TFP (in two place) d. Check the oil level of cooling unit (in 2 place)SR-1& SR-2 e. Check the oil level of gear case (in 6 place) f. Oil level of CPA	Above/below min Above/below min Above/below min Above/below min Above/below min Above/below min
9.	Working of equipment / circuit a. Check the wkg of SPM-1 b. Check the wkg of SPM-2 c. Check the wkg of wiper in cab-1 d. Check the wkg of wiper in cab-2 e. Check the wkg of AFL f. Check the wkg of regenerative brake	 W/NW W/NW W/NW W/NW W/NW W/NW
10.	Ensuring availability and positioning of followings a. Spare screw coupling b. Spare BP hose pipe c. 04 nos.of wooden wedges d. All the rotating switches are normal position. In SB-1 Switch No. 152-0, 154-NORM. 160-1, 237.1-1 (In sealed position). In SB-2 OCR relay target in OK condition switch No.110-ON	 A/NA A/NA A/NA OK/N OK
11.	Under gear inspection ensuring the following a. All TM axle cap bolts are in sealed condition b. All TM cables are secured properly c. All air ducts are properly sealed and no air leakage is existing d. No bogie crack is existing e. All TM nose spheri block with link f. Traction link. g. Wheel set guide	 OK/N OK OK/N OK OK/N OK OK/N OK OK N OK OK N OK OK N OK
12.	Ensure the cleanness of following a. Inside the locomotives and cab are properly cleaned b. All the doors & shutters are in working order c. All the look out glasses, head light, flasher light,marker light glasses are properly cleaned	 OK/N OK OK/N OK OK/N OK
13.	All sub system to be checked by in panel “C”	OK/ N OK
14.	Special remarks if any a. MCB 100 provided in HB2 panel b. PT fuse provided in SB1 panel c. Speed sensor selector switch provided above SR1&2. (If speed not coming more than 1KMPH, then change one by one switch)	Avl/Not Avl

Signature of the loco pilot.	Signature of the supervisor
Name	Name
Desgn / Hqrts:	/Home shed
Date / time	Date / Time

Annexure - 3.01

INSPECTION OF ELECTRIC LOCOS

Maintenance Schedules and Periodicity of Electric Locomotives

Conventional Locos

Coaching locos - WAM-4/WCAM-1, 2/WCG-2

Maintenance Schedule	Periodicity	Duration
Trip inspection (TI)	After 3000 kms or one trip whichever is later.	2 hrs
IA	40 + 3 days	4 hrs
IB	80 + 3 days	6 hrs
IC	120 + 3 days	8 hrs
TOH	12 months + 15 days	6 working days
IOH	36 months + 1 month or 4 lakh kms (6 lakh for WAP-1 loco) whichever is earlier.	9 working days
POH	6 years + 3 months or 8 lakh kms (12 lakh for WAP-1 loco) whichever is earlier.	24 working days

Coaching locos - WCAM-2P & 3 fitted with Roller bearing MSU

Maintenance Schedule	Periodicity
Trip inspection (TI)	After 3000 kms or one trip whichever is later.
IA	45 + 3 days
IB	90 + 3 days
IC	135 + 3 days
TOH	18 months + 15 days
IOH	48 months + 1 month or 4 lakh kms whichever is earlier.
POH	8 years + 3 months or 8 lakh kms whichever is earlier.

Coaching locos - WAP-4, WAP-1 & WAG-5 TAOChi Passenger

Maintenance Schedule	Periodicity	Duration
Trip inspection (TI)	After 3000 kms or one trip whichever is later.	2 hrs
IA	60 days	4 hrs
IB	X	X
IC	120 days	8 hrs
TOH	18 months + 15 days (WAP-4 & WAG-5 TAOchi)* 12 months + 15 days (WAP-1)	6 working days
IOH	36 months + 1 month or 6 lakh for whichever is earlier.	9 working days
POH	6 years + 3 months or 15 lakh kms whichever is earlier.	24 working days

***On trial basis for 2 years**

Freight locos - WAG-5 locos (Fitted with TAO TMs)

Maintenance Schedule	Periodicity	Duration
Trip inspection (TI)	15 days	2 hrs
IA	45 + 3 days	4 hrs
IB	90 + 3 days	6 hrs
IC	135 + 3 days	8 hrs
TOH	18 months + 15 days	6 working days
IOH	54 months + 1 month or 6 lakh kms whichever is earlier.	9 working days
POH	9 years + 3 months or 12 lakh kms whichever is earlier.	28 working days

Freight locos - WAG-5 TAOchi, WAG-5H, WAG-7, WCAG-1 & WCM-6 locos

Maintenance Schedule	Periodicity	Duration
Trip inspection (TI)	20 days	2 hrs
IA	60 + 3 days *	4 hrs
IB	120 + 3 days *	6 hrs
IC	180 + 3 days *	8 hrs
TOH**	24 months + 15 days *	6 working days
IOH	72 months + 1 month or 6 lakh kms whichever is earlier.	9 working days
POH	10 years + 3 months or 12 lakh kms whichever is earlier.	28 working days

****AOH is re-designated as TOH (Term overhaul)**

***On trial basis for 2 years**

3-Phase locomotives

Coaching Locos - WAP5/WAP7 locos

Maintenance Schedule	Periodicity	Duration
Trip inspection (TI)	3000 kms or one trip, whichever is later	2 hrs
IA	90 days	4 hrs
IB	180 days	6 hrs
IC	270 days	8 hrs
TOH**	24 months	6 working days
IOH	4 years + 6 months or 12 lakh kms. whichever is earlier	WAP-7 - 11 working days WAP-5 - 20 working days
POH	9 years + 6 months or 24 lakh kms. whichever is earlier.	28 working days

****MOH is re-designated as TOH (Term overhaul) Freight Locos - WAG9/WAG9H locos**

Maintenance Schedule	Periodicity	Duration
Trip inspection (TI)	45 days	4 hrs
IA	90 days	4 hrs
IB	180 days	6 hrs
IC	270 days	8 hrs
TOH**	24 months	6 working days / 8 working days for 2nd MOH
IOH	6 years + 6 months or 12 lakh kms. whichever is earlier.	11 working days
POH	12 years + 6 months or 24 lakh kms. whichever is earlier.	28 working days

****MOH is re-designated as TOH (Term overhaul)**

A. Trip Inspection (TI)

The trip inspection is mainly required for topping of oils, distilled water and attention of various minor defects which have been recorded in the log book by Loco pilot. In addition, certain checks are necessary mainly due to hot, humid and dusty working conditions. .

1. Periodicity of trip inspection shall be as given in Annexure 3.01.
2. During trip Inspection the Engine Examiner will -
   a. Carryout detailed checks in regard to any unusual occurrence reported by the drivers in the loco log book.
   b. Visually inspect the auxiliaries for satisfactory starting and operation.
   c. Feel by hand the temperature of axle roller bearings.
   d. Visually inspect mechanical components like springs, equaliser pin, dampers etc. and the brake rigging to detect any abnormality.
   e. Check the controls and indication and alarm circuits for correct functioning.
3. Specific items to be attended in TI are-
   a. General roof inspection : Check the roof generally for any foreign materials such as wire pieces; clean the Insulators and check visually for cracks or chips; Check for abnormalities such as flashovers;
   b. Pantographs : Check for copper deposition, grooving of strips and proper lubrication; visually check springs and articulation and also test raising and lowering;
   c. Air Blast Circuit Breakers/Vacuum Circuit Breaker: Check for satisfactory operation.
   d. Return Current Shunt: Check the shunt connections between the body/ bogie frame/axle boxes, traction motor/axle are intact, tighten if necessary.
   e. Bogies: Remove foreign matter and dirt picked up on run. Visually inspect for loose, defective or missing parts.
   f. Battery: Check and record battery voltage; top up cells as required.
   g. Auxiliaries : Check all auxiliaries for correct operation;
   h. Oil level: Check and top up oil in suspension bearing, exhausters, compressors, auxiliary compressors and gear cases and record in the log book.
   i. Air Reservoirs: Drain all accumulated water from all reservoirs.
   j. Cab and Floor: Clean the cab and dust the flooring; and remove oily deposits.

k. Controls and Indications: Visually check and test for proper operation of the master controller, the tap changer, all EP contactors, wipers, whistles, brakes, auxiliary equipment and indication and alarm circuits.

l. Transformer oil level: Check oil level; ascertain the cause if it is low/high.

m. Clean look out glasses.

n. Adjust the brake block, if the locomotive moves on the second notch (with N32 tap changer)/ fourth notch with N40 tap changer) with full application of locomotive brakes.

o. Check the following safety items.

i. Speed recorder / speed indicator for any abnormality
ii. KAVACH, TPWS, VCD for any abnormality
iii. Flasher lights, head lights, marker lights etc.
iv. Wipers
v. Sanding gear for any abnormality. Fill sand boxes with sand of specified quality.
vi. Wheel and axle for visual defects such as shelling cracks, flat spots etc.
vii. Brake gear for (i) loose fasteners (ii) brake shoe wear, (iii) brake shoe release, (iv) operation of all the brake cylinder pistons and (v) leakage in the bogie hose pipe.
viii. CBC & draft gear
ix. Safety sling of brake shoe holder Brake pull rod safety brackets Safety brackets
x. Cattle guard Rail guard
xi. RSI & RS2 emergency brakes
xii. Gear case for any missing parts and loose fasteners.
xiii. Hand brakes
xiv. VEF
xv. HQOP position
xvi. Isolation of any component
xvii. BP and FP pressure and leakage

4. Wherever time and facilities are available, the passenger locomotives should immediately be washed.

5. Test the locomotive on HT and LT and record observations on the test proforma.

B. IA, IB, IC, TOH Inspections.

The following tests should be carried out before and after inspection of a locomotive:

1. Preliminary tests with 25 kV supply on -
   a. Measure and record battery (BA) voltage.
   b. Measure and record Generator (GE) or battery charger voltage.
   c. Check time taken to build up compressed air pressure from 1 kg to 8-9 kg/ cm2
   d. Check cut in and cut out pressure of compressor Regulator (RGCP).
   e. Check blowing out of safety valves.
   f. Note pressure gauge reading when brakes are applied.
   g. Check working of braking electro-valve VEF.
   h. Check working of blowers under “direct’ and ‘automatic’ starting conditions,
   i. Note and record air leakages for one minute in main reservoirs and brake cylinders,
   j. Test headlights,
   k. Test working of cab heaters and fans.
2. Preliminary tests with 25 kV supply off --
   a. Measure and record time required for raising and lowering both the pantographs.

b. Measure and record time taken for various time-delay relays.
c. Test functioning of Auxiliary circuits Earth Relay (QOA) by creating an earth fault.
d. Test functioning of Power circuit Earth Relay (QOP) by creating an earth fault.
e. Check functioning of all lights.
f. Check wind-screen wipers and horns.

3. Test under High Tension before and after inspection successively from cab 2 and cab 1.
   a. Raising of pantographs.
   b. Working of Auxiliary Compressor motor (MCPA), Arno and particularly observing behaviour during starting and for abnormal noise.
   c. Working of main compressor, charging time of main reservoir from 0 to 10 kg/cm2 and from 8.5 to 10 kg/cm2 with one compressor working. Record rate of leakage in reservoir and brake pipe and brake and feed pipe pressure.
   d. Check up proper functioning of auto drain, HS4, HB5, RS, D1 emergency valve and air flow indicator.
   e. Check up all brake cylinders for leakage from exhaust port and record brake cylinder pressure.
   f. Working of blowers particularly watching for abnormal noise.
   g. Observation of contactors for abnormal sound and sparking.
   h. Observe deviation of main ammeters taking two traction notches in forward and reverse directions.
   i. Test differential (QD), progression and regression relays.
   j. Test electro-valve VEF.
   k. Measure and record depression in loco with all blowers functioning.

4. Low tension test before and after inspection-
   a. Testing of master controller for notch by notch progression and regression and total time for regression.
   b. Test working of sanders.

C. Intermediate Overhaul (IOH)

1. IOH of locos may be done at the homing shed itself or at workshop nominated for the purpose.

2. During IOH, in addition to thorough inspection of all mechanical and electrical items detailed under AOH, the following items also should be attended to -

2.1 Remove all electrical equipment including pantograph, circuit breaker, tap changer, SMGR, rectifiers, smoothing reactors, traction motors, auxiliary machines along with blowers, compressor and exhausters from the locomotive. Overhaul and replace all worn out items and rubber components.

2.2 Take out transformer oil sample for check up of dielectric strength, dissolved gas analysis and acidity. Dismantle transformer, clean winding and transformer tank with transformer oil jet, inspect for any overheating sign, loosening of cleats, nuts and bolts, condition of insulation. Centrifuge the transformer oil and measure the IR values and acidity and if it is found beyond the permissible limit, replace the transformer oil. Carry out all the tests after assembly.

2.3 Remove all brake equipment and electro-pneumatic valve from the locomotive and clean the pneumatic pipe with the help of pressurised air. Overhaul and replace worn out items and rubber components, if any, match metallic seating of pneumatic valves and test them for their proper function.

2.4 Clean the cable trenches. Examine for any damage to cable, lugs and repair it. Provide proper cable sheathing and cleats. Measure and record insulation resistance of all HT and LT cables. Tighten all the terminal connections.

2.5 Dismantle bogie, brake riggings and clean the bogie in washing tank. Check up for any crack and weld it as per the instructions laid down by RDSO. Overhaul these equipment and replace all worn out components. Ensure squareness of bogie frame. Overhaul axle box bearings and all wheels should be re-profiled.

2.6 Overhaul all traction gears and check up their P and K values and record them.

2.7 All approved modifications which can be executed in the shed should be carried out.

3. On compaction of IOH, the loco should be subjected to detailed HT and LT testing and should also be given a short trial run before it is declared fit for traffic.

D. Periodical Overhaul (POH)

1. The nominated POH workshop should issue a programme for POH of locos at least six months in advance giving the individual numbers of locos to be called in, each month. The homing shed will then send to the workshop a list of the important points to be specially attended to during POH and the list of modification to be carried out. This will enable the Workshop to plan the POH work and arrange for the procurement/ shop manufacture of components required.
2. The loco should be sent on its own power from the homing shed to the workshop under escort and along with its History Book. A complete list of all deficiencies in the loco should be handed over to the workshop representative who should jointly check the loco along with the shed representative.
3. All electrical, mechanical and pneumatic equipment should be taken out of the locomotive and overhauled during POH. All worn out rubber components and bearings should be replaced.
4. All panels should be removed from the locomotive and cleaned/overhauled. They should be tested for their proper functioning.
5. All the dimensions of the under frame should be recorded. The deformation, if any, should be set right.
6. Super structure and underframe should be thoroughly cleaned. Corroded and damaged portion should be rehabilitated. All body joint gaskets should be replaced.
7. All axle and axle boxes should be overhauled and rediscing/retyring should be done. All wheels should be re-profiled.
8. All reservoirs should be cleaned and tested for their safe working.
9. All approved modifications should invariably be carried out during POH. Deferment of any item may be done only with the personal approval of PCEE controlling the POH shops in concurrence with the PCEE controlling the homing shed and under advice to the homing shed. In addition to all the items indicated against IOH renewal of liners, bushes, etc. should be done so as to ensure clearances and tolerances mentioned in Para 'F' below with adequate margin for wear in service till the next POH.
10. In addition to complete LT and HT testing of the locos on completion of POH, individual items should also be subjected to detailed tests after overhaul and repair. Detailed test schedules should be laid down for each item, for mechanical as well as electrical tests, and standard proforma should be available for recording the test results for each equipment. A typical list of tests to be carried out on equipment is given below.
    a. **Rotating Machines:** Insulation resistance by megger, no load tests, full load tests (except for traction motors) drop test of armatures, resistance measurement of field coils, temperature rise measurement.
    b. **Transformers:** For small transformers in control circuits, ratio test and insulation resistance measurement.

For main transformer, testing of oil for BDV and acidity, insulation resistance measurement, ratio test of regulating windings and auxiliary windings, induced high voltage tests if any repairs have been carried out.

c. **Relays:** Measurement of resistance and insulation values for operating coils, pick-up and drop-off values of voltage/current/temperature, time delay where applicable, opening and closing of contacts.
d. **Contactors:** Measurement of pick up and drop-off values for operating coils, check for simultaneous closing of all phases where applicable, leakages from valves and cylinder in the case of electro-pneumatic contactors.
e. **Cables:** Insulation and continuity test, high voltage tests for rewired panels.
f. **Resistors, condensers and reactors:** Measurement of insulation resistance and ohmic values of resistance / reactance.
g. **No-fuse breakers:** (MCBs) Tests for tripping at rated instantaneous trip value.
h. **Tap-changer:** Insulation resistance. BDV and acidity testing of oil, correct functioning with minimum air pressure, correct progression and regression sequence.
i. **Silicon Rectifiers:** Forward voltage drop, inverse resistance, HV test for complete assembly, voltage sharing between diodes, testing of cell-check device.
j. **Compressors:** Volumetric efficiency and leakage tests.
k. **Speedometers:** Calibration by comparison with a standard meter,
l. **Meters and Gauges:** Calibration with sub-standard instruments.

11. On completion of POH, the loco should be taken over by a representative of the homing shed after a joint inspection at the workshop. Details of work done and modifications carried out should be entered in the History Book which should be returned along with the loco.
12. On completion of POH, the loco should be subjected to detailed HT and LT testing and should be given a short trial run. Loco will be returned working on its own power, and if possible working as a train, after POH to the Homing Railway.

E. Rebuilding and Recabling of Locomotive

1. During every alternate POH, depending upon the cable/pneumatic pipe condition, which will be advised by Sr. DEE of the Shed, the locomotive will be recabled and repiped. Recabling and replacement of pneumatic pipes during the third POH will be an essential item if it could not be replaced during 2nd POH. The workshop should therefore plan these works well in time.
2. During every 4th POH, mechanical components and traction gear may need rehabilitation. Some of the major components will also need replacement. POH shops should plan for such works. Opportunity should be taken to upgrade the parts and use the state of art equipment during- such extensive repairs.

F. Mechanical Inspection of Locos

1. Locos provided with solid wheel disc will conform to Specifications IRS M2-65 and IS 1030- 1962.
2. All springs should be checked up for any crack and damage. Free height and loaded height should be recorded. Only matched tested springs should be provided in the locomotive bogies.
3. An important part of the maintenance of the locos is the checking, at prescribed intervals, of important mechanical clearances and dimensions which have a bearing on safe and efficient operation, to ensure that they are within the prescribed limits. Such measurements should be recorded suitably either in registers or on printed cards and preserved so as to be readily available for reference in the PPO at all times. The items and interval at which they are to be checked up are indicated. Limits will be specified for each type of locomotives by the PCEE based on the manufacturers'/RDSO recommendations.

Clearances:

Mechanical Clearances for Electric locomotives (As per Instruction Bulletin No. MP.IB. BD.02.16.01(Rev.01) Dt: 31.12.2009)

Loco	New Wheel Diameter	Wear Limits			Bogie Clearances				Difference in Wheel Diameter		
		Root	Flange	Tread	Measurements	New Condition		Service Limit	Location	As Turned/ New	Service Limit
						Min	Max				
WAG7	1092+5/- 0.0	6.0	3.0	6.5	As per MP.IB.VL-02.03.06 (Rev.0.00) dated 27.01.0-2006				As per MI. VL-01/96		
					Lateral clearances End Axle per axle (C1+C2+C3+C4)	22.0	25.2	30.7	On same Axle	0.5	2.5
					Lateral clearances Middle Axle per axle (B1+B2+B3+B4)	2.4	6.0	11.5	On same Bogie	2.0	8.0
					Longitudinal Clearances for Middle & End axles per axle box (A1+A2)	2.0	4.0	6.0	On same Loco	15.0	25.0

Loco	New Wheel Diameter	Wear Limits			Bogie Clearances				Difference in Wheel Diameter		
		Root	Flange	Tread	Measurements	New Condition		Service Limit	Location	As Turned/ New	Service Limit
						Min	Max				
WAG7	1092+5/- 0.0	6.0	3.0	6.5	As per MP.IB.VL-02.03.06 (Rev.0.00) dated 27.01.0-2006				As per MI. VL-01/96		
					Lateral clearances End Axle per axle (C1+C2+C3+C4)	22.0	25.2	30.7	On same Axle	0.5	2.5
					Lateral clearances Middle Axle per axle (B1+B2+B3+B4)	2.4	6.0	11.5	On same Bogie	2.0	8.0
					Longitudinal Clearances for Middle & End axles per axle box (A1+A2)	2.0	4.0	6.0	On same Loco	15.0	25.0

Loco	New Wheel Diameter	Wear Limits			Bogie Clearances				Difference in Wheel Diameter		
		Root	Flange	Tread	Measurements	New Condition		Service Limit	Location	As Turned/ New	Service Limit
						Min	Max				
WAP7,	1092 (+0.5/-0)	4	2.5	6.5	Technical Circular No. ELRS/TC/0082 (Rev.'1) dt:17-09-15				No. SD. WA1 dated 24.06.05		
WAG9	1092 (+0.5/-0)	6	3.0	6.5	Vertical Clearance between Axle Box & Bogie Frame	30	35	27 to 35	Same Axle	0.5	2.5
					Lateral Clearance between Axle Box & Bogie Frame	15	19	15 to 22	Same Bogie	2.0	4.0
					Vertical Clearance between Bogie Frame & Under Frame	35	60	32 to 60	Same Loco	15.0	20.0
					Lateral Clearance between Bogie Frame & Under Frame	45	50	45 to 55			
WAP5	1092 (+0.5/-0)	4	2.5	6.5	Report No. MT-60 September 96 & drawing no. 1A011-00140 Sheet 2				No. SD. WA1 dated 01.09.02		
					Vertical Clearance between Axle Box & Bogie Frame	27	35	–	Same Axle	0.5	2.5
					Lateral Clearance between Axle Box & Bogie Frame	15	20	–	Same Bogie	2.0	4.0
					Vertical Clearance between Bogie Frame & Under Frame	30	40	–	Same Loco	15.0	20.0
					Lateral Clearance between Bogie Frame & Under Frame	20	40	–			

Loco	New Wheel Diameter	Wear Limits			Bogie Clearances				Difference in Wheel Diameter		
		Root	Flange	Tread	Measurements	New Condition		Service Limit	Location	As Turned/ New	Service Limit
						Min	Max				
WCAM1, WCAM2	1092 (+ 5/-0)	6	3	6.5	As per MP.IB.VL- 03.04.06 (Rev.00) dt 13.06.06				As per MP/MI 36/73 April 79		
					Lateral Clearances End Axle per axle (C1+C2+C3+C4)	22.4	24.8	30.0	Same Axle	0.5	1.5
					Lateral Clearances Middle Axle per axle (B1+B2+B3+B4)	4.0	6.6	12.0	Same Bogie	2.0	5.0
					Longitudinal Clearances Middle & End Axle per axle box (A1+A2)	0.4	1.9	3.5	Same Loco	15.0	20.0
WCAM3/ WCAG1	1092(+ 5/-0)	6	3	6.5	Letter no. EL/ 3.2.108 dated 16.10.07				As per VL.MI - 01/ 96		
					Lateral Clearances End Axle per axle (C1+C2+C3+C4)	22.0	25.2	30.0	Same Axle	0.5	2.5
					Lateral Clearances Middle Axle per axle (B1+B2+B3+B4)	2.4	6.0	11.5	Same Bogie	2.0	8.0
					Longitudinal Clearances Middle & End Axle per axle box (A1+A2)	2.0	4.0	6.0	Same Loco	15.0	25.0

4. Wheels: Check the following.

S. No.	Items to be inspected	Periodicity	Permissible clearance
1	Tyre profile to be Root wear Y checked Flange wear X with condemning gauge	IA, IB, IC	6 mm for freight 4mm for passenger loco
2	Flats on the running surface	All inspection	50 mm for locos having speed less than 100 km/h.40 mm for locos having speed of 100 km/h more.
3	'A' proud metal at the edge	do	less than 6mm
4	'B' block thickness of the flange		Condemning=40mm

Standard “thick” and “wear adapted” profiles are shown in the Fig. 3.01 and Fig 3.02

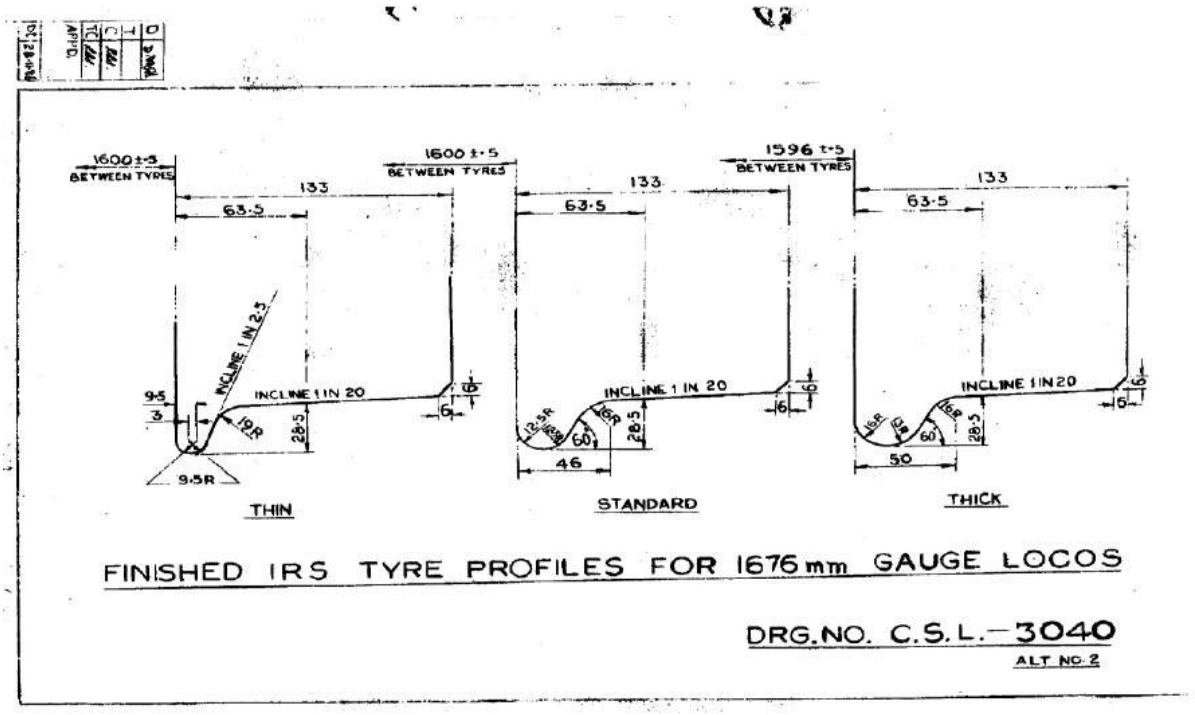


Fig. 3.01

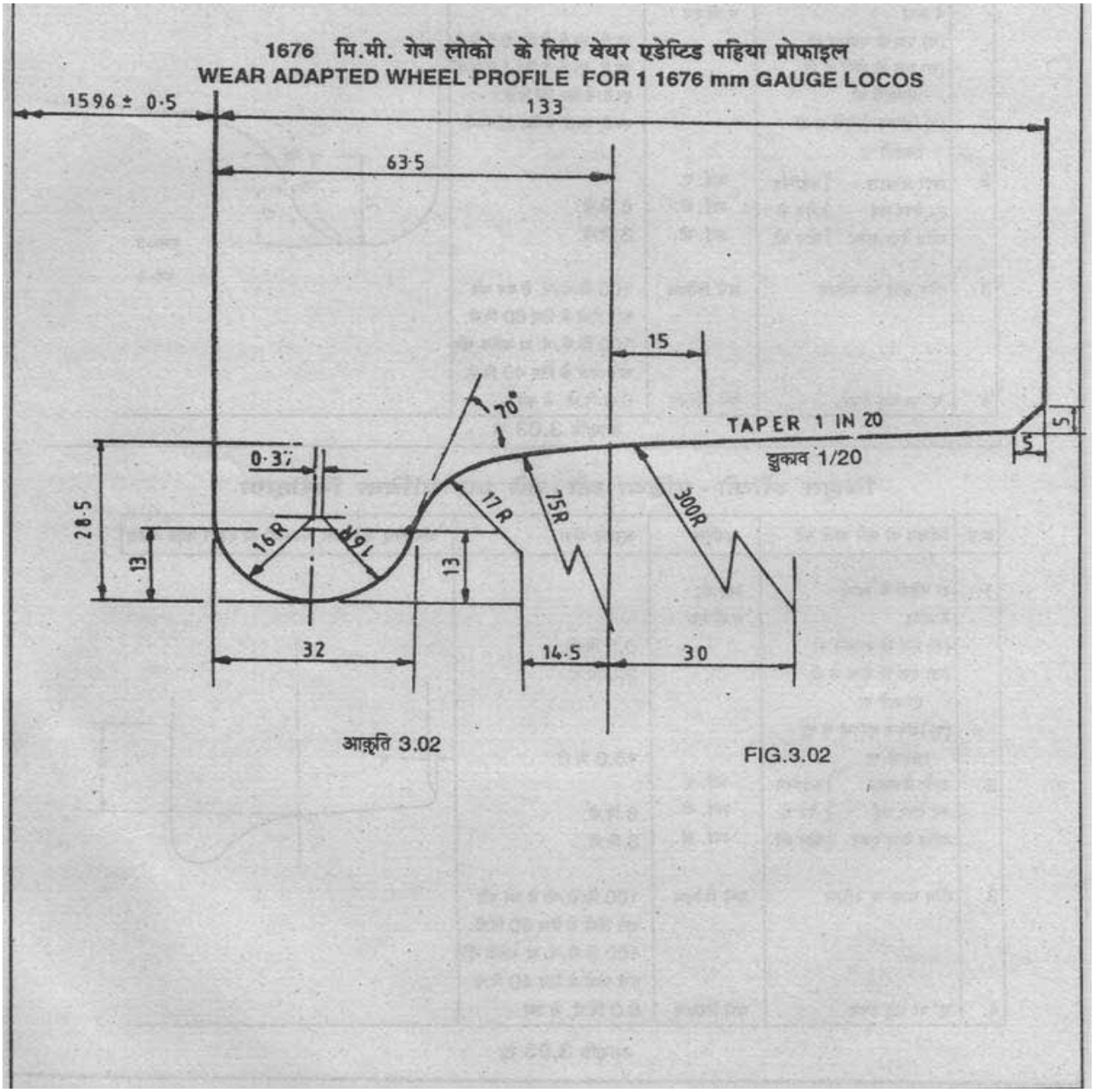

1676 मि.मी. गेज लोको के लिए वेयर एडेप्टिड पहिया प्रोफाइल
WEAR ADAPTED WHEEL PROFILE FOR 1 1676 mm GAUGE LOCOS
1596 ± 0·5
133
63·5
15
70°
TAPER 1 IN 20
ढुकाव 1/20
5
5
0·37
28·5
13
13
16R
16R
17R
75R
300R
32
14·5
30
आकृति 3.02
FIG.3.02

Fig. 3.02

MECHANICAL INSPECTION OF ELECTRIC LOCO-WHEEL BO-BO

SL	ITEMS TO BE INSPECTED	PERIODICITY	PERMISSIBLE CLEARANCE	SKETCH SHOWING THE CLEARANCES TO BE CHECKED
1.	VARIATION IN THE DIAMETERS OF TWO WHEELS-	IC, A OH		
	(A) ON THE SAME AXLE		0.5 mm FOR FT & MT	
	(B) ON THE TWO AXLE OF THE SAME BOGIES		1.0 mm FOR FT & MT 6.0 mm FOR MT	
	(C) ON THE TWO AXLE OF DIFFERENT BOGIES		20 mm FOR FT AND MT	
2.	TYRE PROFILE (TO BE ROOT WERY CHECKED WITH FLANGE WEAR COND X EMNING GAUGE	IA, IB, IC	6 mm 3 mm	
3.	FLATS ON THE RUNNING SURFACE	ALL INSPECTION	60 mm FOR LOCOS HAVING SPEED LESS THAN 100 KMPH HAVING SPEED OF 100 KMPH AND MORE	
4.	'A' PROUD METAL AT	DO	LESS THAN 6 mm	

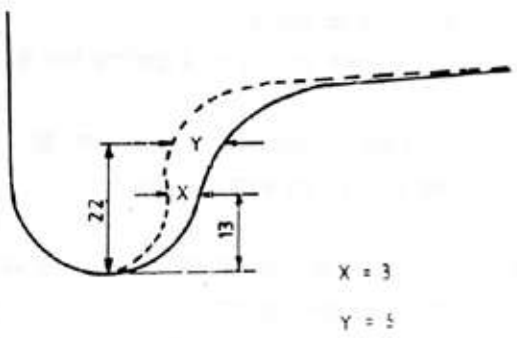


Fig. 3.03A

MECHANICAL INSPECTION OF ELECTRIC LOCO-WHEEL CO-CO

SL	ITEMS TO BE INSPECTED	PERIODICITY	PERMISSIBLE CLEARANCE	SKETCH SHOWING THE CLEARANCES TO BE CHECKED
1.	VARIATION IN THE DIAMETERS OF TWO WHEELS-	IC, A OH		
	(A) ON THE SAME AXLE		0.5	
	(B) ON THE TWO AXLE OF THE SAME BOGIES		2.0	
	(C) ON THE TWO AXLE OF DIFFERENT BOGIES		15.0	
2.	TYRE PROFILE (TO BE ROOT WERY CHECKED WITH FLANGE WEAR COND X EMNING GAUGE	IA, IB, IC	6 mm 3 mm	
3.	FLATS ON THE RUNNING SURFACE	ALL INSPECTION	60 mm FOR LOCOS HAVING SPEED LESS THAN 100 KMPH HAVING SPEED OF 100 KMPH AND MORE	
4.	'A' PROUD METAL AT	DO	LESS THAN 6 mm	

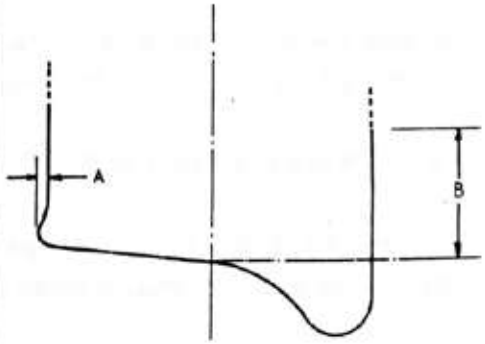


Fig. 3.03 B

G. Bogies

1. Squaring of bogies.

Due to heavy mechanical stress and impacts suffered by bogies in service, some of them get out of shape and distorted. During IOH and POH, it is essential to restore the bogies to their correct shape and alignment. To check this, at every major shed and POH shop, a test rig with a substantial foundation should be provided over which the bogie can be placed and the amount of distortion which has taken place accurately measured. By application of adequate pressure at appropriate points either hydraulically or by other means, frame distortions should be corrected as required, so as to ensure proper mechanical alignment of all parts assembled over the bogie.

2. Cracks on Co-Co bogies.

The bogie shall be thoroughly cleaned as per RDSO's recommendations. The extent of cracks shall be located by visual inspection as well as with magnetic particle/dye-penetrant method. After marking out the full extent of the cracks, arrest-holes of suitable size of minimum dia. 10mm shall be drilled at least 25 mm away from the vicinity of the cracks. The entire cracks shall be eliminated by opening the affected section right upto the bottom. The removal of defective area shall be done by grinding/arc gouging/chipping. The section thus opened out shall extend into the arrest holes and shall be checked up with the help of dye-penetrant or magnetic particle technique to ensure freedom from any other cracks. The welding shall be carried out as per the procedure laid down by RDSO with the help of specified electrodes. It shall be also ensured that all modifications recommended by RDSO are carried out during POH on the bogies.

H. Axle Roller Bearing

These bearings are used on electric locomotives using trimount Co-Co bogies. The assembly consists of two cylindrical axle roller bearings capable of taking radial as well as axial thrust loads. The bearing is composed of inner and outer race along with rollers and cages. The cages while carrying no load keep the rolling elements axially apart and also prevent the latter from falling out while handling. The outer ring is slide fit in the axle box housing while the inner ring is an interference fit on the axle journal forming part of the axle when in place. The rollers are plain, straight, solid cylinders and are flat on both ends. These bearings should be maintained as per RDSO Maintenance Instructions No. MPMT-98/81, March 1981.

The riding properties of these locomotive fitted with Co-Co bogie have been further improved upon by using axial resilient thrust unit on axle 1, 3, 4 and 6. Axle 2 and 5 are provided with float bearings so as to permit negotiability over sharp curves and turn-outs. This arrangement involves changes in bogie frames and axle boxes. Axle box roller bearings fitted with resilient thrust units should be maintained as per RDSO's Maintenance Instructions No. MT. 04.004.

Proper service tools should be used for servicing and maintenance of axle roller bearing which are also indicated in the Maintenance Instructions. Whenever bearings are removed for overhaul, inspection, repairs replacement or lubrication, proper precautions should be taken to avoid ingress of dust, metal contents, etc. Grease specified by RDSO should only be used.

I. Suspension roller bearing

In WAG-5 with Hitachi motor, axle suspension roller bearing have been used. In this arrangement, taper roller bearings are used on either end of the suspension tube. The maintenance of these bearings should be done as per approved Instructions. While overhauling, various defects due to stains, discolouration, spalling smearing, indentation, brinelling and electrical burns etc., should be examined. Proper precaution should be taken to ensure that bearings are overhauled in dust-free environment and all clearances should be maintained as given in the Maintenance Instructions.

Annexure – 3.01 A

SCHEDULE ACTIVITIES FOR MINOR & MAJOR SCHEDULES:

A. Conventional Electric Locomotives:

S. No	Activity	IA	IB	IC	TOH	IOH	POH
I	**Maintenance Group -E1**						
1.	**Loco roof and body**						
	Blowing of loco before inspection	x	x	√	√	√	
	Cleaning of loco roof & body	√	√	√	√	√	
	Trouble shooting	√	√	√	√	√	
	Tightness of all bolts on roof	x	x	x	√	√	
	Condition of look-out glass, gasket, sun visors	√	√	√	√	√	
	Check condition of door hinges, shutters	√	√	√	√	√	
	Replace Hinges of all doors	x	x	x	x	x	√
	Lighting Arrester – Measure Insulation & 3 rd Harmonic resistive leakage current as per RDSO TC No. RDSO/2016/EL/TC/0136 (Rev'0') dated 08.08.2016	x	x	x	√	√	√
	Schedule activities of Roof insulator (RDSO SMI NO. RDSO/ELRS/SMI/274 (REV-0) Dt. 29.03.12)						
	Clean all the roofline and pantograph insulators externally with a wet cloth and finally rub them dry.	√	√	√	√	√	√
	Check the general condition of the insulators and look for visible cracks, unglazed surface/dry bands and flash marks, replace the insulator, if any defect is noticed.	√	√	√	√	√	√
	One thin coat of silicone oil to be applied to all the insulators before the onset of winter i.e, before November	√	√	√	√	√	√
	Repeat application of silicon oil during every inspection.	√	√	√	√	√	√
	Replace HL reflector & cover gasket.	x	x	x	√	√	x
	Twin beam Headlight Reflector with holder, gaskets & bulbs	x	x	x	x	x	√
2.	**Silicon rectifier and Supervisory control equipment**						
	Checking of tightness of cells with torque wrench			√	√		
	Dusting and cleaning			√	√		
	Checking the clearances to earth			√	√		
	Visual check of connections and cleaning			√	√		
	Diode checking with cell tester			√	√		
	Check string fuses				√		

S. No	Activity	IA	IB	IC	TOH	IOH	POH
	Check potential dividing resistance visually			√	√		
	Check RC network (with instrument)				√		
	Check functioning of Sperkog units	√	√	√	√		
	Check the condition of telltale fuses and for its proper fixation.	x	x	√	√	√	
	Check the micro switches and the lever assembly for its operation and clean them.	x	x	√	√	√	
	Check the HVSI-1&2 for its operation. Check the connections. Clean the I/Ls and then check the continuity.	x	x	√	√	√	
	Check the power diodes for any physical damage overheating marks and clean them with soft brush.	x	x	√	√	√	
	Ensure tightness of all power & control cable connections. Check for intactness of main fuses. Check DC damping units & ensure the connections tightness at capacitors and resistances.	x	x	√	√	√	
	Secure the rectifier block cover with all fixing bolts.	x	x	√	√	√	
	Ensure tightness of supporting clamps	x	x	√	√	√	
	Blowing of dust with dry compressed air after removing both side covers	x	x	x	√	√	
	Tightness of diode connection	x	x	x	√	√	
	Visual checking of resistors & capacitors for crack, leakage & overheating	x	x	x	√	√	
	Checking of signal fuses for crack overheating	x	x	x	√	√	
	Checking of power fuses for crack & overheating	x	x	x	√	√	
	Tightness of thimbling	x	x	x	√	√	
	Condition of support insulator connection	x	x	x	√	√	
	Condition of power cable connections	x	x	x	√	√	
	Tightness of foundation bolts	x	x	x	√	√	
	Open covers& clean the diodes bus bar & all connections remove all dust & dirt	x	x	x	√	√	
	Check all connections visually	x	x	x	√	√	
	Check tightness of cell with torque wrench, check string fuses (SMI 70)	x	x	x	√	√	
	Check thimbles & tightness of connections	x	x	x	√	√	
	Check MVSI's cables from RSI & SB, RSI to MVSI (SMI 230(REV 0) - 2.5 sq mm	x	x	x	√	√	
	Check for proper securing of cable bunch and use neoprene rubber sheet	x	x	x	√	√	
	Replace RSI Block PTFE Cable	x	x	x	x	x	√

S. No	Activity	IA	IB	IC	TOH	IOH	POH
	Replace RC network	x	x	x	x	x	√
II	**E-2 Section**						
1	**Batteries as per** CAMTECH publication No. CAMTECH/2005/E/loco-BA/1.0, (April,2005)						
	Remove all covers of battery boxes.	√	√	√	x	x	x
	Remove antitheft rod, supporting bar, wooden packings and inter connections and check their conditions.	x	x	√	x	x	x
	Clean the battery surface.	√	√	x	x	x	x
	Clean battery box.	√	√	x	x	x	x
	Check condition of battery box.	√	√	√	x	x	x
	Take out all batteries from the battery boxes.	x	x	√	x	x	x
	Check condition of battery terminals, connecting leads and lugs.	x	x	√	x	x	x
	Clean battery boxes and batteries with non-metallic brush.	x	x	√	√	x	x
	Apply black acid resistant paint inside the battery boxes.	x	x	√	x	x	x
	Wash batteries with water using non-metallic brush.	x	x	√	x	x	x
	Check fixing arrangement of battery box.	√	√	√	x	x	x
	Check battery containers for any leakage, cracks, buckling and swelling etc.	√	√	√	√	x	x
	Remove all vent plugs of the battery.	√	√	√	x	x	x
	Check the electrolyte level and top up each cell with demineralised water, if required.	√	√	√	x	x	x
	Check specific gravity of electrolyte of each cell and record. It should be within 1.240 – 1.250. Carry out charging if required.	√	√	√	x	x	x
	Check voltage of each cell with	√	√	√	x	x	x
	High Rate Discharge Cell Tester. Replace the particular battery if any of its cell voltage is less than 1.7 V.						
	Tighten all interconnections and other connections.	√	√	√	x	x	x
	Check condition of all conduit pipes and clamps.	√	√	√	√	x	x
	Tighten all vent plugs and place batteries in battery box.	√	√	√	x	x	x
	Apply petroleum jelly on all bare connections.	√	√	√	x	x	x
	Ensure provision and fitment of antitheft rod.	√	√	x	x	x	x

S. No	Activity	IA	IB	IC	TOH	IOH	POH
	Check condition of sleeve on antitheft rod.	√	√	x	x	x	x
	Place wooden packing between and around batteries properly so that batteries should neither loose nor too tight.	√	√	√	√	x	x
	Check intactness of supporting bar.	√	√	√	x	x	x
	Check leakage current on main positive and main negative. It should be zero.	√	√	√	√	x	x
	Provide battery box covers properly.	√	√	√	√	x	x
	Connect supporting bar.	x	x	√	√	x	x
	Connect antitheft rod.	x	x	√	√	x	x
	Fit battery box covers properly.	x	x	√	√	x	x
	Remove the batteries from battery box on arrival of the locomotive in shed and bring them to battery section for attention.	x	x	x	√	x	x
	Check fixing arrangement of battery box.	x	x	x	√	x	x
	Check the battery container for any leakage.	x	x	x	√	x	x
	Remove the vent plugs/ float plugs and clean with wet cloth to remove the dust particles.	x	x	x	√	x	x
	Record the individual cell voltage and specific gravity.	x	x	x	√	x	x
	Keep battery set on charging bed.	x	x	x	√	x	x
	Top up cells wherever necessary with demineralised water to the correct level.	x	x	x	√	x	x
	Charge the battery set as follows:	x	x	x	√	x	x
	Leave battery set idle for 12 hours after toping up of de- mineralised water to cool down the cell temperature to ambient temperature.	x	x	x	√	x	x
	Record individual cell voltage before charging.	x	x	x	√	x	x
	Connect the positive and negative leads of the source to the positive and negative of the battery set respectively as marked on the terminals.	x	x	x	√	x	x
	Charge the batteries at the normal charging rate of 7.5 amps. at room temperature.	x	x	x	√	x	x

S. No	Activity	IA	IB	IC	TOH	IOH	POH
	Continue charging until the voltage and specific gravity of the electrolyte in each cell have reached a maximum and show no further rise over three successive hourly readings. Ensure all cells are gassing freely. The fully charged battery should attain specific gravity from 1.240 – 1.250. Allow the cells of battery set to cool down for a period about 12 hours.	x	x	x	√	x	x
	i. Under charging is indicated by the specific gravity being frequently below1.220 or by the specific gravity gradually falling over a period.	x	x	x	√	x	x
	ii. Overcharging is indicated by the specific gravity being generally beyond 1.250. It may be due to loss of water.	x	x	x	√	x	x
	Now to observe the healthy condition of cells, discharge the battery set as follows:	x	x	x	√	x	x
	i. Connect the battery set to a rheostatic load and adjust the load so that constant current of 15 amps. flows. Keep the load current constant throughout the complete discharge process of 5 hours.	x	x	x	√	x	x
	ii. Measure and record the hourly readings of each cell voltage and specific gravity until the voltage of cell have reached a minimum value of 1.7 V. If the battery set shows capacity less than 80% due to any defective cell/ battery unit, it should be replaced with healthy battery unit.	x	x	x	√	x	x
	Re-charge the battery set for service at normal rate of 7.5 amps. until cell voltage remain constant over 3 successive hourly readings and adjust specific gravity to 1.240 - 1.250.	x	x	x	√	x	x
	Replace defective float guides and vent plugs, if any. Tighten all vent plugs.	x	x	x	√	x	x
	Apply a thin layer of petroleum jelly on all intercell connectors and terminals to protect them from corrosion.	x	x	x	√	x	x
	Clean battery boxes and repaint using a good quality acid resistant paint.	x	x	x	√	x	x
	Check condition of battery box covers, anti theft rods, supporting bar, wooden packing and interconnections. Replace defective item if any.	x	x	x	√	x	x

S. No	Activity	IA	IB	IC	TOH	IOH	POH
	Place the batteries in battery box.	x	x	x	√	x	x
	Provide interconnections after cleaning and tighten them properly.	x	x	x	√	x	x
	Replace Battery lead acid with battery box.	x	x	x	x	√	x
2	**Battery charger**						
	Clean dust and dirt						
	Check the connections			√	√		
	Cleaning preferably done by compressed air						
	Adjust the CHBA voltage 110 + 1.0 V with nominal trickle charge 3 to 5 A	√	√	√	√		
3	**Auxiliary contacts**						
	Visual inspection cleaning	√	√	√	√		
	Lubrication						
4	**Transformer**						
4a.	**Code of Practice For Maintenance of Transformer Oil In Service as given below.**	As Per RDSO SMI NO. RDSO/ELRS/SMI/158 Dt.19.01.95					

S. N.	Tests	Test methods	Permissibl e limits	Reqmt of new filtered oil	Periodicity
1.	Visual inspection	--		--	IC/AOH/ IOH/ POH
2.	Dissolved Gas Analysis	SMI-138	As per SMI 138	--	IC/AOH/ IOH/ POH
3.	Electrical strength (Break down voltage)	IS:6792-72	30KV(rms) (Min)	60KV(rms)	IC/AOH/ IOH/ POH
4.	Water content(PPM)	IS:335-1983	35 PPM(max)	25 PPM (max)	IC/AOH/ IOH/ POH
5.	Specific resistance at 90 degree C (ohm-cm)	IS:6103-71	0.1x10 ohm cm(min)	35x10 ohm cm(min)	IC/AOH/ IOH/ POH
6.	Dielectric dissipation factor (Tan delta) at 90 degree C	IS:6262-71	1.0 (max)	0.002 (max)	IOH/AOH/ POH
7.	Total acidity	IS: 1448-67	0.5mg KOH/ gm (max)	.03mg KOH/ gm	IC/AOH/ IOH/ POH
8.	Sediments and perceptible sludge	IS:1866-83 Appendix-A	0.05 bv wt.	No sediment or perceptible sludge shall be detected.	IOH/AOH/ POH
9.	Flash point	IS: 1448-1970	125 deg. C (Min)	140 deg.C (Min)	IOH/POH

10	Interfacial tension at 27 deg. C	IS: 6104-71	0.018 N/m (Min)	0.04 N/m (Min)	IOH/POH					
11	Oxidation inhibitor	IS: 335-1983 Appendix `D`	0.3% by mass Max	0.3% by mass (max)	AOH/IOH/ POH					
4b	**Schedule activities of Transformer**		Schedule activities as per para No. 3.1 & 3.2 CAMTECH publication No. CAMTECH/E/2006/ TPT/ 1.0, (Jan,2006)							
	Check the condition of power bushings (a3, a4, a5, a6 & a0) visually for any flash mark or oil leakage and tightness.		√	√	√	√	√			
	Any oil leakage from bushings. If leakage is there, it should be attended.		x	√	√	√	√			
	Check oil level (Min. 15 deg. Mark)		√	√	√	√	√			
	Check A34 and A0 bushings.		√	x	x	x	x			
	Check condition of Silicagel. (Change, if decolourised)		√	√	√	√	√			
	Check oil leakage from PHGR joints.		√	√	√	√	√			
	Check tightness and cleaning of all TFVT connections.		√	x	√	√	√			
	Clean all bushing.		x	√	√	√	√			
	Visual checking of RC network across a0, a1 bushings.		x	√	√	√	√			
	Check condition of main transformer & Aux. Transformer bushing for any flash mark or heating marks on cable socket.		x	x	√	√	√			
	Check condition of Surge Arrestor & Capacitors.		x	x	√	√	√			
	Clean Transformer bottom.		x	√	√	√	√			
	Disconnect the A33, bushing for removing auxiliaries from transformer block.		x	x	x	√	√			
	Check power cable of junction box on under frame.		x	x	x	√	√			
	Transformer oil to be drain out for removing Radiator, MPH etc. for O/H.		x	x	x	√	√			
	Check the tap changer and remove if required.		x	x	x	√	√			
	Do transformer modification work if necessary.		x	x	x	√	√			
	Replace transformer gasket if needed.		x	x	x	√	√			

	Carry out centrifuging of transformer oil.	x	x	x	√	√	
	After fitting the auxiliaries, fit the removed bushings.	x	x	x	√	√	
	Do dissolved gas analysis (DGA)	x	x	√	√	√	
	Following common tests to be carried out in the transformer either in case of failure or during overhauling.						
	i. Insulation resistance test. ii. Continuity test iii. Winding resistance test iv. Ratio test	x	x	x	√	√	
	Meggering Check the insulation resistance of windings. It should be minimum 100 M ohms. Primary to earth by 2.5 kV megger. Secondary to earth by 1000V megger. Primary to secondary by 1000 V megger. Primary to Aux. by 1000V megger. Aux. to earth by 1000V megger. Secondary to Aux. by 1000 V megger.	x	x	x	√	√	
	Continuity Test Check the continuity of the following windings with the multimeter: Primary winding across A0 – A33 Secondary windings across a3 – a4, a5 – a6 Auxiliary winding across a0 – a1	x	x	x	√	√	
	Winding Resistance Test	x	x	x	√	√	
	WINDING RESISTANCE VALUE **HETT 3900 HETT 5400 AC** 1. A0 – A33 0.843 – 1.243 0.698 – 1.116 2. A0 – A34 0.430 – 0.598 0.241 – 0.320						
S. No.	**Activity**	**IA**	**IB**	**IC**	**TOH**	**IOH**	**POH**
	3. a3 – a4 0.0015- 0.0025 0.0015- 0.0025 4. a5 – a6 0.0015- 0.0025 0.0015- 0.0025 5. a0 – a1 0.0025- 0.004 0.0025- 0.004						
	Ratio Test	x	x	x	√	√	√

5.	**Maintenance schedule activities of Tap Changer, SMGR, CGR, Circuit Breaker, PHGR & RGR as per CAMTECH publication No. CAMTECH/2002/E/GR/1.0 March, 2002**						
5a.	**SMGR**						
	Carry out general inspection and cleaning	√	√	√	√	√	
	Check tightness of connections	√	√	√	√	√	
	Overhaul SMGR	x	x	x	√	√	
	Examine all auxiliary contacts for cracks, carbonisation, tightness of all connections. If required, replace by nylon auxiliary switch.	x	x	√	√	√	
	Clean all auxiliary contacts.	x	x	√	√	√	
	Check and lubricate all the gears and other parts.	x	x	√	√	√	
	Check all drive parts visually for any abnormality.	x	x	√	x	x	
	Overhaul control block.	x	x	√	√	√	
	Check proper clamping and strengthening of ZSMGR panel.	x	x	√	√	√	
	Check smooth operation of ZSMS	x	x	√	√	√	
	Ensure locking of SMGR foundation bolts by plate or lock nut.	x	x	√	√	√	
	Check notching spring, selector lever bolt. SMGR foundation for any cracks.	x	x	√	x	x	
	Check connection tightness of SB and foundation bolts.	x	x	√	x	x	
	Die penetrant test on crankshaft, SMGR	x	x	x	√	√	
	Ensure 100% replacement of change items	x	x	x	√	√	
	Leakage testing of SMGR.	x	x	x	√	√	
	Load testing of SMGR along with GR and CGR on test panel.	x	x	x	√	√	
	Paralleling of SMGR auxiliary cam switches with spare one.	x	x	√	√	√	
	Check SMGR crank shaft alignment during overhauling as per Adtranz Jigs and Fixture.	x	x	x	√	√	
	Modification to connection lever of SMGR for tap changer to avoid air leakage RDSO/WAM4/58.	x	x	x	√	√	
	Modification to control lever of	x	x	x	√	√	

	SMGR for tap changer - RDSO/WAM4/117.						
	Application of loctite between the mating surface of cams shafts and grub screw and tap holes of tap changer- RDSO/WAM4/145.	x	x	x	√	√	
	Ensure provision of ceramic filter.	x	x	x	√	√	
5b.	**Tap Changer**						
	Check condition of RGR and RPGR	√	√	√	√	√	
	Check oil level if less, add up to 40o C	√	√	√	√	√	
	Check colour of silica gel and replace/ recondition if necessary.	√	√	√	√	√	
	Check connection of double pole bushing to CGR1 and 3.	√	√	√	√	√	
	RGR (Other than Lacchman make) IR valve to be checked (with 1000 V valve to be checked (with 1000 V	√	√	√	√	√	
	Check BDV of oil as per IS: 6772	x	x	√	√	√	
	Check condition of selector (In 2nd IC)	x	x	√	√	√	
	Check tangential play in moving contact (2nd IC)	x	x	√	√	√	
	Check DGA, if acetylene contents are more than 3 PPM then open the GR cover and check.	x	x	√	√	√	
	GR oil flushing to be done if due.	x	x	√	√	√	
	Check for any oil leakage.	√	√	√	√	√	
	Drain the oil and remove the cover. Clean with jet and nylon brush.	x	x	x	√	√	
	Check angle setting and contact shorting.	x	x	x	√	√	
	Check RPGR value and condition.	x	x	x	√	√	
	Replace all gaskets	x	x	x	√	√	
	Check safety valves and manual drive for proper functioning. Overhaul safety valve.	x	x	x	√	√	
	Replace top and bottom oil seal.	x	x	x	x	√	

	Maintenance of Tap changer by set of jigs and fixtures and special tools of M/s. Adtranz only.	x	x	x	√	√	
	Fastening RGR and CGR support plates on Tap changer assembly RDSO/WAM4/ 52.	x	x	x	√	√	
	Modified flexible connection	√	√	√	√	√	
	between RGR & GR - RDSO/ WAM4/136.						
	Provision of canopy on safety valves of Tap changer RDSO/WAM4/187.	√	√	√	√	√	
	Permanent connection of 16th Tap in place of spring loaded connection. RDSO/WAM4/192.	x	x	x	√	√	
	Replacement of insulating oil & Silica gel of Air drier of GR.	x	x	x	√	√	
	100%Replacement of "Must Change Items"	x	x	x	√	√	
	Check working of safety valves whenever GR cover open/ canopy provided	√	√	√	√	√	
	Overhaul	x	x	x	√	√	
5c.	**CGR**						
	Check Arc Chute for flash mark, crackness and ensure intactness of latches.	√	√	√	x	x	
	Measure contact pieces dimensions.	√	√	√	√	x	
	Lubricate mechanical joints/ pins of CGR assembly.	x	x	√	√	√	
	Check CGR sequence through MOM.	x	√	√	√	√	
	Check CGR to RGR and CGR1 to A34 connection. it shall not be close to foundation.	√	√	√	√	√	
	Check tightness of contact screw and foundation screw.	√	√	√	√	√	
	Check play of camshaft of CGR assembly and replace if required.	x	x	x	√	√	
	Check arc horn.	x	x	√	√	x	
	Overhaul.	x	x	x	√	√	
	Use of high temperature grease type MECKBR-300 for GR.	x	x	√	√	√	
	Check sequence pressure of CGRs as per SMI 50.	x	x	x	√	√	
	Testing of contact pressure of CGRs as per SMI 50.	x	x	x	√	√	

	Modification to fixing arrangement for blow out coil of CGR to ensure locking of Tap changer. RDSO/ WAM4/128.	x	x	x	√	√	
	14 Provision of latch assembly of CGR arc chute.	√	√	√	√	√	
	Replacement of contact tips should not be done ON position.	√	√	√	√	√	
5d.	**Circuit Breaker**						
	Dismantle switching elements (load switch)	x	x	x	√	√	
	Inspect cams of S 2220.1 ... S 2220.3 for wear and tear/ functional check.	x	x	x	√	√	
	Clean/inspect arcing chamber S	x	x	x	√	√	
	27 & arcing horn S 2531.						
	Inspect/replace CGR contacts S 2529 and S 2530. Tighten Allen bolts with 2.5 Kg meter torque.	x	x	x	√	√	
	Clean switching elements and carry out functional checks with the use of special tools.	x	x	x	√	√	
	Lubricate contact pivot (S2528) with high temperature grease.	x	x	x	√	√	
	Tighten Allen key bolts M6, M8 & M12 with torque wrench.	x	x	x	√	√	
5e.	**PHGR**						
	Check the working of PHGR	√	√	√	√	√	
	Check visually for any leakage.	√	√	√	x	x	
	Tightness of pipe line clamp as per RDSO/MODI/114.	√	√	√	√	√	
	Overhaul PHGR and replace rubber items.	x	x	x	√	√	
	Filter cleaning to be done.	x	x	√	x	x	
	Attend the booking if any.	√	√	√	x	x	
	Provision of modified PHGR.	√	√	√	√	√	
	Ensure support for oil flow indicator as per RDSO/MODI/162.	√	√	√	√	√	
5f.	**RGR**						
	Inspect elements for overheating/ cracking.	x	x	√	√	√	
	Inspect insulators for cracks.	x	x	x	√	√	
	Carry out meggar test and measure resistance value.	x	x	x	√	√	
	After overhauling, carry out tests as described and record.	x	x	x	√	√	

6	Schedule activities of Electro - Pneumatic contactors L1-L6, C145 and shunting contactors as per para no. 3.4 of CAMTECH publication No. CAMTECH/2000/E/EPC/1.0, July, 2000						
	Check the condition of arc chute and fixing of pole plate.	√	√	√	x	x	
	Check condition of movable and fixed contactors	√	√	√	x	x	
	Check tightness of movable and fixed contactors	√	√	√	x	x	
	Ensure proper lubrication of servomotor.	√	√	√	x	x	
	Ensure no air leakage during testing from Electro valve etc.	√	√	√	x	x	
	Open line contactors for overhauling.	x	√	√	x	x	
	Check condition of electro valve. Attend, if found defective.	x	√	√	x	x	
	Check condition of pole plate and contactors.	x	√	√	x	x	
	Check connections of all bus bars and cables.	x	x	√	x	x	
	Check connections of SBBA 1 and SBBA2.	x	x	√	x	x	
	Check tightness of nuts and bolts.	x	x	√	x	x	
	Check shunting resistances for over heating marks cracks and flashes.	x	x	√	x	x	
	Check all connections of bus bars and power cables.	x	x	√	x	x	
	Check for no missing of negative link stickers.	x	x	√	x	x	
	Check proper working of contactors.	x	x	√	x	x	
	Examine the contactor removed from locomotive for any abnormality	x	x	x	√	√	
	Remove insulating sleeves and distance pieces.	x	x	x	√	√	
	Remove the movable assembly and blow out coil.	x	x	x	√	√	
	Check condition of blow out coil, arc chutes and contactors.	x	x	x	√	√	
	Clean the contactors. Check insulating parts connections of cables and foundation.	x	x	x	√	√	

	Check rubber bucket of servomotor and clean servomotor.	x	x	x	√	√	
	If the support plate is found cracked or damaged, then it should be changed. Carbon should be removed in case of minor carbonization by rubbing with polish paper. Clean support plate with clothes.	x	x	x	√	√	
	Lubricate articulations.	x	x	x	√	√	
	Replace Servomotor Piston Bucket, Gasket Piston Bucket, Felt Ring, Fixed & Mobile Contacts	x	x	x	x	√	√
	Replace Complete shunt Assembly and Aux Switch with Cam.	x	x	x	x	x	√
	Replace all EPC, C-145, Shunting contactors	x	x	x	x	x	√
7.	Schedule activities of Electro-magnetic contactors as CAMTECH publication No. CAMTECH/2000/E/EMC/1.0, July, 2000						
7a.	**Main Contacts**						
	Clean main contact tips with dry clean rag.	√	√	√	√	√	
	Remove the flash marks.	√	√	√	√	√	
	Verify proper bedding.	x	√	√	√	√	
	Activity	IA	IB	IC	TOH	IOH	POH
	Measure contact wear.	x	x	√	√	√	
	Check the crushing.	x	x	√	√	√	
	Wash with petrol and replace, if necessary	x	x	x	x	√	
7b.	**Auxiliary Contacts**						
	Check for proper fixation and operation	√	√	√	√	√	
	Clean contact tips.	x	x	√	√	√	
	Check for proper alignment.	x	x	√	√	√	
	Wash the contacts with petrol.	x	x	x	x	√	
7c.	**Copper Shunts**						
	Check for damage or loose connection.	√	√	√	√	√	
	Check for flexibility.	x	√	√	√	√	
	Renew, if cut or worn out.	x	√	√	√	√	
	Change, if shunt is discoloured.	x	x	√	√	√	
7d.	**Bearing**						
	Clean the journal bearing with petrol.	x	x	x	√	√	
7e.	**Arc Chute**						

	Check for tightness.	√	√	√	√	√	
	Clean the carbon and copper deposits.	x	x	√	√	√	
	Dismantle into two halves and clean. Replace, if more than half thickness effected with crater.	x	x	x	√	√	
7f.	**Blow out coil**						
	Tighten connection.	x	√	√	√	√	
	Check for overheating marks and damage.	x	√	√	√	√	
	Check for cracks on insulating support.	x	x	√	√	√	
	Dismantle & clean with petrol.	x	x	x	√	√	
7g.	**Operating mechanism**						
	Check the play of insulated shaft.	x	√	√	√	√	
	Check free motion of armature.	x	√	√	√	√	
	Verify armature not fouling with parts.	x	x	√	√	√	
	Rotate the core.	x	x	√	√	√	
	Renew armature, if deformed.	x	x	x	x	√	
7h.	**Magnetic Circuit**						
	Clean the coil with petrol.	x	x	x	x	√	
	Paint with air drying varnish, if insulation is deteriorating.	x	x	x	x	√	
	Economy resistance						
	Clean and check for cracks.	x	√	√	√	√	
7i	**Cronometric relay**						
	Overhaul and lubricate	x	x	√	√	√	
7j	**Bolts, nuts and screw**						
	Tighten the nuts and fixing screws.	x	√	√	√	√	
7k.	**Dusting**						
	Clean the dust with compressed air from all parts of the coil.	x	√	√	√	√	
7l.	**Lubrication**						
	Lubricate shaft bearing	x	x	x	√	√	
	Replace all Electro-magnetic contactor.	x	x	x	x	x	√
8.	**ZPT**						
	Dusting and cleaning and check for free movement, proper contact and finger pressure			√	√		
9.	**CTF and J**				√		
	Check for any air leakage	√	√	√	√		
	Check the shunt condition and tightness		√	√	√		
	Tighten all nuts and bolts of switch		√	√	√		

	Check the condition of rubber buckets and replace, if necessary			√	√		
	Check the contact gap and pressure of main and auxiliary contacts and contact bedding			√	√		
	Lubricate servomotors and cams			√	√		
	Overhaul				√		
	Replace a. Fork & all Dowel Pins b. Finger & Drum Contacts with brass ball. c. Aux Switches d. Notching Lever Complete	x	x	x	x	x	√
	Replace Servomotor Piston Bucket, Gasket Piston Bucket & Felt Ring	x	x	x	x	√	√
10.	**Schedule activities of Damping panel as per RDSO SMI NO. RDSO/ELRS/SMI/ 230 (REV-0) Dt. 02.04.2004**						
	Visual inspection Flash over of terminals Terminal crack/breakage Bursting Bulging Leakage of electrolyte	√	√	√	√	√	√
	Measurement of capacitance	x	x	x	√	√	√
	Identification of failed capacitor	x	x	x	√	√	√
	Replacement of failed capacitor	x	x	x	√	√	√
	Replace VCB Damping panel	x	x	x	x	x	√
	Replace TFP damping panel	x	x	x	x	x	√
	Replace Capacitors of RC network	x	x	x	x	x	√
	Replace Other Damping panels	x	x	x	x	x	√
11.	**Master controller**						
	Check the operation & connections tightness	√	√	x			
	Clean the Auxiliary interlocks-1 & 2 (MPCS), 1, 2, 3 for (Non MPCS)	√	√	√			
	Ensure availability and proper tightness of MP-1&2 couplers with 2 safety clamps at top and bottom	√	√	√			
	Ensure tightness and condition of MP operating wheel locking pin.	√	√	√			
	Check the mechanical interlocking device, clean dust, tighten the MP fixing bolts.	x	x	√			

	Lubricate the shaft and interlocking device.	x	x	√			
	Check the condition of auxiliary contacts and replace if necessary. Check up the proper sequence of operation of MP, MPJ, MPS.	x	x	√			
	Remove MP from loco and blow out the dust.	x	x	x	√	√	
	Check the operation before dismantling.	x	x	x	√	√	
	Check the springs for proper tension.	x	x	x	√	√	
	Check the condition of rollers.	x	x	x	√	√	
	Check the levers for any deformity and arrest, if any.	x	x	x	√	√	
	Check the condition of switches. If any nylon roller is damaged replace the switch during AOH/IOH and replace the switch compulsory in POH.	x	x	x	√	√	√
	Clean the contact area and ensure proper contact by continuity checker.	x	x	x	√	√	
	Check the contact gap	x	x	x	√	√	
	Clean all the parts and lubricate.	x	x	x	√	√	
	Check the condition of the positioning cams.	x	x	x	√	√	
	Check the continuity of cables from conk to switches.	x	x	x	√	√	
	Check the condition of RC panel.	x	x	x	√	√	
	Change the nameplates if necessary.	x	x	x	√	√	
	Ensure proper seating of retaining ring of conk male pin assembly.	x	x	x	√	√	
	Check condition of MP conk	x	x	x	√	√	
	Check the contact pressure	x	x	x	√	√	
	Check the Driving wheel. Replace, if damaged.	x	x	x	√	√	√
	Replace locking pin of the driving wheel,	x	x	x	x	√	√
12.	**SL, SJ and ATFEX**						
	Check the tightness of connections			√	√		
	Blow through side cover			√	√		
	Clean Teflon piece, remove bottom cover and blow			√	√		
	Check for the overheating marks			√	√		

	Measures to improve reliability of SL as per SMI-240	x	x	x	√	√	√
	Maintenance/ Testing of Smoothing Reactor (SL- 42/30) as per SMI No. RDSO/2017/EL/SMI/0304 (Rev.0) dt. 22.03.17 (TAN Delta test not required as per Amendment 1)						
	Check complete SL visually for any insulation damage.	x	x	x	x	x	√
	Pre- Heating of SL in an oven for 2 hrs. 100o C.	x	x	x	x	x	√
	Baking of complete assembly in an oven for 12 hrs at 140o C. This shall be done after varnishing.	x	x	x	x	x	√
	Check the coil resistance at 20oC .	x	x	x	x	x	√
	Check the impedance (Z) at 50 Hz, Z=V/I	x	x	x	x	x	√
	Check the Inductance at 50Hz	x	x	x	x	x	√
	Check the secondary insulation sleeve between core supporting rods and bracket.	x	x	x	x	x	√
	Tinning of terminal	x	x	x	x	x	√
	Check the insulation resistance with 1 kv megger between terminal & earth.	x	x	x	x	x	√
	HV testing by giving 2.5kv AC for one minute between terminal & body.	x	x	x	x	x	√
	Tap all the thread holes and ensure good condition of threads.	x	x	x	x	x	√
	Check the SL cover for any crack and damage.	x	x	x	x	x	√
	Check the frame holes for ovality.	x	x	x	x	x	√
	Clean the iron particles available in the air gaps and core and in between coils at final stage by magnetic rod.	x	x	x	x	x	√
	Apply 2.5kv for one minute between winding/ coils and frame/ cores. The reactor shall successfully withstand the applied voltage as above & record the leakage current.	x	x	x	x	x	√
	Replace SL covers	x	x	x	x	x	√
13	**MU couplers - Dusting & cleaning**			√	√		

	Replace MU coupler jumper pins	x	x	x	x	x	√
14	**Driver's switch desk/ CAB & General Equipments**						
	Check the condition of BL/Switches		√	√	√		
	Check the condition of pilot lamp holders and connections check RSI-2	√	√	√	√		
	Lubricate the rollers and actuating bars			√	√		
	Check limit switches, switches of BL Box and replace worn out contacts and clean				√		
	Check the condition of Cab fans & clean the fans.	√	√	√	x	x	x
	Overhaul the cab fans	x	x	x	√	√	√
	Replace BL Box complete with switches	x	x	x	x	x	√
	Replace Rubber mat	x	x	x	x	x	√
	Replace All relay covers	x	x	x	x	x	√
	Replace Bakelite separators of TK panel	x	x	x	x	x	√
	Replace A9 valve	x	x	x	x	x	√
	Replace BL box of driving desk	x	x	x	x	x	√
	Replace Cab fans	x	x	x	x	x	√
	Replace Cab heaters	x	x	x	x	x	√
	Replace Cab window assembly complete	x	x	x	x	x	√
	Replace All gauges, meters, indication panel & light fittings	x	x	x	x	x	√
	Replace Wiper servo motor assembly complete with arms/blades/control valves	x	x	x	x	x	√
	Replace All Push buttons	x	x	x	x	x	√
	Replace All PC8 Relay Contacts & springs	x	x	x	x	x	√
	Replace RU of all voltmeters	x	x	x	x	x	√
	Replace Analog NR	x	x	x	x	x	√
	Replace Indication panel	x	x	x	x	x	√
	Replace Driver and Asstt. Driver seat	x	x	x	x	x	√
	Replace Front look out glass and corridor glasses	x	x	x	x	x	√

	Replace all perishable items like rubber gaskets, rubber grommets, felts, rubber pipes, hoses rubberized cork sheets, oil seals etc.	x	x	x	x	x	√
	Replace all Brake block, carbon brushes, silica gel, grease nipple, metalized carbon strip for pantograph etc.	x	x	x	x	x	√
	All oil and greases to be replace	x	x	x	x	x	√
	Replacement of filters, pipelines, ceramic filters in DJ & SMGR	x	x	x	x	x	√
	Replace all type of washers, spring washers etc.	x	x	x	x	x	√
	Various ball type isolating cocks, check valve, pressure cut out switch etc. to be replaced.	x	x	x	x	x	√
	All O rings, bushes, gasket & Diaphragm to be replaced.	x	x	x	√	√	√
	All flexible shunts	x	x	x	x	x	√
	Auxiliary Switches (SMGR, MP, CTF, J, C-118	x	x	x	x	x	√
	A9 & SA9 pipe line (To be replaced with stainless steel pipe line)	x	x	x	x	x	√
15	Twin Beam Headlight, DC- DC Converter & Flasher light						
15a.	**Maintenance activities of DC-DC converter as per SMI 253 dt. 28.04.08 & CAMTECH Publication No. CAMTECH/E/2007/HLFL/1.0 , Feb.2007**						
	Check tightness of foundation bolts.	√	√	√	x	x	
	Clean and check tightness of all connections.	√	√	√	x	x	
	Confirm that the input (i.e. left hand side) terminals are powered from loco battery and the output (i.e. right hand side) terminals are used for headlight connection.	√	√	√	x	x	

	Check fuses and condensers during IC. If found defective, replace following and wire them as per wiring diagram: a. Power card b. Control card c. MOSFET card	√	√	√	x	x	
	Change the position of change over switch, so that converter 1 and 2 are in operation alternatively. This is essential to utilize both the converter units during the service life of DC-DC converter.	√	√	√	x	x	X
	Open DC-DC converter box for removal of dust & dirt. Clean the heat sink with petrol or Iso-propyl alcohol.	x	x	x	√	√	√
	Check the tightness of input and output connection.	x	x	x	√	√	√
	Visually check the condition of input filter electrolytic capacitor. Replace the same, if it is found leaking.	x	x	x	√	√	√
	Check the IR value as shown below	x	x	x	√	√	√
Megger the electronics circuit with respect to earth and check the insulation level with 500V megger. The time of the meggering shall not be less than 60 sec. 110 V circuit and earth : 20 M ohms. Control and Electronics to earth : 10 M ohms. Screen to earth : 10 M ohms. Input/ Output to earth : 10 M ohms. If IR values are less than the specified values take the following actions: i. Replace mica insulation between MOSFET and heat sink and use one layer of Kapton tape of 2 mm thick in addition to the mica insulation. ii. Check wiring and connections.							
	Measure the output voltage keeping constant output current at 15.8 amp as given below:	x	x	x	√	√	√

	Output voltage Input current Set Output Switch ON/ Switch Input current at 15.8 OFF from I/P ON/OFF from voltage A by varying side 5 times & side 25 times the load measure O/P & measure voltage O/P voltage. 70V 6.2-6.6A 15.8 Amp 25.5 V 1% 25.5 V 1% 110 V 4.0-4.5A 15.8 Amp -Do- -Do- 140 V 3.2-3.5A 15.8 Amp -Do- -Do- If the output voltage is not within the range the same should be obtained by adjusting the voltage pot given on PCB before final fitment. If the rated output is not obtained then MOSFET, capacitors, choke coils should be checked and replaced, if found defective.						
	Verify the reverse polarity protection at 140 V for one minute by making the connection to reverse polarity and unit shall function normal after restoring the connection to correct polarity.	x	x	x	√	√	√
	Replace the electrolytic capacitor (input filter) irrespective of its condition. Purchase the capacitor of required value for different OEMs (1000 mfd 200 V for Signotron make and 470 mfd 200 V/1200 mfd 200 V for Matsushi make) from reputed make like Nippon/ Nichicon/ Micon available commercially in the market.	x	x	x	x	√	√
	Do conformal coating on condition basis and replace rubber gasket.	x	x	x	x	√	√
	Replace DC-DC converter if it has served for 9 years i.e replace during POH of freight locomotives and on time basis in passenger locomotives. However, replace the main capacitor irrespective of its condition.	x	x	x	x	x	√
	Maintenance activities of Twin Beam Headlight as per SMI 253 dt. 28.04.08 & CAMTECH Publication No. CAMTECH/E/2007/HLFL/1.0, Feb.2007						
	Visually check and ensure that bulbs filaments are in good condition and fitment of bulb in beam.	√	√	√	x	x	

	Clean the twin beam headlight glass. If replacement is required, mount the front glass with gasket and bird guard.	√	√	√	x	x	
	Keep the nuts & bolts properly tightened of headlight.	√	√	√	x	x	
	Clean the reflector and ensure that it is in good condition. Replace if required. Ensure headlight focusing.	√	√	√	x	x	
	Check the bulb holders/connector for tight grip. Replace if required.	√	√	√	x	x	
	Check SB connections.	√	√	√	x	x	
	Replace connector for halogen lamp and bulbs irrespective of condition of bulb during major schedule.	√	√	√	x	x	
	One independent fuse of 10A is to be provided in output of DC- DC converter main PCB circuit.	√	√	√	x	x	X
	Clean the headlight by taking out the bulb from inside and outside manually and replace the bulb.	x	x	x	√	√	√
	Check the condition of reflectors and replace if there are black spots or otherwise physically in bad shape.	x	x	x	√	√	√
	Check the illumination level at 8mtr as per clause no. 6,3,7,2,1 of RDSO specification no. ELRS/SPEC/ PR/0024 Rev '1' which should be ideally 4800 lux. Change the sealed reflectors if the illumination level is less than 4000 lux.	x	x	x	√	√	√
	Check the condition of connectors before fitment of bulb in locomotive.	x	x	x	√	√	√
	Replace the mounting gasket.	x	x	x	√	√	√

	All lamp units to be brought to the shop floor and replace the following components during IOH. i. Sealed Halogen reflector with 4 mm toughened glass. ii. Front cover toughened glass 6 mm thick. iii. Spring loaded lamp holder. iv. 'U' type neoprene gasket 6 mm thick. v. Strip type sponge gasket. vi. Connector for halogen lamp with PTFE wire & sleeves.	x	x	x	x	√	√
	Maintenance activity for Flasher light as per para No. 2.1.3 of CAMTECH Publication No. CAMTECH/E/2007/HLFL/1.0, Feb.2007						
	Clean and check the lamp front glass. Replace if required.	√	√	√	x	x	
	Tighten all nuts & bolts of the lamp unit properly.	√	√	√	x	x	
	Check flasher light hood for proper fitment. Also check condition of gasket.	√	√	√	x	x	
	Check tightness of foundation of control unit	√	√	√	x	x	
	Check for loose connection of flash unit and control unit in SB and at terminals.	√	√	√	x	x	
	Physically check switch fuse and control unit for any abnormality. If found defective, replace following and wire them as per wiring diagram: a. Buzzer b. Control Card c. Fuse	√	√	√	x	x	
	Check and ensure correct rating of spare fuses provided.	√	√	√	x	x	
	Replace lamp unit if partial LEDs are not glowing.	√	√	√	x	x	
	Confirm that the input (i.e. Left hand side) terminals are powered from loco battery and the output (i.e. right hand side) terminals are used for lamp unit.	√	√	√	x	x	

	Check the nylon cap of the switch. If missing put new cap. It saves switch from dust & moisture & help to prolonged operation from it.	√	√	√	x	x	
	Replace flasher light unit & Lamp box and Marker light.	x	x	x	x	x	√
16	**Switch Board**						
	Dusting and cleaning, check the condition of switches and connections, check the condition of fuses and fuse boards			√	√		
	Lubricate the rollers and actuating parts or pin				√		
17	**Terminal board**						
	Checking, cleaning and tightness			√	√		
18	**All resistances**						
	Checking the condition, connections and cleaning		√	√	√		
	Measure the resistance value, if found out of the limits, then replace	x	x	x	√	√	√
19	**Auxiliary programme switches**						
	Check the contacts for flash mark and proper contacts and clean the contacts	√	√	√	√		
	Replace all programme switches including HOM switch, selector switch, SPDP toggle switch & D type fuses.	x	x	x	x	x	√
20	**Body side filter**						
	Remove, clean and re-fit	√	√	√	√		
	Change supporting gaskets				√	√	√
	Replace Body Filters	x	x	x	x	x	√
21	Dynamic Brake Resistor						
	Examine insulators and supports. Wipe insulators with a clean dry cloth	√	√	√	√		
	Check tightness of nuts, bolts and screws			√	√		
	Blow out resistor bank with dry compressed air			√	√		
	Inspect resistor for damage, overhaul and record resistance				√		
	Replace DBR Grids	x	x	x	x	x	√

22	**Check connection tightness of VEPT, VESA, VEF**			√	√		
23	**Corridor**						
	Replace all Pressure switches and air flow relays-micro switch and diaphragm	x	x	x	x	x	√
	Replace all NR valves, NC4, NC7 valves	x	x	x	x	x	√
	Replace SMGR-PR valve	x	x	x	x	x	√
	Replace all gauges	x	x	x	x	x	√
	Replace all Micro switch of relays	x	x	x	x	x	√
	Replace all Time delay relay timer	x	x	x	x	x	√
	Replace all Shunt for QF relay & traction ammeter	x	x	x	x	x	√
	Replace all TM cable cleats	x	x	x	x	x	√
	Replace all gauges and meters	x	x	x	x	x	√
	Auxiliary contactors for EP contactors with power contact tips, all insulators and hardware's including square head bolt.	x	x	x	x	x	√
	Tri-plate panel All valves rubber components, all valves base gasket, O ring between plates, NC-4 & NC-7 valves and pressure switches.	x	x	x	x	x	√
III	**E3 Section**						
1	**Hitachi Traction Motor as per CAMTECH Publication No. CAMTECH/E/2005/TM/H/ 1.0, Jan.2005**						
	Clean inspection covers before removing them and check their condition.	√	√	√	x	x	x
	Examine the commutator thoroughly with the help of torchlight or hand lamp for a uniformly coloured, well polished surface, free from bar marked, groove and high mica.	√	√	√	x	x	x
	Remove copper beads from the commutator surface with fine cloth.	√	√	x	x	x	x
	Check commutator riser for solder run out.	√	√	x	x	x	x

	Check the following through inspection window up to possible extent.	√	√	x	x	x	x
	Check the condition of arcing horns and clearance (11.5-13.5 mm)	√	√	√	x	x	x
	Check brush holder and positive/ negative lead insulators for proper glaze and clean them.	√	√	√	x	x	x
	Check the carbon brushes for chipping, mechanical damages and breakage of pig tails.	√	√	√	x	x	x
	Check the size of carbon brushes and if required, change the brushes which are likely to wear beyond the permissible limit before the next maintenance schedule. (Exchange limit 30mm) (New 64mm condemn - 25mm)	√	√	√	x	x	x
	Check the flexible leads are finally secured to the brush holders.	√	√	√	x	x	x
	Check the tightness of rocker lock pin and rocker holding bolt.	√	√	√	x	x	x
	Check the condition of T.M. bellows and if required, got them replaced.	√	√	√	√	x	x
	Replace the Bellow	x	x	x	x	√	√
	Rotate rocker if found necessary.	√	√	x	x	x	x
	Examine the motor for signs of flashover, overheating, loose connections and damaged insulation.	√	√	√	x	x	x
	Check the cables of all traction motors visually for any rubbings or damages.	√	√	√	x	x	x
	Check the MP & IP bolts and if required, apply the 'M' seal/RTV compound.	√	√	√	x	x	x
	Check visually from PE end shield net for any abnormality.	√	√	x	x	x	x
	Check visually earthing brush connection, terminal covers, cables cleats, both ends end shields and overall appearance for any abnormality.	√	√	x	x	x	x
	Blow out the interiors of the motor.	x	x	√	x	x	x

	Clean commutator with fluff – free cloth, moistened with a suitable solvent (such spirit)	x	x	√	x	x	x
	Remove copper beads from the commutator surface with fine cloth and inspect visually commutator end banding and risers for abnormality.	x	x	√	x	x	x
	Check interpole lead for any crack.	x	x	√	x	x	x
	Clean hands with suitable solvents & cloth.	x	x	√	x	x	x
	By Rotating the rocker ring , check the following.	x	x	√	x	x	x
	Measure spring tension of each spring and check their condition and record in format 'A' (2.82 kg. to 3.44 kg. per brush)	x	x	√	x	x	x
	Check up spring pins by hand.	x	x	√	x	x	x
	Check each brush is free in its pocket. If it is sticking, wipe the brush with a fluff-free cloth moistened with a suitable solvent and also clean the brush pocket.	x	x	√	x	x	x
	Measure the gap (clearance) between brush holder bottom and commutator and record in format 'A'. (2 – 4 mm)	x	x	√	x	x	x
	Check the bellow net, there should be no foreign material or oil.	x	x	√	x	x	x
	Lubricate inspection covers latches.	x	x	√	x	x	x
	Check connections of earth return brush.	x	x	√	x	x	x
	Check visually from PE end shield net for any abnormality.	x	x	√	x	x	x
	Ensure availability and proper tightness of PE/CE end shields and bearing covers bolts	x	x	√	x	x	x
	Check bearing covers of PE & CE side endshields for any looseness or hitting marks.	x	x	√	x	x	x
	Replace the gaskets of inspection cover/ terminal covers if required.	x	x	√	x	x	x
	Check visually top & bottom lug, PE/ CE end shields, cable cleats and overall general appearance for any abnormality.	x	x	√	x	x	x

	Clean terminal box covers, remove them and check tightness of terminal box connections.	x	x	√	x	x	x
	Check grease leakage from armature bearings, clean and got attended if required.	x	x	√	x	x	x
	Grease both end armature bearings with pneumatic grease pump.	x	x	√	x	x	x
	Hitachi TM suspension tube bolt	x	x	x	x	x	√
	PE end bearing	x	x	x	x	x	√
	CE end bearing	x	x	x	x	x	√
	Brush holder assembly of TM	x	x	x	x	x	√
	All carbon brushes liners, gaskets, needle roller bearings of TM	x	x	x	x	x	√
	Teflon ring of armature	x	x	x	x	x	√
	Insulating rod, 5565/675 & 5565/740	x	x	x	x	x	√
	Sandwich mounting assembly for passenger fit locos	x	x	x	√	√	√
	Sandwich mounting assembly for goods locos	x	x	x	x	√	√
	Overhauling activities as per Chapter No. 3	x	x	x	√	√	√
2	**Schedule activities of TAO Traction Motor.**	**As per CAMTECH Publication No. CAMTECH/97/E/TM/3.0, Jan.2005**					
	TM on general						
	a. Appearance	√	√	√	√		
	b. Inspection cover.	√	√	√	√		
	c. Loosening of bolts.	√	√	√	√		
	d. Ingress of dust & water	√	√	√	√		
	e. Condition of lead wire , cleat & contact of terminals.	√	√	√	√		
	f. Grease adding to armature bearing.	x	x	√	√		
	Armature						
	a. Glass band.	x	x	x	√		
	b. Commutator	x	x	x	√		
	i. Diameter-new 380mm	x	x	x	√		
	ii. Eccentricity	x	x	x	√		
	iii. Inequality in diameter	x	x	x	√		
	iv. High bar or low bar.	x	x	x	√		
	v. Under cutting depth.	x	x	x	√		
	vi. Chamfering.	x	x	x	√		
	vii. Width of riser.	x	x	x	√		
	viii. Difference of voltage drop between bars	x	x	x	√		
	x. Di-electric test.	x	x	x	√		
	Armature coil						
	a. Cleaning.	x	x	x	√		

	b. Insulation test	x	x	x	√		
	Shaft, bearing & pinion						
	a. Diameter of shaft bearing on pinion end.	x	x	x	√		
	b. Diameter of shaft bear ing on commutator end	x	x	x	√		
	c. Taking off, cleaning ins pection & oiling of Brg.	x	x	x	√		
	d. Radial clearance of roller bearing on PE.	x	x	x	√		
	e. Radial clearance of roller bearing on CE.	x	x	x	√		
	f. Ultrasonic testing of armature shaft.	x	x	x	√		
	g. Replace pinion	x	x	x	x	x	√
	Stator						
	a. Dimensions of mounting parts.	x	x	x	√		
	b. Dent of pole retaining bolt shall be filled with compound.	x	x	x	√		
	c. Stator coil,lead wire and connector.	x	x	x	√		
	Brush holder & carbon brush						
	a. Cleaning & checking.	x	√	√	√		
	b. Spring pressure.	x	√	√	√		
	c. Dimension of brush holder pocket.						
	i. Thickness	x	x	√	√		
	ii. Width	x	x	√	√		
	d. Clearance from comm.	x	x	√	√		
	e. Length of carbon brush	x	√	√	√		
	f. Chipping of carbon brush.	x	√	√	√		
	g. Breakage of pigtail	x	√	√	√		
	Assembly & testing						
	a. Bedding of carbon brush.	x	x	√	√		
	b. Insulation resistance test.	x	x	√	√		
	c. No load test Examine abnormal vibration & noise.	x	x	x	√		
	d. Load test.	x	x	x	√		

3	**Preventive measures to be taken for crack detection of traction motor nose stray & lifting lugs**	**As per RDSO SMI No. RDSO/2017/EL/SMI/0308 (Rev '0') dt. 26.08.17**

SN	Activities	Reference
1	a) During all major overhauling and repair of traction motors, proper DPT of welded joints of nose stay and lifting lugs shall be carried out to eliminate weld failures and any cracks.	RDSO's Lr.No.EL/3.2.172 dt.1309.2011 and Railway Board's Lr.No. 2007/ Elect(TRS)/441/8pt dt.03.02.2014.
	b) For carrying out DPT, grinder shall not be used for cleaning of weld area. Cleaning shall be done by cleaning agents and wire brush etc.	
2	Checking of condition of nose stay along with sandwich pins etc. shall be the focus of under frame examination at out pits. Gap between TM nose stay and bogie transom bracket should be checked visually and any excessive gap should be reported with attention to loco at nearest/ home shed depending upon the condition.	Railway Board's Lr.No.2007/ Elect(TRS)/4 41/8 pt dt.03.02.2014.

SN	Instruction No.	Details
1	Special maintenance instruction No. ELRS/SMI/186 dt.15.05.1997 along with its amendment No.2 dt.01.04.2014.	Instructions for bonded rubber sandwich mounting for nose suspension of traction motors.
2	Technical circular No. RDSO/2014/ EL/TC/0126, Rev '0' dt.25.03.2014.	Instructions to maintain gap between traction motor bottom nose and bonded rubber sandwich mounting unit.

Activity	IA	IB	IC	TOH	IOH	POH
3	Modification sheet No. RDSO/2011/ ELRS/MS/0392, Rev '0' dt.11.02.2011.	Modification in traction motor nose suspension system for provision of additional L clamps and split pins to prevent falling of vertical nose pin of traction motor type HS 15250A/TAO 659.				
4	Specification No. RDSO/2014/EL/ SPEC/0115 Rev '0' dt.22.08.2014.	Specification for bonded rubber sandwich mounting for nose suspension of traction motor for electric locomotives.				
5	Technical circular No. RDSO/2013/EL/ TC/0123, Rev '0' dt.16.05.2013 along with its amendment No.2 dt.16.05.2016.	Instructions for replacement of sandwich mounting assembly in POH.				

	6	Technical circular No. ELRS/TC/0029 Rev.1 dt.15.07.2002.	Instructions for replacement of sandwich mounting assembly in IOH.					
	7	Technical circular No. ELRS/TC/0029 Rev.1 dt.15.07.2002 aolong with its amendment Ni.1 dt.28.06.2017.	Instructions for replacement of sandwich mounting assembly of WAP4 locomotives in every TOH schedule.					
4	**Auxiliary machines**							
	Check looseness of cooling fan blade	√	√	√	√	√	√	
	Check the alignment and realign the driving and driven shaft			√	√	√	√	
	Check the duct for cracks and fixing bolt	√	√	√	√	√	√	
	Check visually the availability of bed, and duct bolts and tighten them. Check impeller, duct stand for any cracks / damages.	√	√	√	√	√	√	
	All Aux. Motors must be provided with proper terminal covers with proper fastening and sealing with gasket.	√	√	√	√	√	√	
	Couplings:							
	Adjustment, alignment and lubrication. Replace on age- basis.			√	√			
	Check foundation bolts and terminal connections	√	√	√	√			
	Grease the bearings			√	√			
	Overhaul all Auxiliary motors				√	√	√	
4a.	**MVRH**							
	Check the terminals for over heating marks and tighten them. Check the terminal block for any cracks, damage or burnt replace it.	x	x	√				
4b.	**MVSL & MVSI**							
	Check up for any impeller play on the shaft and also shaft play.	x	x	√				
	Check the terminal connections for any overheating marks and tight them.	x	x	√				
4c.	**MPH & MCP**							
	Check the terminals for any overheating marks and tighten them.	x	x	√				
	Put back the terminal cover and ensure that cover is not touching to terminal.	x	x	√				

	Clean the machine outside.	x	x	√			
	Check the MPH joints for any leakage. Tighten the joints and arrest the oil leakage.	x	x	√			
	Overhauling of all Auxiliary motors	x	x	x	√	√	√
	Replace all Auxiliary motor bearings	x	x	x	x	√	√
	Replace MPH	x	x	x	Gaskets to be replace	Gaskets to be replace	√
	Replace MVRH impeller	x	x	x	x	x	√
	Replace DC & AC MVRF	x	x	x	x	x	√
	Replace MVSI, MVSL& MVRF	x	x	x	x	x	√
	All end shields of auxiliary motors	x	x	x	x	x	2nd POH
	All auxiliary motors Rewinding after 12 years. Replacement of Aux motors after 18 years.	x	x	x	x	x	2nd POH
4d.	**Traction Motor Cooling blower and it's motor as per CAMTECH Publication No. CAMTECH/2001/MVMT/1.0, Aug.2001**						
	Check for abnormal noise, vibration, burning smell.	√	√	√	x	x	x
	Check for looseness and crack of motor cooling fan blade.	√	√	√	x	x	x
	Check and tighten the foundation bolts.	√	√	√	x	x	x
	Check and tighten the terminal connections.	√	√	√	x	x	x
	Check the condition of terminal lugs.	√	√	√	x	x	x
	Check the impeller blades, dome and jallie for cracks, looseness etc.	√	√	√	x	x	x
	Check the earthing connections of the motor body.	√	√	√	x	x	x
	Ensure working of program switches and contactors QTD 105 & 106.	√	√	√	x	x	x
	Blow out dust with compressed air.	x	x	√	x	x	x
	Ensure intactness of duct	x	x	√	x	x	x
	Activity	IA	IB	IC	TOH	IOH	POH

	jointing felt, tightness of foundation bolts.						
	Check the insulation resistance. It should not be less than 1 mega ohm by 500-volt megger when machine is cold.	x	x	√	x	x	x
	Check the alignment.	x	x	√	x	x	x
	Check the bearing condition using SPM.	x	x	√	x	x	x
	Where bearings are found to be giving abnormal vibrations and noise by SPM, the clearance of the bearings to be measured and balancing of impellers to be checked.	x	x	√	x	x	x
	Check grease nipples for cracks.	x	x	√	x	x	x
	Lubricate motor bearing by approved grease.	x	x	√	x	x	x
	RDPT/ Magnaflux to be done to check any cracks in impeller, dome and foundations.	x	x	√	x	x	x
	Check for abnormal noise, vibration, burning smell.	√	√	√	x	x	x
	Replace MVMT Impeller with duct	x	x	x	x	x	√
4e.	**Major Schedule activities as per Para No. 2.3 of CAMTECH Publication No. CAMTECH/2001/MVMT/1.0, Aug.2001**	x	x	x	√	√	√
5	**Arno converter**						
	Check up tightness of terminal connections and foundation bolts	√	√	√	√	√	√
	Check visually for top circulating ring of rotor and its top position of rotor bars for cracks	x	x	√	√	√	√
	Check the terminals for any overheating marks or insulator breakage, clean them tighten the connections duly ensuring that max. gap should be available with respect to the cable lugs and other terminals.	x	x	√	√	√	√
	Ensure the terminal cover not touching the terminals.	x	x	√	√	√	√
	Grease bearings	x	x	√	√	√	√
	Overhaul	x	x	x	√	√	√

6	**Blower motor for DBR & Aux Compressor**						
	Measure the brushes and replace, if necessary	√	√	√	√		
	Measure spring tension of brush holder and record.	√	√	√	√		
	Check the looseness and cracks of cooling fan blade and lubricate bearings.			√	√		
6a.	**Schedule activities as per para no. 2.1 of CAMTECH publication No. CAMTECH/99/E/CP/1.0, Sep,1999**						
	Clean the compressor thoroughly.	√	√	√	x	x	x
	Check oil level in crankcase. If required replenish with correct grade of oil upto the maximum level.	√	√	√	x	x	x
	Clean oil collecting tray	√	√	√	x	x	x
	Drain inter cooler and after cooler.	√	√	√	x	x	x
	Check operational noise vibration.	√	√	√	x	x	x
	Check tightness of mounting bolts and fasteners.	√	√	√	x	x	x
	Check air leakage at pipelines and safety valve.	√	√	√	x	x	x
	Clean suction filers thoroughly and refill oil to the correct level.	√	√	√	x	x	x
	Replenish coupling spring with correct grade of graphite grease on condition basis.	√	√	√	x	x	x
	Check suction, discharge operations and the general performance of the compressor.	√	√	√	x	x	x
	Dismantle breather valve. Clean it and check for perfect seating of the valve.	x	√	√	x	x	x
	Check the safety valve setting.	x	√	√	x	x	x
	Open up coupling cover to check shaft alignment and ensure that springs are lubricated.	x	√	√	x	x	x
	Coupling grease seal to be checked.	x	√	√	x	x	x
	Remove all the disc valves by removing the cylinder heads, detailed below,	x	x	√	x	x	x
	i. Dismantle the valves.	x	x	√	x	x	x

	ii. Check the springs, top plates and bottom plates for any scratches or damage in the seating of valve plates, lap if any.	x	x	√	x	x	x
	iii. Replace damaged springs.	x	x	√	x	x	x
	iv. De-carbonise and thoroughly clean all parts in kerosene.	x	x	√	x	x	x
	v. Reassemble the valve and assemble it to the cylinder with new packing.	x	x	√	x	x	x
	All the pipelines to be checked for leaks at joints and packing renew as necessary.	x	x	√	x	x	x
	Replenish the coupling spring with correct grade of graphite grease.	x	x	√	x	x	x
	Overhauling & Repair of compressor as per para no. 2.2 & 2.3 of CAMTECH publication No. CAMTECH/99/E/CP/1.0, Sep,1999	x	x	x	√	√	√
IV	**E4 Section**						
1	**Vacuum Circuit Breaker single bottle (22 CB) as per CAMTECH publication No. CAMTECH/E/2007/SVCB/1. 0, Feb,2007**						
1a.	**Insulators**						
	Check visually for cracks, chips, flash marks. If minor damage (chips, small cracks & scratches) found, it can be repaired with epoxy resin. If the damage is more severe, replace the VCB.	√	√	√	x	x	x
	Clean with soft, clean and dry cloth. If necessary, first use a cloth moistened with white spirit, then finish off with dry lint-free cloth.	√	√	√	x	x	x
1b.	**Incoming and outgoing connections of VCB on the roof of the locomotive.**						
	Check visually for any overheating, flash marks and also check the intactness of connections by hand.	√	√	√	x	x	x
1c.	**Air inlet pipe**						

	Check air inlet pipe connections for tightness and proper support.	√	√	√	x	x	x
1d.	**Air dryer**						
	Remove both air connections from the air dryer. Remove the mounting bolts and release air dryer assembly from locomotive.	x	x	√	x	x	x
	Check the weight of air dryer; if it is more than 0.8 kg from the new weight, change/ regenerate molecular sieves.	x	x	√	x	x	x
	Remount air-dryer assembly inside locomotive and reconnect the pneumatic supply connections.	x	x	√	x	x	x
1e.	**Vacuum interrupter**						
	Check the contact travel, New interrupter contacts = 5.8 – 6.4 mm	x	x	x	√	√	√
	With eroded contacts = 8.8 – 9.4 mm						
	Check the mechanism over travel. This should be between 4.0 mm to 4.9 mm, after contacts close.	x	x	x	√	√	√
	Check the soundness of interrupter by applying 60 kV, 50Hz for one minute across incoming & outgoing terminals, in breaker open condition.	x	x	x	√	√	√
	Check the distance of datum line on the moving contact stem from the edge of interrupter body. For new contacts, this gap = 3 mm and for fully worn contact = 0- 1mm, when VCB is closed. Change top insulator & vacuum interrupter assembly with fully worn out contacts.	x	x	x	x	√	√
1f.	**Insulators**						
	Check for cracks, chips, flash marks.	x	x	x	√	√	√
	Clean with soft, clean and dry cloth.	x	x	x	√	√	√
1g.	**Pressure regulator**						
	Check the setting of regulator using a calibrated pressure gauge. This should be set at 5.0-5.2 kg/cm2.	x	x	x	√	√	√

	Dismantle, wipe clean the parts using lintfree cloth moistened with white spirit and blow out the body with clean compressed air. Re-assemble the parts.	x	x	x	√	√	√
	Change all components provided in replacement kit.	x	x	x	x	√	√
1h.	**Pressure switch**						
	Check the setting of pressure switch using a calibrated pressure gauge fitted to pressure regulator. Ensure that the switch: Closes between 4.6-4.75 kg/cm2 & opens between 3.85 – 4.0 kg/cm2.	x	x	x	√	√	√
1i.	**Auxiliary switch**						
	Clean the contacts.	x	x	x	√	√	√
	Check the tightness of all fixing bolts, nuts and connections.	x	x	x	√	√	√
	Check proper operation of contacts.	x	x	x	√	√	√
	Check the contact pressure (crushing).	x	x	x	√	√	√
	Replace complete switch with new one	x	x	x	x	x	√
1j.	**Magnet valve**						
	Check tightness of all connections and fixing screws.	x	x	x	√	√	√
	Check air leakage by operating manually	x	x	x	√	√	√
	Replace all O-rings & 2 nos. valves (fluted)	x	x	x	√	√	√
1k.	**Air filter**						
	Drain off condensate from filter.	x	x	x	√	√	√
	Wash porous filter element with denatured alcohol or kerosene.	x	x	x	√	√	√
	Blow-out body with clean compressed air.	x	x	x	√	√	√
	Wash the bowl with household soap.	x	x	x	√	√	√
	Change all components provided in replacement kit.	x	x	x	√	√	√
1l.	**Surge suppressor (Magnet Valve)**						
	Check its healthiness by applying 110V AC, 50Hz across it. Current shall be between 14.0 to 19.4mA. Replace if not in range.	x	x	x	√	√	√

	Replace old unit with new one.	x	x	x	x	√	√
1m.	**Relay valve**						
	Replace all O-rings & PTFE valve discs.	x	x	x	√	√	√
	Overhaul and lubricate the relay valve.	x	x	x	√	√	√
	Replace old piston seal ring with new one. -	x	x	x	x	√	√
	Replace old poppet valve with new one.	x	x	x	x	x	√
1n.	**Cylinder piston assembly**						
	Overhaul and lubricate the piston and cylinder bore.	x	x	x	√	√	√
	Replace one no. damper assembly.	x	x	x	x	√	√
	Replace old piston seal ring with new one.	x	x	x	x	√	√
1o.	**Air piping**						
	Check for air leakage at all joints.	x	x	x	√	√	√
1p.	**Electrical connections**						
	Check for proper tightness of all electrical connections at terminal strips, magnet valve, pressure switch & auxiliary switch.	x	x	x	√	√	√
1q.	**Lubrication**						
	Lubricate the relay valve assembly, cylinderpiston	x	x	x	√	√	√
	assembly and all piston seal rings/ Orings including those of magnet valve assembly, with silicon grease (Molykote 55M).						
1r.	**Rubber/ PVC iatems**						
	Change all rubber/PVC/SRBC items supplied in the replacement kits.	x	x	x	x	x	√
1s.	**Springs**						
	Change all compressions spring supplied in replacement kit.	x	x	x	√	√	√
1t.	**Complete VCB assembly**						
	Check the closing speed/ timings with the help of contact travel recorder.	x	x	x	√	√	√
	Measure contact resistance of main circuit.	x	x	x	√	√	√
1u.	**Air dryer**						
	Weigh the air dryer. If increase in weight is more than 0.8 kg from the new weight, regenerate by heating in oven.	x	x	x	√	√	√

	Replace old molecular sieves.	x	x	x	x	√	√
1v.	**R-C network**						
	Measure current value across individual R-C network at 415 V AC (50Hz). Value should be between 2.75A to 3.75A. replace if not in range.	x	x	x	√	√	√
2	**Vacuum Circuit (VCB) TYPE 20 CB OF M/S. ALSTOM**	**Schedules as per RDSO SMI NO. RDSO/ELRS/SMI/ 0208-99(REV-0) Dt. 22.03.99**					
2a.	**Vacuum Interrupter**						
	i. Check the distance between cylinder & each of the moving contact assembly connectors with breakers open. The gaps are to be balanced and are of the order of 2 mm each, if the interrupter is sound. If the gap is unequal, HV test as per item (v) is to be conducted.	x	x	x	√	√	√
	ii. Check the distance of datum line on the moving contact stem from the edge of interrupter body. For new contact this gap = 3mm and fully worn contact = 0-1 mm when VCB is closed. Change vacuum interrupter with fully worn-out contacts.	x	x	x	√	√	√
	iii. Check the contact travel. New interrupter contacts = 8-9mm	x	x	x	√	√	√
	With eroded contacts = 11-12mm						
	iv. Check the piston overtravel. This should be 3mm after contacts close.	x	x	x	√	√	√
	v. Check the soundness of interrupter by earthing the VCB base and applying 40kv, 50Hz for 1 minute across each interrupter, in turn.	x	x	x	√	√	√
	vi. Check the soundness of insulation of air pipes and auxiliary contact operating rod inside the vertical porcelain, by applying 40kv, 50Hz for 1 minute between the cradle and base.	x	x	x	√	√	√

	Vii. Replace piston washer, damper washer, insulation tube & insulation washer.	x	x	x	x	x	√
2b.	**Insulator**						
	i. Check for cracks, chips, flash marks.	√	√	√	√	√	√
	ii. Clean with soft, clean and dry cloth.	√	√	√	√	√	√
2c.	**Cradle, Cover and End cap**						
	i. Check that the 4 drain holes are clear (2 Nos. on cradle and 2 nos.on end cap).	√	√	√	√	√	√
	ii. Replace sealing strip on cradle & cover	x	x	x	√	√	√
	iii. Seal the cradle cover using silicone elasto-mer compound as per SMI-161 (Rev-1)	x	x	x	√	√	√
2d.	**Pressure Switch**						
	i. Check that it Closes at 4.65 Kg/ Cm2 Opens at 4.00 kg/cm2	x	x	√	√	√	√
2e.	**Pressure Regulator**						
	i. Check the setting of regulator using a Master pressure gauge. This should be set At 5.0 kg/cm2 (70 p.s.i).	√	√	√	√	√	√
	ii. Dismantle, clean the parts with denatured Alcohol and blow out the body with clean Compressed air. Re-assemble the parts.	x	x	x	√	√	√
	iii. Replace diaphragm provided in AOH kit.	x	x	x	x	x	x
	iv. Replace all components provided in replacement kit.	x	x	x	√	√	√
2f.	**Auxiliary Switch**						
	i. Clean the contacts.	x	x	√	√	√	√
	ii Check the tightness of all fixing bolts, nuts and connections.	x	x	√	√	√	√
	iii. Check the proper operation of contacts.	x	x	√	√	√	√
	iv. Replace worn out contacts.	x	x	x	√	√	x
	v. Replace complete auxiliary switch assembly	x	x	x	x	x	√
2g.	**Air Filter**						
	i. Porous filter element to be washed with denatured alcohol.	x	x	x	x	√	√
	ii. Blow-out with clean compressed air.	x	x	x	x	√	√

	iii. Wash out with clean compressed air.	x	x	x	x	√	√
	iv. change all components provided in replacement kit.	x	x	x	x	√	√
2h.	**Magnet Valve**						
	i. Check the tightness of all components and fixing screws.	x	x	x	x	√	√
	ii. Check the air leakage when operated manually.	x	x	x	√	√	√
2i.	**Relay Valve**						
	i. Replace 2 nos. PTFE valve discs.	x	x	x	x	√	√
	ii. Overhaul and lubricate the relay valve as per SMI-162 Rev-1.	x	x	x	x	√	√
	iii. Replace poppet valve provided in POH kit.	x	x	x	x	x	√
2j.	**Air Reservoir**						
	i. Check the condition of dessicant. If color Changed from blue to pink, replace the Silicagel. Also weigh the air dryer.	x	x	x	√	√	√
2k.	**Air Dryer**						
	i. Weigh the air dryer. If increase in weight is more than 0.8kg from new weight, replace molecular sieve or regenerate by heating as per SMI-137.	x	x	√	√	√	√
	ii. Replace molecular sieves with fresh ones.	x	x	x	x	x	√
2l.	**Electrical Connections.**						
	i. Check for proper tightness.	x	x	√	√	√	√
	ii. Check the condition and tightness of end connection of the flexible connector (shunt provided between two interrupters).	x	x	x	√	√	√
	iii. Check the condition of fixed contact end connectors. Fit new ones, if necessary.	x	x	x	√	√	√
2m.	**Air Connections**						
	After opening cradle cover and base plate Cover, i. Check for proper air piping.	x	x	x	√	√	√
	ii. Check for air leakage from the exhaust port of air control valve and from manifold port, by operating magnet valve manually.	x	x	x	√	√	√

	iii. Check for air leakage, at all joints.	x	x	x	√	√	√
	iv. Measure air leakage at 6.5 kg/cm2 for 10 minutes in open and close position of breaker. Pressure should not decrease by more than 10% of the net value.	x	x	x	√	√	√
	v. Replace Control & Main Air Pipes in IOH kit.	x	x	x	x	√	√
	vi. Replace all nylon air pipes in POH kit.	x	x	x	x	x	√
2n.	**Surge Suppressor (Magnet Valve)**						
	i. Check its healthiness by applying 110v AC, 50Hz across it. Current shall be Between 14.0 to 19.4 mA. Replace if not In range.	x	x	x	√	√	√
	ii. Replace the surge suppressor unit.	x	x	x	x	x	x
2o.	**Operating Rod Assembly**						
	i. Check that collar, pin and operating lever bonded at ends of rod is not loose.	x	x	x	√	√	√
	ii. Replace operating rod assembly.	x	x	x	x	x	√
2p.	**R-C Network**						
	i. Measure current value across individual R-C network at 380V AC(50Hz). Value should be between 2.5A to 3.5A. Replace if not in range.	x	x	x	√	√	√
2q.	**Lubrication**						
	i. lubricate air cylinder by injecting grease through its small hole, when relay valve is removed, as per SMI-162 Rev-1.	x	x	x	√	√	√
2r.	**Rubber Components**						
	i. Replace all rubber kit items.	x	x	x	√	√	√
	ii. Replace other rubber items not covered in rubber kit.	x	x	x	x	x	√
2s.	**Complete V.C.B Assembly**						
	i. Check the closing speed with the help of contact travel recorder as per SMI-136.	x	x	x	√	√	√

3. Schedule activities of M/s. AAL & M/s. BTIL make VCB (As per OEM manual)

SN	Work to be carried out	IA	IB	IC	TOH	IOH	POH
3.a	Insulators						
	Check for cracks & flash marks.	√	√	√	√	√	
	Clean any parts that are dirty with soft, clean & dry cloth (Do not use cleaning products based on fluorated or chlorated compounds or sodium metasilicate).	√	√	√	√	√	
3.b	Connection for Earthing Isolator						
	Check for damage to connection of the earthing isolator.	√	√	√	√	√	
	Cleaning & greasing, if necessary.	√	√	√	√	√	
3.c	H.V Connection						
	Check the tightening torque 70Nm	x	√	√	√	√	
3.d	VCB fixing screw						
	Check the torque of fixing screw tightening torque 70Nm	x	√	√	√	√	
3.e	Earthing connection						
	Check the earthing connection tightening torque 70Nm	x	√	√	√	√	
3.f	Pressure Regulator						
	Drain the pressure regulator	√	√	√	√	√	
	Check and set value of the regulator (for AAL make)	x	x	x	√	√	
	Check and set value of the regulator (for BTIL make)	x	x	x	√	x	
	Change the filter cartridge with O-ring	x	x	x	√	√	
	Change the complete pressure regulator (for BTIL make)	x	x	x	x	√	
3.g	Air tank (Reservoir)						
	Drain the air tank	x	√	√	√	√	
	Check for any air leakage in VCB	x	√	√	√	√	
	Carry out sealing test for Air tank assembly	x	x	x	√	√	
3.h	Pneumatic Circuit						
	Check the sealing of connectors, flexible pipe, regulator, air tank etc.	x	√	√	√	√	
3.i	Auxiliary Switch (only for AAL make)						
	Check screw for breakage or other damage	x	x	x	√	√	
	Check the moving contact for its continuity	x	x	x	√	√	
	Check the cables and lugs for broken cables, lugs looseness	x	x	x	√	√	
	Securing of auxiliary switch and support plate (Tightening torque-10Nm)	x	x	x	√	√	
	Check the working order of each auxiliary contacts	x	x	x	√	√	
3.j	Auxiliary Switch (only for BTIL make)						
	Change both the Auxiliary switches	x	x	x	x	√	
3.k	Vacuum Switch tube (VST)						
	Check the healthiness of VST (Di-electric test 40kV for 10sec)	x	x	x	√	√	

	Check closing & opening speed (First after 3 years on new breaker & then every major schedule)	x	x	x	√	√	
	Inspections of main contacts wear in vacuum switch tube. First after 3 years on new breaker & then every major schedule.	x	x	x	√	√	
3.l	Shocks Absorber (for BTIL make)						
	Check the tightness of shock absorbers. If found loose tighten with proper torque (10Nm)	x	x	√	√	√	
	Change the shock absorber.	x	x	x	x	√	
3.m	Cabling & Connector						
	Check for any damages, cut & tightness of the connectors, connection, pins etc including pressure switch, EP valve solenoid coil and connector	x	x	√	√	√	
3.n	Air Flow Rod & Shoulder Head Screw (for BTIL make)						
	Check for movement of rod	x	x	√	√	√	
	Check for healthiness of shoulder srew	x	x	√	√	√	
	Chane the driving plate with shoulder screw	x	x	x	x	√	
3.o	Toggle Mechanism (for BTIL make)						
	Check proper fixing/ sticking of Thrust pur and shock absorber plate provided below toggle mechanism.	x	x	x	√	x	
	Change the Trust Pur and shock absorber plate.	x	x	x	x	√	
3.p	Cylinder Mounting Plate (for AAL make)						
	Check proper fixing/ sticking of shock absorber plate	x	x	x	√	x	
	Change the shock absorber plate	x	x	x	x	√	
3.q	Piston Assy (for AAL make)						
	Check air leakage	x	x	x	√	x	
	Replace piston seal	x	x	x	x	√	
	Check compression springs	x	x	x	x	√	
3.r	Side cover/ lateral cover						
	Change the kit of O-ring of side cover (First time after 3 years and then every major schedule)	x	x	x	√	√	
3.s	EP valve solenoid coil (for AAL make)						
	Check the healthiness of EP valve coil resistance 1510Ω±8% at 35°C	x	x	x	√	√	
3.t	Magnetic coils (for BTIL make)						
	Check the resistance of holding coil 66.2Ω±8% at 35°C	x	x	x	√	√	
	Check the healthiness of EV coil for open or short	x	x	x	√	√	
3.u	Pressure Switch						
	Check the setting of pressure switch	x	x	x	√	x	
	Check the tightness of pneumatic connection	x	x	√	√	√	
	Replace pressure switch	x	x	x	x	√	
3.v	Electronic Control unit (for BTIL make)						
	Check closing time, opening time, EV on time & counter operation	x	x	x	√	√	

3.w	Contact Spring						
	Check contact spring	√	√	√	√	√	
	Replace contact spring	x	x	x	x	√	
3.x	Lubrication (forAAL make)						
	Lubricate driving plate assy	x	x	x	√	√	
	Lubricate shafting head bearing guides, vertical spring, flexible braids, piston seal, piston rod and EP valve	x	x	x	√	√	
3.y	Lubrication (for BTIL make)						
	Lubricate toggle mechanism, airflow regulator rod	x	x	x	√	√	
	Lubricate shafting head bearing guides, vertical spring, flexible braids, First after 3 years of new breaker & then every	x	x	x	√	√	
3.z	Torque Tightening						
	Check rear flange- 19.3Nm	x	x	x	√	√	
	Check shafting head- 67Nm	x	x	x	√	√	
	Check vertical insulator- 67Nm	x	x	x	√	√	
	Check tightness of nuts of base plate- 15Nm	x	x	x	x	√	
	Check bolts of cover for holding cylinder- 39.4Nm (AAL) & 15Nm (BTIL)	x	x	x	√	√	
	Check air tank mounting nuts- 15Nm	x	x	x	√	√	
3.a a	Air Dryer						
	Weigh the air dryer. If increase in weight is more than 0.8kg from new weight, regenerate molecular sieves by heating and replace if required.	x	x	√	√	x	
	Replace molecular sieves	x	x	x	x	√	
3.a b	RC Network						
	Measure individual resistance and capacitance value 4.7Ω±10% and 25µF±10%. Replace abnormal components.	x	x	x	√	√	
3.a c	Testing						
	High voltage test for HT section & LT section	x	x	x	√	√	√

Major Schedule Replacement kit of Vacuum Circuit Breaker

Replacement kit for Single bottle VCB Of M/s AAL Type BVAC 25.10							
SN	**Description**	**Part No.**	**Unit**	**Qty/ VCB**	**TOH**	**IOH**	**POH**
1.	PRESSURE REGULATOR KIT	SG-300140-R 0001		1	√	√	√
1.1	Filter Element (40µm)	4300014000	Nos.	1	√	√	√
1.2	'O' Ring	69.211.215	Nos.	1	√	√	√
2.0	KIT OF O-RING FOR LATERAL COVER	SG300141R 0001		1	x	√	√
2.1	O-Ring	HSBA432579P0001	Nos.	2	x	√	√
2.2	Anti Breaking screw M6X20	SG300120 P0001	Nos.	8	x	√	√
2.3	Elastic washer (ø 6.1)	9AVA 330-11	Nos.	8	x	√	√
3.0	PRESSURE SWITCH KIT	SG-300146 R0001		1	x	√	√
3.1	Pressure Switch	HSBA432553 P0001	Nos.	1	x	√	√
3.2	Union Bend 90º	SG-300067 P0001	Nos.	1	x	√	√
4.0	MOLECULAR SIEVES IN KG	4320010700	Kgs.	4	x	√	√
5.0	O-RING	HSBA432095 P0025	Nos.	1	x	√	√
6.0	O-RING	HSBA432095 P0028	Nos.	1	x	√	√
7.0	O-RING	HSBA432095 P0027	Nos.	1	x	√	√
8.0	O-RING	HSBA432095 P0026	Nos.	1	x	√	√
9.0	Flat Gasket	HSBA432551P0002	Nos.	1	x	√	√
10.0	ELASTIC WASHER (ø 8.2)	9AVA 330-4	Nos.	4	x	√	√
11.0	ELASTIC WASHER (ø 8.2)	9AVA 330-12	Nos.	4	x	√	√
12.0	Elastic washer (ø 4.1)	9AVA 330-100	Nos.	8	x	√	√
13.0	RING TYPE JOINT	HSBA432577 P0001	Nos.	1	x	√	√
14.0	Thrust Pur	SG300157P0001	Nos.	1	x	√	√
15.0	Shock Absorber Plate	HSBA432426P0001	Nos.	1	x	√	√
16.0	Tension Spring	HSBA433308 P0001	Nos.	2	x	√	√
17.0	Driving plate for toggle joint	HSBA331410P0001	Nos.	1	x	√	√
18.0	Shouldered Screw	HSBA432548P0001	Nos.	1	x	√	√
2.0	Valve Cone			1	x	x	√
3.0	Diaphragm assembly			1	x	x	√
4.0	AUXILIARY SWITCH COMPLETE	SG-300138R0001	Nos.	1	x	x	√
5.0	AUXILIARY SWITCH COMPLETE	SG300139 R0001	Nos.	1	x	x	√

6.0	O-RING	HSBA432095P002 7	Nos.	1	x	x	√
7.0	Auxiliary Drive Screw	HSBA433491 P0001	Nos.	2	x	x	√
8.0	O-RING (sealing)	HSBA432580 P0002	Nos.	1	x	x	√
9.0	ELASTIC WASHER ø 12.4	9AVA330-6	Nos.	14	x	x	√
10.0	ELASTIC WASHER ø 8.2	9AVA330-4	Nos.	4	x	x	√
11.0	ELASTIC WASHER ø 8.2	9AVA330-12	Nos.	22	x	x	√
12.0	Spring washer ø 8.2	NB335805 P0511	Nos.	2	x	x	√
13.0	Lock Nut M4	9ADA 299-2	Nos.	4	x	x	√
14.0	Elastic Washer ø 4.1	9AVA 330-100	Nos.	7	x	x	√
15.0	Flange Screw M5 X 12	HSBA433531 P0002	Nos.	2	x	x	√
16.0	RING BS	SG300073 P0002	Nos.	1	x	x	√
17.0	O-RING	HSBA432095 P0020	Nos.	2	x	x	√
18.0	O-RING	HSBA432095 P0026	Nos.	1	x	x	√
19.0	O-RING	HSBA432580 P0001	Nos.	1	x	x	√
20.0	O-RING	HSBA432579 P0002	Nos.	1	x	x	√
21.0	Lock Nut M6	9ADA 299-4	Nos.	4	x	x	√
22.0	Cap Male	HSBA432531P000 1	Nos.	3	x	x	√
23.0	TANK FLAT GASKET	HSBA432550 P0001	Nos.	2	x	x	√
24.0	RING BS	SG300073 P0003	Nos.	1	x	x	√
25.0	O-ring for solenoid valve		Nos.	1	x	x	√

Replacement Kit for Single Bottle VCB of M/s BT Type BVAC 25.10							
SN	**Description**	**Drawing no.**	**Part No.**	**Qty/ VCB**	**TOH**	**IOH**	**POH**
1.	PRESSURE REGULATOR KIT	SG-300140-R1		1	√	√	√
1.1	Filter Element (40µm)	3EYC-400147-P1	80.16.1	1	√	√	√
1.2	'O' Ring	3EYC-400148-P1	80.16.2	1	√	√	√
2.0	Pressure switch kit	SG-300146-R1		1	x	√	√
2.1	Pressure Switch	HSBA-432553-P1	80.9	1	x	√	√
2.2	Taper Stud with Coupling	SG-300067-R1	80.8	1	x	√	√
3.0	Kit of 'O' ring for lateral cover		40.4		x	√	√
3.1	O-ring	HSBA-432579-P1	290	2	x	√	√
3.2	Anti breaking screw	SG-300120-P1	1300	8	x	√	√
3.3	Elastic washer (6.1)	9AVA 330-11	310.13	8	x	√	√
4.0	Flat gasket	HSBA-432551-P2	141	1	x	√	√
5.0	RUBBER STOP (THRUST PUR)	SG-300157-P1	40.15	1	x	√	√
6.0	SHOCK ABSORBER PLATE	HSBA-432426-P1	40.13	1	x	√	√
7.0	O-RING	HSBA-432095- P27	110	1	x	√	√
8.0	O-RING	HSBA-432095- P25	131	1	x	√	√
9.0	O-RING	HSBA-432095- P28	132	1	x	√	√
10.0	O-RING	HSBA-432095- P26	90	1	x	√	√
11.0	ELASTIC WASHER (8.2)	9AVA 330-12	1085	4	x	√	√
12.0	ELASTIC WASHER (8.2)	9AVA 330-4	1084	4	x	√	√
13.0	RING TYPE JOINT	HSBA-432577-P1	10.3	1	x	√	√
14.0	ELASTIC WASHER (4.1)	9AVA 330-100	1211	8	x	√	√
15.0	MOLECULAR SIEVES IN KG	3EC-400100-P18	4001.3.1	4	x	√	√
16.0	Tension spring	HSBA-433308-P1	205	2	x	√	√
17.0	Drive plate	HSBA-331410-P1	40.4	1	x	√	√
18.0	Shouldered screw	HSBA-432548-P1	40.11	1	x	√	√
2.0	AUXILIARY CONTACT KIT (NO TYPE)	SG-300138-R1		1	x	x	√
2.1	Auxiliary Contact BA19(5NO)	SG-300016-R1	210	1	x	x	√

2.2	Pusher	HSBA-433315-P1	203	1	x	x	√
2.3	Elastic Washer Dia 4.1	9AVA 330-100	1211	2	x	x	√
2.4	Hex Screw M 4x30	3EYC-400126-P9	1210	2	x	x	√
2.5	Lock Nut M4	9ADA 299-2	1201	2	x	x	√
3.0	AUXILIARY CONTACT KIT (NC TYPE)	SG-300139-R1		1	x	x	√
3.1	Auxiliary Contact BA24 (5NC)	SG-300016-R2	211	1	x	x	√
3.2	Pusher	HSBA-433315-P1	203	1	x	x	√
3.3	Elastic Washer Dia 4.1	9AVA-330-100	1211	4	x	x	√
3.4	Hex Screw M 4x30	3EYC-400126-P9	1210	2	x	x	√
3.5	Lock Nut M4	9ADA 299-2	1201	2	x	x	√
4.0	KIT OF SOLENOID VALVE (SET OF O-RINGS)			1	x	x	√
5.0	Diaphragm assembly for pressure regulator		80.16.3	1	x	x	√
6.0	Valve cone for pressure regulator		80.16.4	1	x	x	√
7.0	Drive Screw	HSBA-433491-P1	202	2	x	x	√
8.0	NYLOC NUT M6	9ADA-299-4	40.101	4	x	x	√
9.0	Lock nut M4	9ADA-299-2	40.102,1201	6	x	x	√
10.0	CAP G 3/8	HSBA-432531-P1	80.24,320	3	x	x	√
11.0	ELASTIC WASHER DIA 12.4	9AVA-330-6	1011/160.19/ 260.12/1011/ 260.19	14	x	x	√
12.0	ELASTIC WASHER DIA 8.2	9AVA-330-12	260.16/1085	18	x	x	√
13.0	ELASTIC WASHER DIA 6.1	9AVA-330-11	40.103	8	x	x	√
14.0	Elastic Washer M4	9AVA 330-100	1211	8	x	x	√
15.0	Spring washer	NB-335805-P511	260.14,1121	4	x	x	√
16.0	Flange screw M5X12	HSBA-433531-P2	1230	2	x	x	√
17.0	TANK S FLAT GASKET	HSBA-432550-P1	80.22	2	x	x	√
18.0	PACKING RING	SG-300073-P3	80.26	1	x	x	√

19.0	PACKING RING	SG-300073-P2	80.15, 80.110	3	x	x	√
20.0	O-RING	HSBA-432095- P20	80.19	2	x	x	√
21.0	O-RING	HSBA-432095- P27	PIPE SIDE	1	x	x	√
22.0	O-RING	HSBA-432095- P26	110	1	x	x	√
23.0	O-RING	HSBA-432579-P2	260.9	1	x	x	√
24.0	O-RING	HSBA-432580-P1	260.6	1	x	x	√
25.0	O-RING	HSBA-432580-P2	261	1	x	x	√

Replacement Kit For Single Bottle VCB Of M/s ALSTOM Type 22CB							
Sl. No	**Title / Description**	**Drawing Number**	**Part Number**	**Qty./ VCB**	**TOH**	**IOH**	**POH**
1.	AOH replacement kit consisting of :	--	5510740				
	a- 'O' Ring for magnet valve assembly	LSC : 58/5	5260700	3	√	√	√
	b- 'O' Ring for magnet valve assembly	LSC : 58/6	5260800	2	√	√	√
	c- Valve (fluted) for magnet valve	LSC : 127	5260600	2	√	√	√
	d- 'O' Ring for Relay valve and reducer	LSC : 612 / 4	5570080	2	√	√	√
	e- 'O' Ring for relay valve assembly	LSC : 612 / 2	5570090	1	√	√	√
	f- 'O' Ring for relay valve assembly	LSC : 612 / 1	5570100	1	√	√	√
	g- 'O' Ring for relay valve assembly	LSC : 612 / 5	5570110	1	√	√	√
	h- PTFE valve discs for relay valve	LSC : 99	5150020	2	√	√	√
	i- Special washer for main Piston	LSC : 554	5540060	1	√	√	√
	j- Special washer for bottom cover	LSC : 612 / 6	5510163	8	√	√	√
	k- Retaining Ring for bottom cover	LSC : 678	5510164	8	√	√	√
	l- Diaphragm Assembly for Pressure Regulator	-	3410-55	1	√	√	√
	m- Repair kit for air filter consisting of one O-ring, two Gaskets and one Stud.	-	5110600	1 kit	√	√	√
2.	IOH replacement kit consisting of :	--	5510750		x	√	√
	a- AOH replacement kit	-	5510740	1 kit	x	√	√
	b- Grommet for base plate	LSD:238	5380650	1	x	√	√

	c- O ring (between flanges)	LSC: 612/3	5510390	1	x	√	√
	d- Selon washer (for plug of cylinder)	-	5510450	1	x	√	√
	e- Gasket for base plate	LSC:702	5510810	1	x	√	√
	f- Sealing strip for bottom cover	-	5510162	2.3 mt.	x	√	√
	g- Damper assembly for cylinder	LSC:549	5540030	1	x	√	√
	h- Piston seal ring for relay valve piston	LSC: 612/7	5570050	1	x	√	√
	i- Piston seal ring for main piston	LSC: 612/8	5540023	1	x	√	√
	j- Repair kit for pressure regulator consisting of one no. each, slip ring, valve, valve seat, gasket seat & valve spring.	-	5110422	1kit	x	√	√
	k- Molecular sieves for Air Dryer	-	5390090	4 Kg	x	√	√
	L- Surge suppressor for magnet valve assembly*	LSC: 169	5350100	1	x	√	√
	a- IOH replacement kit	-	5510750	1 kit	x	x	√
	b- Belleville washer M6	-	5520200	6	x	x	√
	c- Auxiliary contact unit (8-way)	LSC: 286/A	5203400	1	x	x	√
	d- Compression springs for Magnet valve assembly.	LSD: 128	5260900	2	x	x	√
	e- Surge suppressor for magnet valve assembly	LSC: 169	5350100	1	x	x	√
	f- Poppet valve for relay valve assembly	LSC: 101	5150010	1	x	x	√
	g- Compression spring for relay valve assembly	LSC: 186	5150090	1	x	x	√
	h- Compression spring interrupter mechanism	LSC: 525	5520130	6	x	x	√
	i- Compressor spring interrupter mechanism	LSC: 528	5520180	6	x	x	√

Replacement Kit For Single Bottle VCB Of M/s ALSTOM Type 22CB							
S. N	**Title/ Description**	**Drg.No**	**Part.No**	**Qty/ VCB**	**AOH**	**IOH**	**POH**
1	AOH Replacement kit (Code. No. 5110610)	--	--	--	√	√	√
a.	Sealing strip for cradle and cover	--	5380750	3mts	√	√	√
b.	O-ring Air valve Assembly	LSC:58/4	5150070	1	√	√	√
c.	O-ring AZir valve Assembly	LSC:58/3	5150080	3	√	√	√
d.	PTFE Valve Discs for Air valve Assly.	LSC:99	5150020	2	√	√	√
e.	O-ring for magnet valve & manifold	LSC:58/5	5260700	5	√	√	√
f.	O-ring for Magnet Valve Assembly	LSC:58/6	5260800	2	√	√	√
g.	Valve (fluted) for Magnet Valve	LSC:127	5260600	2	√	√	√
h.	O-ring for Reservoir Assembly	LSC:58/2	5142040	1	√	√	√
i.	Molygraf-44 Grease	--	86700233	1 Tube	√	√	√
j.	Diaphragm Assly for pressure regulator	--	3410-55	1	√	√	√
k.	Replacement kit for air filter consisting of one O-ring, two gaskets & one stud.	--	5110600	1Set	√	√	√
1	IOH Replacement kit (Code. No.5110620) consisting of :	--	--	--	√	√	√
a.	AOH Replacement kit	--	5110610	1 kit	x	√	√
b.	Control air pipe with grommet, ferrule & nut	LSB:89/1	5110110	1	x	√	√
c.	Main air pipe with grommet, ferrule & nut	LSB:89/2	5110100	1	x	√	√
d.	Repair kit for pressure regulator consisting of one number each, slip ring, valve, valve seat, gasket seat & valve spring.	--	5110442	1 kit	x	√	√
e.	Molecular sieves for air dryer	--	5390090	4 kg	x	√	√
1	POH Replacement kit (Code.No. 5110630) consisting of:	--	--	--	x	x	√
a.	IOH replacement kit	--	5110620	1 kit	x	x	√
b.	Piston washer (ring)	LSC:76	5120100	2	x	x	√
c.	Damping washer	LSC:81/1	5120030	2	x	x	√
d.	Insulation tube	LSC:74	5120050	6	x	x	√
e.	Insulation washer	LSC:81/2	5120040	12	x	x	√
f.	Air pipe (Filter to regulator)	LSC:88/4	5110210	1	x	x	√
g.	Air pipe (Regulator to reservoir)	LSC:88/3	5110060	1	x	x	√

h.	Air pipe (Reservoir to unequal-cross)	LSB:93/5	5110050	1	x	x	√
i.	Air pipe (Pressure switch)	LSC:88/2	5110080	1	x	x	√
j.	Air pipe (Manifold to unequal-cross)	LSC:88/1	5110070	1	x	x	√
k.	Poppet valve for air valve assembly	LSC:101	5150010	1	x	x	√
l.	Operating rod assembly	LSC:62	5160000	1	x	x	√
m.	Auxiliary switch assembly (6- way)	LSC:255	5203200	1	x	x	√
n.	Surge suppressor for magnet valve	LSC:169	5350100	1	x	x	√
o.	Sealing strip for bottom cover	LSC:104	5290020	2.5Mts	x	x	√
p.	O-ring for Reservoir assembly	LSC:58/1	5140020	2	x	x	√

Sl. no	Activity	IA	IB	IC	TOH	IOH	POH
4	**General purpose relay: Schedule activities as per para no. 2.0 of CAMTECH publication No. CAMTECH/2001/E/F&R/1.0, March,2001**						
4a.	**Auxiliary contacts:**						
	Check contact, contact pressure and wipe	√	√	√	√		
	Visually examine and clean contacts, terminals and contact support, bus bar connectors	√	√	√	√		
	Check and tighten all wiring terminals		√	√	√		
	Check hardware for tightness		√	√	√		
	Check proper alignment and bedding of contacts			√	√		
4b.	**Coil:**						
	Check coil for Electrical or Mechanical damage.		√	√	√		
	Dusting - all relay parts	√	√	√	√		
4c.	**Bolts, nuts, screws and wiring terminals**						
	Tighten the nuts and fixing screws	√	√	√	√		
4d.	**Time delay relay**						
	Check the time setting and operation	√	√	√	√		
	Overhaul all relays and test				√		
5.	**Earth Fault Relays as per CAMTECH publication No. CAMTECH/E/2006/TP-EFR/1.0, March,2006**						
	Following tests should be carried out before and after inspection of a locomotives during L.T. testing (with 25 kV supply off). Test functioning of Auxiliary circuit earth relay (QOA) by creating an earth fault. Test functioning of power circuit earth relay QOP1 & 2 by creating an earth fault.	√	√	√	√	x	x

	Check all relays (QOP 1 & 2, QOA) for proper fitment and seal. If seal is found in broken condition, relay to be checked and calibrated and to be sealed.	√	√	√	√	x	x
	Check resistances (RQOP1&2, RPQOP1&2, RQOA, RPQOA) for any crack and overheated marks.	√	√	√	√	x	x
	Tighten the nuts and fixing screws of wiring terminals from back side (In IC schedule only).	√	√	√	√	x	x
	Check and clean resistances (RQOP1&2, RPQOP 1&2, RQOA, RPQOA) for any abnormality.	x	x	x	√	x	x
	Check connection tightness of all resistance terminals and their lug crimping for any looseness.	x	x	x	√	x	x
	Overhauling of Relays. Guidelines for overhauling to be followed as per CAMTECH Publication no. CAMTECH/E/2006/TP-EFR/1.0 March'2016	x	x	x	x	√	√
6	**HOM**						
	Check operation	x	√	√	√	√	
	Clean and lubricate	x	√	√	√	√	
	Replace HOM Air valve	x	x	x	x	x	√
V	**M3 Section**						
1	**Pantograph AM12, AM-92 & IR-03H (High Speed)**						
	Replace Bow assembly with plunger	x	x	x	x	x	√
	Periodic Maintenance/Checks For Pantograph AM12, AM-92 & IR-03H (High Speed)	As per RDSO Technical Audit Report No. RDSO/2016/EL/TAR/0006, Rev '0' Dt. May'2016					
2	**VESA, VEPT, VEF**						
	Overhaul throttle valve VEPT, VESA & VEF				√		
	Check for any air leak in the pipe line	√	√	√	√		
3	**A9/SA9**						
	Overhaul and check the free operation			√	√		
4	**Drain/ Isolating cocks**						
	Check for free movements, replace if necessary.			√	√	√	
5	**Non-return valves, reducing valves and check valves**						
	Clean and check the function		√	√	√		
	Overhaul and replace gaskets				√		
6	**Wiper and servomotor**						
	Check operation	√	√	√	√		
	Overhaul servomotor			√	√		
7	**CP and CPA**						
	Check foundation bolts, fan and its blade and clean the equipment and tray	√	√	√	√	√	
	Check coupling and lubricate	√	√	√	√	√	

	Check intercooler, after cooler			√	√	√	
	Check drain pipe of trays and suction pipe	√	√	√	√	√	
	Lubricate bearings			√	√	√	
	Overhaul				√	√	
8	**DJ non-return valve**						
	Overhaul			√	√		
9	**DJ pneumatic connections**						
	Check for leakage	√	√	√	√		
10	**Safety valves**						
	Overhaul and adjust setting			√	√		
11	**Sanding valves**						
	Overhaul	√	√				
12	**F1, , MU-2B**						
	Distributor valve	√	√	√	√		
	Checks function				√		
	Overhaul	√	√	√	√		
13	**Overhaul all valves and replace gaskets, match seating**				√		
14	**Horns and Horn valves**						
	Check diaphragm 'O' ring and rubber seat			√	√		
	Overhaul and replace rubber components				√		
	Replace Diaphragm for horns with horn valve	x	x	x	x	x	√
15	**Gauges**						
	Check all gauges	√	√	√	√		
	Overhaul and calibrate				√		
16	**Pneumatic Valves**						
	Overhauling checks and Tests	As per CAMTECH publication No. CAMTECH/E/2007/SVCB/1.0, Feb,2007					
VI	**Section M1**						
	Maintenance of Flexicoil Bogie (WAP1/WAP4)	Schedule activities as per para no. 2.2 of CAMTECH publication No. CAMTECH/2002/E/Bogie/1.0, May,2002					
1.	**Bogie and Bolster**						
	Cleaning of bogie frame	x	x	√	√	√	
	Thorough cleaning of bogie frame in washing tank	x	x	x	x	√	
	Cleaning and painting	x	x	x	√	√	
	Examine for defective and missing parts and cracks Bolster - I and II Bogie frame I and II	√	√	√	√	√	
	Check bolster liner. Provide if deficient.	√	√	√	√	√	
	Overhaul Bogie frame and bolster	x	x	x	√	√	
	Check bogie squareness	x	x	x	x	√	
1a.	**Bogie Pivot**						
	Check centre pivot housing for cracks.	x	x	√	√	√	
	Check proper sizes and clearances	x	x	x	√	√	
1b.	**TM Nose Suspension**						
	Check condition of nose suspension bolts etc.	√	√	√	√	√	

	Provide overhauled nose pad	x	x	x	√	√	
	Check for wear on bogie lug wear plate	√	√	√	√	√	
	Ensure intactness of pins of nose suspension	√	√	√	√	√	
	Check clearance between nose pad and TM lug.	x	x	x	√	√	
1c.	**Adaptors and Liner bolts**						
	Check, all adaptors and adaptor liners. Replace if worn out.	√	√	√	√	√	
	Provide modified adaptors.	x	x	x	√	√	
1d.	**Brake Gear**						
	Overhaul	x	x	x	√	√	
	Check the brake shoe and change if required.	√	√	√	√	√	
	Check brake assembly for loose, missing and worn-out parts.	√	√	√	√	√	
	Check trunion assembly. Replace if worn-out.	√	√	√	√	√	
	Check connection strap of both outside and inside for wear etc.	√	√	√	√	√	
	Change if worn out more than 1.5 mm.						
	Check proper fitment of backside long bolt.	√	√	√	√	√	
	Check lock hinge after brake block changing	√	√	√	√	√	
	Ensure 10-mm gap between wheel and brake block.	√	√	√	√	√	
	Check the fitment of bolts for brake cylinders.	√	√	√	√	√	
	Check inside hanger. Replace if worn out	√	√	√	√	√	
	Ensure double 'J' bracket over connection strap.	√	√	√	√	√	
	Ensure safety sling on flange and connection straps.	√	√	√	√	√	
1e.	**Hand Brake**						
	Clean the hand brake parts and check for tightness of bolts.	√	√	√	√	√	
	Check and ensure its working.	√	√	√	√	√	
	Lubricate and adjust as necessary.	√	√	√	√	√	
1f.	**Outer Hangers**						
	Overhaul	x	x	x	√	√	
	Check condition of outer hanger	√	√	√	√	√	
	Uncouple the hanger pins. Check for groove, worn out and refitted properly.	x	x	√	√	√	
	Check hanger bush before fitting. Repair the pin hole if found oval.	x	x	√	√	√	
	Provide safety bracket.	x	x	√	√	√	
1g.	**Suspension Spring**						
	Check all primary and secondary springs for breakage if any.	√	√	√	√	√	
	Clean with brush don't scrape.	x	x	x	√	√	
	Dimensional check and pairing by colour coding and record	x	x	x	√	√	
1h.	**Safety plates**						
	Check tightness of all safety plate bolts. Attend if found loose	√	√	√	√	√	

1i.	**Buffer Height**						
	Check and record buffer height of the locomotive at both ends. Adjust if Required.	√	√	√	√	√	
1j.	**Axle Boxes**						
	Check grease condition.	x	x	√	√	√	
	Check the fixation screw of bearing end plate.	x	x	√	√	√	
	Remove old grease. Replace with fresh.	x	x	√	√	√	
	Check lateral and longitudinal clearances between axle boxes and pedestal horn liner.	x	x	√	√	√	
	Check the condition of liners for welding and replace, if necessary.	√	√	√	√	√	
	Check and ensure proper fixation of front covers.	√	√	√	√	√	
	Check proper tightness of stay plate.	√	√	√	√	√	
	Overhaul axle boxes.	x	x	x	x	√	
1k.	**Wheel and Axle**						
	Check wheel for crack, other defects and overheating signs	√	√	√	√	√	
	Measure and record flange wear, root wear, tread wear, wheel diameter. Re-profile, if necessary.	x	x	√	√	√	
	Ultrasonic testing of axle to be done.	x	x	√	√	√	
	Measure wheel gauge.	x	x	√	√	√	
	Check and record all dimensions of axle.	x	x	x	√	√	
1l.	**Gear Case**						
	Check for any damage to felt seal, crackness etc.	√	√	√	√	√	
	Ensure provision of strengthening plate over gear case boss.	√	√	√	√	√	
	Checks for leakage of oil SC- 170.	√	√	√	√	√	
	Check and ensure proper tightness and locking of gear case bolts. Torque values for M20 25 kg-m M30 55 kg-m.	√	√	√	√	√	
	Check oil level in gear case. Top up, if necessary and provide cap.	√	√	√	√	√	
	Overhaul – Passenger locos	x	x	x	√	x	x
	Replace - Passenger locos	x	x	x	x	√	√
	Overhaul – Goods locos	x	x	x	√	√	x
	Replace - Goods locos	x	x	x	x	x	√
2.	**Inspection schedule of Maintenance for WAM4/WAG5/WCG2/WCAM 1 locos provided with Co-Co trimount Bogies as per SMI No. 194 Dt. 14.01.1998**						
2a.	**Equaliser Tie Pin**						
	Check for breakage/cracks of pin head	√	√	√	√	√	√
	Check for cotter pin condition	√	√	√	√	√	√
	Remove the tie pin Check for visual cracks and get it Zyglo tested for invisible surface cracks	x	x	x	√	√	√
2b.	**Equaliser Spring Seat**						

	Visually check for cracks/ breakage of spring seat face	√	√	√	√	√	√
	Check for the gap between spring seat face and equaliser beam (1.19mm min. 3.75mm max.) If the gap is less than minimum check for Bush wear of the yoke pin. Wear of yoke pin itself Breakage/cracks of yoke pin.	√	√	√	√	√	√
	Red Dye penetration test/Ultrasonic testing of spring seat specially on the yoke pin and spring seat face positions. If crack/breakage is found replace the same by new one.	x	x	x	√	√	√
	Check the wear of yoke pin bush. allowed dia is 63.19 mm to 65.19 mm)	x	x	x	√	√	√
	Check wear of yoke pin dia (63+0.0) -0.4	x	x	x	√	√	√
2c.	**Safety bracket**						
	Visually check the condition of safety bracket especially for cracks/breakage at the end projections. If so, it means spreading of equaliser beams has started and the spring seat assembly/ equaliser tie pin needs urgent attention.	√	√	√	√	√	√
	Holding screws of safety bracket (size M 16) to be sealed with sealing wire.	√	√	√	√	√	√
	Check the clearance between safety bracket and equaliser (3.18 mm min 6.35 mm max)	√	√	√	√	√	√
3	**TM axle suspension bearing**						
	Oil samples to be tested for presence of moisture and dirt	x	x	√	√		
	Check TM axle cap bolts for tightness	√	√	√	√		
	Replace Suspension bearing (Replacement/ Remetalling)	x	x	x	x	√ Remetalling only	√
4	**Felt wick:**						
	Remove complete wick assembly and clean wicks by soaking them in specified lubricants	√	√	√	x	x	x
	After soaking, remove the foreign material from lubricating surface with soft bristle brush, do not use wire bristle.	√	√	√	x	x	x
	Replace Lubricating pad assly.	x	x	x	√	√	√
5	**Oil pump (TAO Motors)**						
	Dismantle and overhaul	x	x	√	√	√	√
	Replace Oil pump both gears as per TC No. 123	x	x	x	x	x	√
6	**Traction motor nose suspension**						
	Check the condition of nose suspension bolts etc and inspect for water on nose suspension wear plate	√	√	√	√		
7	**Bogie pivot casting and side mounting pads**						

	Check visually for any cracks as far as practicable, if necessary, by magnetic particle/ dye-penetrant method	√	√	√	√		
	Check centre pivot side housing for cracks, check side bearer cover for proper seating			√	√		
8	Buffers as per MP MI NO. 116/82 (REVISION 02) NOVEMBER, 2000						
	Lubricate	√	√	√	√	√	x
	Check wear plate under buffer for wear and tightness of bolt			√	√	√	x
	The general condition of buffer assembly including permanent set (Max. permissible 20 mm), visible cracks, damage, looseness, missing components, holding nuts etc. of buffer assembly shall be thoroughly checked after proper cleaning.	√	√	√	√	√	x
	Replace Side buffer assembly along with fixing bolts	x	x	x	x	x	√
9	**Equaliser**						
	Check for free runs of equaliser pin and condition of wear liners	√	√	√	√		
	Check equaliser for cracks			√	√		
	Ultrasonic testing procedure for Compensating beams, Equalizer beam and Link for WAG-7, WCAM3 & WCAG1 locomotive as per RDSO SMI No. RDSO/SMI/ 0233/2005 REV.0 dt. 17.03.05	x	x	x	√	√	√
10	**Suspension springs**						
	Visually inspect springs for any cracks or breakage	√	√	√	√		
	Replace Springs, Springs seat & equalizer of trimount bogie.	x	x	x	x	x	√
11	**Friction snubbers**						
	Check the snubber assembly for broken springs by inserting a stiff wire from bottom seat	√	√	√	√		
	Snubbers & Shock Absorber	x	x	x	x	√	√
	Replace all Vertical and Horizontal dampers	x	x	x	x	x	√
12	**CBC coupler and transition screw coupling**						
	Check CBC coupler for proper working and presence of locking pin	√	√	√	√		
	Check transition screw coupling for crack	√	√	√	√		
	Check the wear plate under CBC coupler and replace, if worn out				√		
	Replace complete CBC assembly	x	x	x	x	x	√
	Knuckle for HT Transition CB coupler	x	x	x	x	√	x
	Clevis for HT Transition CB coupler	x	x	x	x	√	x
	Knuckle pivot pin with washer for HT Transition CB coupler	x	x	x	x	√	x

	Maintenance procedure and schedule to be followed for CBC and draft gear assembly as per RDSO SMI No. RDSO/EL/SMI/0213 (Rev 0) Dt. 12.07.99	√	√	√	√	√	√
13	**Wheel and axles**						
	Check wheel for crack and other defect	√	√	√	√		
	Measure and record wheel flange root wear, wheel dia and re-profile, if necessary	√	√	√	√		
	Measure wheel gauge				√		
	Ultrasonic testing of axle as per RDSO TC. No. 47 (Rev.02)	**Loco Type/ Speed** Goods & passenger < 120 Passenger ≥ 120			**Periodicity** 12 months 6 months		
14	**Axle boxes and MSU roller bearings**						
	Check grease condition for metal content			√	√		
	Check the fixation screw of bearing end plate			√	√		
	Remove old grease- replace with fresh			√	√		
	Check the lateral and longitudinal clearances between axle boxes and pedestal horn liners of all axles			√	√		
	Check the condition of liners and replace, if necessary				√		
	Grease suspension roller bearings				√		
	Wheel items: Axle box bearing, MSU & its bearings, (DE& NDE side) MSU bolts, Axle box complete.	x	x	x	x	x	√
	Schedule activities	As per para No. 3.4 of CAMTECH publication No. CAMTECH /99/E/RB/1.0, July,1999					
15	**Brake Gear**						
	Give a general check on the brake rigging for loose nuts, pins, cylinder piston working	√	√	√	√	√	
	Clean brake cylinder and check for proper working	√	√	√	√	√	
	Check for wear on brake shoes and replace the shoes. Check the piston strokes after fitting new brake shoe	√	√	√	√	√	
	Observe for any leak in the bogie hose pipe connection and rectify	√	√	√	√	√	
	Check the fixing bolts of brake cylinder	√	√	√	√	√	
	Overhauling of brake cylinder & Replace the Bucket.	x	x	x	√	√	√
	Replace complete brake rigging along with pins, bushes and fasteners.	x	x	x	x	x	√
16	**Gear case**						
	Check gear case for any damage to felt seal and oil leakage	√	√	√	√	√	
	Check gear case bolts for tightness. Check oil leakage, if so, rectify	√	√	√	√	√	
	Check oil level top up if necessary	√	√	√	√	√	

	Overhaul Gear case	x	x	x	√	√	
17	**Earthing Brush**						
	Check condition of earthing shunts and ensure proper tightness	√	√	√	√		
	Check the condition of earthing brush mounted near the traction motor oil pump, replace brush, if necessary			√	√		
18	**Slack adjuster**						
	Lubricate slack adjuster	√	√	√	√		
19	**Hand brake**						
	Clean the hand brake parts and check visually for any looseness	√	√	√	√		
	Apply the hand brake and ensure that the brake shoes are binding on the wheels	√	√	√	√		
	Lubricate hand brake parts, brake gear pins and bushes with oil			√	√		
20	**Sanding**						
	Check and fill the specified grade of sand in all the boxes	√	√	√	√	√	√
	Replace Sander pipe arrangement including rubber hose for sanders.	x	x	x	x	x	√
21	**Rail Guard and Cattle Guard**						
	Check cattle guard for proper fixing	√	√	√	√		
	Check rail guard for proper fixing and its proper height, adjust	√	√	√	√		
	Replace Cattle guard with rail guard	x	x	x	x	x	√
22	**Bogie General**						
	All Cotter pins and Split pins to be replaced.	x	x	x	√	√	x
	Replacement of equalizer & compensating beam, pin, bushes, modified centre block, side bearer, D-shackle (high adhesion bogie), tie rod for equalizer, snubbers, split cotters	x	x	x	x	x	√
	All spring seats, wearing plate, all synthetic liners/pads, oil seal felts, pins, bushes, high tensile fasteners, safety clamps of bogie & axle box etc.	x	x	x	x	x	√
	Foot step assembly	x	x	x	x	x	√
	Maintenance kits of brake cylinder	x	x	x	x	x	√
	WAP-4 bogies items: outer & inner straps, Conical thrust pad, Hanger pin, bush, Brake head spring, brake hanger, happy pad	x	x	x	x	x	√
	Wheel items: Axle box bearing, MSU & its bearings, (DE& NDE side)MSU bolts, Axle box complete	x	x	x	x	x	√
	Horizontal and vertical polymide bush in center pivot of WAP1/WAP4 locos	x	x	x	√	√	√
	O' ring and rubber pad/ bushes in axle box	x	x	x	x	√	√
	All liners including Horn-check liners	x	x	x	x	√	√

	Replacement os side bearers (High adhesion bogie)	x	x	x	x	√	√
	All pins & bushes (Except Mn - pin/bush) of Bogie / Brake rigging	x	x	x	x	√	√
	Replace EMU type inter and after cooler	x	x	x	x	x	√

VII. 180 KVA Static Inverter (SIV) (Ref- RDSO SMI NO: RDSO/2016/EL/SMI/0291(Rev'0'))

Sl. No	Description of work	IA	IB	IC	TOH	IOH	POH
1	Data to be down loaded, stored from Static Inverters during schedules & Temporary repair. Transient failures are also to be attended.	√	√	√	√	√	√
2	Check the tightness of all mounting / fixation bolts	√	√	√	√	√	√
3	Check the earth connections of SIV.	√	√	√	√	√	√
4	Check the battery charger load current, battery charger voltage.	√	√	√	√	√	√
5	Overall cleaning of converter and Battery Charger	√	√	√	√	√	√
6	Cleaning of heat sink duck by Vacuum cleaner / Dry air	x	x	x	√	√	√
7	Checking the mounting and connection tightness of chokes and capacitors	x	x	x	√	√	√
8	Proper functioning of QSVM relay	√	√	√	√	√	√
9	Checking the status of tightness of cables bus bars capacitors, MOVs, PTs, CTs and connectors of cards	x	x	√	√	√	√
10	Checking the sealing of cable entry and front cover and battery charger	x	x	x	√	√	√
11	Checking of functioning of churning fan by pressing the push button switch provided at power panel side.	√	√	√	√	√	√
12	ALL OFC coupler connections to be checked.	x	x	√	√	√	√
13	Visual checking of DC link capacitors for its healthiness to be carried out.	x	x	√	√	√	√
14	Check the earth fault protection	√	√	√	√	√	√
15	Check loads 'turn on and off' for its sequence and timing. Check functioning of relays in control circuit.	√	√	√	√	√	√
16	Checking of functioning of cooling fan & churning fan.	√	√	√	√	√	√
17	Check all the system parameters on the display of SI unit.	√	√	√	√	√	√
18	Check the condition of out-put choke, DC filter choke	x	x	x	√	√	√
19	Clean the dust accumulated on all the internal parts including heat sink cooling fan impeller etc.	x	x	√	√	√	√

20	Clean the dust accumulated on all the internal parts including heat sink cooling fan impeller etc. and check the cable connections of all components including capacitors, chokes, sensors, PTs, CTs.	x	x	x	√	√	√
21	Protection & fault simulation test for various faults.	x	x	x	√	√	√
22	Checking of protection settings and reload the software if required.	x	x	x	x	√	√
23	Replacement/Repair of cooling & churning fan:The rotational movement of Churning fan & the bearing of cooling fan are to be verified during TOH, IOH schedule. But the replacement of the bearing of cooling fan is to be replaced as per schedule submitted by firm or as & when required.	x	x	√	√	√	√
24	Battery Charger: Monitoring of battery charger condition by taking following reading: Item Normal Values Actual Values CHBA load - 8 Amp (Max) current (Amp) CHBA Voltage - 107 - 114 V Battery Voltage - 100 - 110 V	√	√	√	√	√	√
25	**QSVMRelay: -**						
i.	Proper functioning of QSVMrelay to be checked (Only functional test for shutdown of SIVfor 02 Sec after BLVMT switched ON and then re-start).	x	x	√	√	√	√
ii.	Visual checking the condition and connection of C1-C2 damping panel near auxiliary winding of transformer and values to be measured.	x	x	√	√	√	√
26	Earth fault & its by-pass mode checking.	x	x	x	√	√	√
27	Total SIV blowing in major schedule.	x	x	x	√	√	√
28	Visual checking, tightness of fixing bolts and couplers, intactness of earthing shunt and availability of gasket on door and cable entry point/hole is being checked in every schedule .	√	√	√	√	√	√
29	Tightness of cooling fan mounting bolts is being ensured in every schedule	√	√	√	√	√	√
30	Checking of capacitor bulging in all SIV's	√	√	√	√	√	√
31	Measurement of capacitance of AC output filter and checking its healthiness.	x	x	x	x	√	√
32	Measurement of output current, capacitor of battery Charger for its healthiness.	x	x	x	x	√	√
33	Replacement of Gasket: The replacement of gasket on door and cable entry point/hole is being checked in every schedule and replacement on conditional basis.	√	√	√	√	√	√

34	Measurement/ checking of resistances of input / output CTs and ZCTs for its healthiness.	x	x	x	√	√	√
35	Condition of QCON timer card. Replacement of QCON timer card on conditional basis wherever applicable	x	x	x	√	√	√

VIII. MICROPROCESSOR BASED CONTROL & FAULT DIAGNOSTIC SYSTEM (MPCS) (Ref- RDSO SMI NO: RDSO/2016/EL/SMI/0288(Rev'0'))

SN	DESCRIPTIONOF WORK	IA	IB	IC	TOH	IOH	POH
1.	**Fault Data**						
	Download fault log data through laptop/ Pen drive and check for any abnormal messages. Necessary corrective/ preventive action to be taken on the abnormal messages. Record of loco wise fault data should be kept.	√	√	√	√	√	√
	Verification of driver log Book: verify drivers log book and record bookings related to MPCS functionality.	√	√	√	√	√	√
	Verification of Remote Monitoring Data from website for MPCS version-3 for proper working of remote monitoring module.	√	√	√	√	√	√
2.	**Visual inspection**						
	Clean the dust with a dry cloth or vacuum cleaner on all subassemblies of MPCS like control unit, display units, PT, SCU and ISCUs etc.	√	√	√	√	√	√
	Check all cards/ cables/units/ connectors/ couplers/bolts etc. for proper tightness / securing/ fitment.	√	√	√	√	√	√
	Check proper earthing of all subassemblies like main unit, SCU, ISCU, display unit etc. to locomotive body.	√	√	√	√	√	√
3.	**Functionality check**						
	Control card (CPU card) Redundancy check: Observe the control card change over with DJ operung by observing blinking of LED on working CPU card.	√	√	√	√	√	√
	Digital input check: Observe simultaneous glowing of LEDs 110V (Green) and 5V (Yellow) on Fascia of all digital input cards.	√	√	√	√	√	√
	Digital output check: Observe simultaneous glowing of LEDs IIOV (Green) and 5V (Yellow) Fascia of all digital output cards.	√	√	√	√	√	√
	Power supply card test: check all LEDs on Fascia of the both power supply module glowing.	√	√	√	√	√	√
	Communication Check: Check the health status of all subassemblies in test mode on display.	√	√	√	√	√	√
	Check functionality of VCD in MPCS version-3 including foot switch, bypass switch etc.	√	√	√	√	√	√

	Check functionality of Remote monitoring module (including antenna) in MPCSversion-3.	√	√	√	√	√	√
	Check the Date, time and loco no. for proper entry.	√	√	√	√	√	√
	Check both the display units and buzzer for proper functioning.	√	√	√	√	√	√
	Check healthiness of spare and redundant input & output cards of MPCS	√	√	√	√	√	√
	Digital input/ output Redundancy checks: Check the input/output status of mam input/ output cards and redundant input/output cards on display unit at power on and after closing DJ on HT testing mode. Ensure both main and redundant card input/output status are same.	x	x	x	√	√	√
	Display unit Check:						
	LCD Check: Display units In both cabs and its operation, through menu driven keys.	x	x	x	√	√	√
	Notch Indicator Check: In MPCS version- 2, check the working of seven segment display of notch indicator	x	x	x	√	√	√
	Buzzer Check: Verify buzzer is working or not by simulating any fault.	x	x	x	√	√	√
	SCU Unit Check:						
	Check the voltage of auxiliary supply and redundant auxiliary supply, Arno/ Static Inverter voltage are available when loco is in energized condition.	x	x	x	√	√	√
	Observe the Battery Charger (CHBA) voltage on display unit in LT and HT testing mode.	x	x	x	√	√	√
	Observe the TM voltage on display unit by increasing the Notches in LT and HTtesting mode.	x	x	x	√	√	√
	ISCU Unit Check:						
	Working of QD-1 and QD-2 functionality.	x	x	x	√	√	√
	Observe the TM currents on display unit.	x	x	x	√	√	√
	All rubber gaskets and grommets to be replaced.	x	x	x	√	√	√
	Check the condition of Real Time Clock (RTC) battery and replace if required. RTC battery should be replaced before completion of its codal life as prescribed by respective OEM.	x	x	x	√	√	√
	MotherBoard Check: Check the control unit mother board for formation of dust and also observe the tracks on mother board for any abnormality. Abnormalities of mother board tracks to be attended or mother board to be changed if necessary.	x	x	x	√	√	√
	Check calibration of all analog parameters like voltage, current and pressure etc.	x	x	x	√	√	√

	Check buzzer functionality for three different frequency used in MPCS version-3	x	x	x	√	√	√
	Checking proper working of notch encoder for notch indicator fitted with SMGR in MPCSVersion-3.	x	x	x	√	√	√
	Check for proper setting of all eliminated relays like Q20, Q30, QF, QD etc.	x	x	x	√	√	√
	Checking Uniformity of configuration parameters in both CPU cards.	x	x	x	√	√	√
	Check the condition of lock in front door of main control panel and replace if required.	x	x	x	√	√	√
	Checking of all types of sensors used in MPCS like hall effect, pressure etc.	x	x	x	√	√	√
	Replacement of VCD foot switch in MPCS V3.	x	x	x	√	√	√
	Check for proper functionality of VCD Bypass switch.	x	x	x	√	√	√

Note: In addition to above, modifications/reliability improvement measures/instructions related to MPCS issued by Railway Board/ RDSO/ Manufacturers from time to time shall be considered as part of Schedule activity.

IX. Microprocessor based Electronic Speed cum Energy Monitoring System (ESMON) (Ref- RDSO SMI NO: RDSO/2016/EL/SMI/0289(Rev'0'))

Sl. No	Description of Work	IA	IB	IC	TOH	IOH	POH
1	Physical Checking of the cables and cleaning of the unit with soft cloth. Inspect the cable for any damage. Cable should be properly clamped and it should not brush with bogie.	√	√	√	√	√	√
2	Checking for any grease ingress into the PG & removing of dust inside the PG unit. Check the free movement of the shaft with the hand to ascertain the proper functioning of bearings.	√	√	√	√	√	√
3	Inspection of driving fork for any damage. Length of driving pin shall be such that even with axial play, it engages the driving fork fully.	√	√	√	√	√	√
4	Cleaning of speed sensors.	√	√	√	√	√	√
5	Check the availability of protection guard on the axle cover to protect PG for cattle run over/ foreign object hitting.	√	√	√	√	√	√
6	Checking the proper fitment and tightness of all Screws, bolts and connectors used for interconnection and mounting of different equipments.	√	√	√	√	√	√
7	Checking of installation of PG as per OEMs installation manual.	√	√	√	√	√	√
8	Verify the correctness of setting of the various parameters made earlier.	√	√	√	√	√	√

9	Data downloading and checking of Error Log Memory for problems recorded.	√	√	√	√	√	√
10	Maintaining of CF card and data downloading & evaluation software.	√	√	√	√	√	√
11	Enter the new value of Wheel Diameter; if required & do the calibration.	√	√	√	√	√	√
12	Keep Record of maintenance work.	√	√	√	√	√	√
13	Checking of components used in PCB and replacement of the components if required.	x	x	x	√	√	√
14	Change the AOH/IOH/POH kit as recommended by OEMs.	x	x	x	√	√	√
15	Functional test after maintenance work as per governing specifications.	x	x	x	√	√	√
16	Keep Record of maintenance work.	x	x	x	√	√	√
17	Time setting as per SMI No. RDSO/2016/EL/SMI/0302 (Rev'0') Dt: 01.12.16	√	√	√	√	√	√

Note: In addition to above, modifications/reliability improvement measures/instructions related to ESMON issued by Railway Board/RDSO/Manufacturers from time to time shall be considered as part of scope of AMC

X. VIGILANCE CONTROL DEVICE (VCD) (Ref- RDSO SMI NO: RDSO/2016/EL/SMI/0290(Rev'0'))

S. No.	DESCRIPTION OF WORK	IA	IB	IC	TOH	IOH	POH
	Fault Data						
	Download fault log data through laptop/ Pen drive and check for any abnormal messages and corrective action for VCD.	√	√	√	√	√	√
	Verification of driver log Book: Verify drivers log book and record bookings related to VCD functionality.	√	√	√	√	√	√
	Visual inspection						
	Clean the dust with a dry cloth on all sub-assemblies of control unit, CABUNITS,EMvalve and pressure switches.	√	√	√	√	√	√
	Check tightness of connections at digital input and digital output of control unit cables and cab unit cables at Terminal board.	√	√	√	√	√	√
	Check tightness of PB valve connections on the valve & VCD pressure switch connections at pressure switch.	√	√	√	x	x	x
	Check proper earthing of all assemblies like main unit, cab units etc. to locomotive body.	√	√	√	x	x	x
	Check the proper tightness of MS connections at Main unit, cab units of control cables.	√	√	√	√	√	√

	Check Shielding continuity from earth stud to Body of the Locomotive of Control Unit and Cab units.	x	x	x	√	√	√
	Checking of proper shielding of VCD cables.	x	x	x	√	√	√
	Check tightness of Screws for control unit and Cab Unit of Back cover.	x	x	x	√	√	√
	Secure the all the cables properly by putting rubber sheets, where ever you find the possibility of cable rubbing.	x	x	x	√	√	√
	Checking of soldering work properly.	x	x	x	√	√	√
	Functionality check						
	Control card check: On LCD display 60 seconds to 1 second count down indication should show. Observe on the cab unit working lamp should glow continuously.	√	√	√	√	√	√
	Digital input check: Any input of locomotive e.g. Master controller or sander operated, on the LCD display 60 seconds to 1 second count down time should be restart.	√	√	√	√	√	√
	Digital output check: After completion of vigilance cycle Penalty brake valve should be de-energized and locomotive brakes should be applied and BP should drop.	√	√	√	√	√	√
	Power supply card test: Check on Fascia of the control unit LCD display any massage should show.	√	√	√	√	√	√
	Health status of the system is LCD display should show any message and "Working Lamp" should glow continuously on Cab unit.	√	√	√	√	√	√
	Cab Unit Check: (for both the cabs)						
	i. Lamp Indication: working lamp should glow continuously. ii. Warn lamp should glow after 60 seconds of vigilance cycle period. iii. Bypass lamp should glow by putting the bypass switch in '0' position. iv. Hooter check: By allowing warning cycle period after 60+8 sees	√	√	√	√	√	√
	v. Functionality check of VCD bypass switch (HVCD).	x	x	x	√	√	√
	Functionality of foot switch operation to be checked for its healthiness.	√	√	√	x	x	x
	Check the condition of Real Time Clock (RTC) battery and replace if required.	x	x	x	√	√	√

	Check following items to be Replaced if they are damaged: Back door Gaskets, cabinets of Main unit/ cab unit etc.	x	x	x	√	√	√
	Replacement of foot switch to be carried out.	x	x	x	√	√	√

XI. Roof Mounted Air Conditioning System for CABs of Electric Locomotives (Ref- RDSO SMI NO: RDSO/2016/EL/SMI/0293(Rev'0'))

S.N	Activities	IT	IA	IB	IC	TOH	IOH	POH
	General							
	Check the loco logbook and attend the defects recorded.	√	√	√	√	√	√	√
	Run the AC unit in (Off, Auto, Manual cooling) all modes. Attend to any abnormalities observed.	√	√	√	√	√	√	√
	Clean dust from control panel by compressed air or vacuum cleaner and tighten the cable terminals.	x	√	√	√	√	√	√
	Remove return air filters by opening the grill. Clean these filters with water/vacuum cleaner or compressed air.	x	√	√	√	√	√	√
	Check for damaqed/ jointed cable	x	√	√	√	√	√	√
	Ensure top cover of AC unit proper locking and gasket. Replace gasket if damaged.	x	√	√	√	√	√	√
	Run the AC unit for half an hour and record the current drawn by various equipments with the help of clamp tester. **Equipment** — **Nominal Current** AC unit in cooling mode — 4.5 - 6.0 Amp. AC unit in heating mode — 2.0 - 3.0 Amp. Compressor Motor — 2.0 - 4.0 Amp. Condenser Motor — 0.6 - 0.8 Amp. Blower Motor — 0.4 - 0.6 Amp.	x	√	√	√	√	√	√
	Switch 'ON' the AC unit (Blower motor ON, Condenser motor ON, Compressor ON) and rotary switch set the manual cooling mode then check the time delay relay for its operation. Compressor must start within 180+15 Sec.	x	√	√	√	√	√	√
	Run the AC unit in auto mode and check the cut-in and cut-out of thermostat. If thermostat is not working properly check the following: i. Clean the cooling sensor probe and heater sensor probe. ii. Ensure Thermostat connector is properly tightened.	x	√	√	√	√	√	√

	Ensure that there is no leakage of condensate water from trough to driver cab. Rectify any leakage.	x	√	√	√	√	√	√
	Remove return air filters by opening the grill. Clean these filters with water/vacuum cleaner or compressed air.	x	x	x	x	√	Replace	
	Ensure proper locking of top cover of AC unit and provision of gasket. Replace gasket if damaged.	x	x	x	x	√	Replace	
	Control Panel							
	Check intactness of control panel connectors.	x	√	√	√	√	√	√
	Check working of rotary switch by rotating forward and backward. Replace, if found loose, damaged and jammed.	x	√	√	√	√	√	√
	Check the working of all LED's indications for proper function: i. Rotate the rotary switch in manual cooling mode position and check the status of LED (Main -ON, BLR-ON, COMP-ON, COOL-ON). ii. Rotate the rotary switch in Auto mode position and check the status of LED (Main-ON, BLR-ON, COMP-ON, COOL-ON in summer) and (Main - ON, BLR-ON, HTR-ON in winter). In case LEDs do not light up, check 110 V AC control supply. Rectify any abnormalities.	x	√	√	√	√	√	√
	Check and clean step-down transformer (Control Transformer) 415V/110V and its connections.	x	√	√	√	√	√	√
	Condenser motor and blower motor							
	Clean the body of condenser motor and blower motor by compressed air.	x	√	√	√	√	√	√
	Check condenser motor visually for crack on blade or body.	x	√	√	√	√	√	√
	Check and ensure mounting fasteners are properly tightened.	x	√	√	√	√	√	√
	Check connection at terminal boxes of motor for proper tightens & cables are terminated with IUQs.	x	√	√	√	√	√	√
	Check insulation resistance of motors by 500 V DC megger from the control panel. Attend the motors if insulation resistance is less than 2 M Ohms.	x	√	√	√	√	√	√
	Check motors for any abnormal sound while running	x	√	√	√	√	√	√

	Overhauling of blower and condenser fan motor: i. Measure Insulation Resistance (IR) between motor terminals and frame before and after overhauling. The value should not be less than 10 M Ohms when the measured with 500 V megger. ii. Check terminal block and connecting lead for any physical damage or any flash mark. iii. Perform HV (Di-electric) test on stator by applying 1.5 kV AC apply for one minute. The leakage current which should not exceed 1.0 mA. iv. SCT (Surge comparison test) of stator at 1 kV. v. Measure starting current of motors on no load. It should not exceed 14A. No load current of motors should not exceed 1.4 A. vi. Measure winding resistance of motors between UV, VW and WU phases. Ensure that they are balanced ± 10%. vii. Spray water over running motor by jet having 10 mm dia from all side. After spray check IR value. It should not be less than 10M Ohms.	x	x	x	x	√	√	√
	Compressor							
	Check and ensure mounting fasteners are properly tightened.	x	√	√	√	√	√	√
	Check electrical terminal box is properly tightened and cables are terminated with lugs.	x	√	√	√	√	√	√
	In case of abnormal sound: - i. Check the sequence of electric connection. ii. Ensure that the winding resistances of compressor motor between UV, VW and WU phases are balanced ± 3%.	x	√	√	√	√	√	√
	Heater							
	Ensure proper mounting of heater without touching side bodies.	x	√	√	√	√	√	√
	Ensure proper clamping of electric wires to heater.	x	√	√	√	√	√	√
	Remove dust accumulation on heating element gently by soft brush/dry air.	x	√	√	√	√	√	√
	Clean thermostat temperature probe (OHP). Replace if cracked or broken.	x	√	√	√	√	√	√
	Check heater at the beginning of winter season by checking current drawn at control panel by clamp tester. (Nominal 2.0 - 3.0 Amp.)	x	√	√	√	√	√	√
	Trough							

	Make sure condensate/rain water drains properly. This can be checked by opening the evaporator top and condenser top of the system by pouring water into the trough and clean the trough pipe by adequate size of round brush. It should be assured that there is no blockage in drain pipes.	x	√	√	√	√	√	√
	Ensure that there is no leakage of water to cab.	x	√	√	√	√	√	√
	OHP (Over heat protection), HP (High pressure), LP (Low pressure)							
	Check the mounting fasteners are properly tightened.	x	√	√	√	√	√	√
	Ensure that control wires to HP/LP/OHP cut-out are properly clamped.	x	√	√	√	√	√	√
	Time Delay Relay (TOR)							
	Clean the complete assembly by compressed dry air jet.	x	√	√	√	√	√	√
	Check the condition of the TDR for physical damage.	x	√	√	√	√	√	√
	Tighten terminal & mounting screws.	x	√	√	√	√	√	√
	Replace damage thimbles/lugs.	x	√	√	√	√	√	√
	MCBs (Miniature circuit breaker) & MPCB (Motor protection circuit breaker)							
	Clean the MCSs and MPCS with dry compressed air.	x	√	√	√	√	√	√
	Check the condition of MCBs and MPCB for physical damage.	x	√	√	√	√	√	√
	Ensure that end locks are provided.	x	√	√	√	√	√	√
	Tighten electric cable connections and DIN rail screws.	x	√	√	√	√	√	√
	Contactors							
	Clean the contactors with dry compressed air	x	√	√	√	√	√	√
	Check continuity between the incoming and outgoing terminals.	x	√	√	√	√	√	√
	Ensure tightness of connection.	x	√	√	√	√	√	√
	Connector							
	Open the connectors and check for flash marks/ damage to pins.	x	√	√	√	√	√	√
	Ensure that they are tightened properly.	x	√	√	√	√	√	√
	Remove moisture by blowing air through hot air gun.	x	√	√	√	√	√	√
	Refrigerant pipe line /Thermostatic expansion valve							
	Check visually for proper clamping/ support	x	x	x	x	√	√	√
	Ensure that thermostatic expansion valve of distributors to evaporator coil does not have any sharp bend or kinks.	x	x	x	x	√	√	√
	Evaporator/Condenser Fins							

	Check that the mounting fasteners are properly tightened.	x	x	x	x	√	√	√
	Ensure that there is no damage to fins	x	x	x	x	√	√	√
	Clean the evaporator and condenser fins with pressurised water and blow dry with moisture free air at 10-15 psi.	x	x	x	x	√	√	√
	OHP (Over heat protection), HP (High pressure), LP (Low pressure) Cut-outs:							
	Disconnect blower motor through MPCB to cause compressor tripping on low pressure (LP) 30±5 psi. Disconnect condenser fan motor through MPCB to cause compressor tripping in (HP) 450±15 psi.	x	x	x	x	√	√	√
	Check the tripping of heater through OHP by switching off the blower. The probe of digital thermometer should be placed near the OHP sensor and the heater should trip at 65°C.	x	x	x	x	√	√	√
	Time Delay Relay (TOR)							
	Check the time setting on test bench. (180±15 sec.)	x	x	x	x	√	√	√

XII. 1750 LPM capacity lubricated reciprocating Compressors for Electric Locomotive (Ref- RDSO SMI NO: RDSO/2016/EL/SMI/0296(Rev'0'))

SN	Scheduled inspection chart for	IA	IB	IC	TOH	IOH	POH
	Check the abnormal sound and abnormal working during operation.	√	√	√	x	x	x
	Clean the compressor thoroughly.	√	√	√	x	x	x
	Drain the condensate from the intercooler, after cooler and the air receiver.	√	√	√	x	x	x
	Check the tightness of mounting bolts and other fasteners.	√	√	√	x	x	x
	Breather should be dismantled and cleaned.	√	√	√	x	x	x
	Remove the oil filter assembly from crank case and clean the oil filter strainer.	√	√	√	x	x	x
	Check the oil levels in crank case and contamination levels, change if found contaminated or otherwise replenish with correct grade of oil as recommended by OEM.	√	√	√	x	x	x
	Open the crankcase side cover and check all the connecting rod nuts and the split pins.	x	√	√	x	x	x
	All the pipe lines should be checked for leaks at the joints.	x	√	√	x	x	x

	Check for the pressure building time as per RDSO Technical Circular No. RDSO/2012/EL/TC/0113, Rev.'0' dated 29.03.12 and if CP is taking more time to build up pressure, remove the valves from the cylinder head, dismantle and clean them thoroughly. Examine all the parts. Service and check all the valves according to procedure prescribed by the OEM and de- carbonize the inter-cooler and after-cooler.	x	√	√	x	x	x
	Check the condition and setting of safety valve, if found disturbed or blown off, test & set them for correct operation and attend, service the safety valves. Test and set them for correct operation.	x	√	√	x	x	x
	Replace the oil filter and air filter element on condition basis during minor schedules.	x	√	√	x	x	x
	Drain the oil from the crankcase.	x	x	√	x	x	x
	Run the compressor for 2-3 minutes and drain the oil while the compressor is in hot condition.	x	x	√	x	x	x
	Remove the oil pump and the oil filter from the crankcase and remove fan and coupling and check for defects if any and replace the defective parts. Oil pump in case of compressor model 2A 320D of M/s. FTRTIL. The kit to be changed on condition basis. The pump kit is must change in IOH schedule.	x	x	√	x	x	x
	The compressor should be completely dismantled. All parts should be thoroughly cleaned by kerosene/ petrol, examined and attended in a clean surrounding.	x	x	x	√	√	√
	Replace all the packings and rubber items.	x	x	x	√	√	√
	Remove the valves from the cylinder head, dismantle and clean by kerosene/ petrol them thoroughly. Examine all the parts. Service and check all the valves according to procedure prescribed by the OEM.	x	x	x	√	√	√
	De-carbonize the inter-cooler and after- cooler.	x	x	x	√	√	√

	Remove the motor portion from the compressor. Remove the rotor and the fan from the motor shaft. Drain the oil from the crankcase. Remove the oil pump and the oil filter from the crankcase. Remove the crankcase vent and the dipstick from the crankcase. Remove the pipe connectors at the suction and delivery ports of the cylinder heads. Now remove the shroud. (Only in case of Compressor Model 2A 320D of M/s. FTRTIL).	x	x	x	√	√	√
	Inspect suction and delivery valves for pitting, wear and distortion. Spring plates should be checked for any sign of fatigue. Ensure that the locating pin is not worn out or bent or loose in valve seat. It is recommended to replace the valve plates and spring plates to avoid fracture due to fatigue. It is not recommended to recondition the valves, disc valve and concentric valves should be replaced.	x	x	x	√	√	√
	De-carbonize and thoroughly clean the cylinder heads. Use new gasket and new spring washers below the nuts.	x	x	x	√	√	√
	Remove the nuts fixing the cylinders to the crankcase. Examine the cylinder bores for any damage. Measure the bore diameter at the top, middle and bottom at two places 90 deg. apart, as recommended by OEM. If the cylinder or piston is damaged replace the same.	x	x	x	√	√	√
	Check the dimensions of the HP cylinders and pistons. If it is damaged or worn out beyond limits as recommended by OEM replace the same by a new one.	x	x	x	√	√	√
	Check connecting rods and mark the bearings for their condition and ensure that the oil holes are properly located and fully opened. Change the bearings if required.	x	x	x	√	√	√
	Check for the play (shake) of piston on the connecting rod. If there is a small play, the small end bearing bush has to be replaced. Examine the gudgeon pin for damages or play, replace the same if required.	x	x	x	√	√	√
	Measure the side clearance and gap. If the limits as recommended by OEM are reached the rings should be replaced.	x	x	x	√	√	√

	Check the bore size of the bearings and if it is worn out or exceeds the condemning limit as recommended by OEM, change the bearing.	x	x	x	√	√	√
	Check the oil pump for all worn out parts. All worn out or damaged parts should be replaced.	x	x	x	√	√	√

XIII. Distributed Power Wireless Control System (DPWCS) (Ref- RDSO SMI NO: RDSO/2016/ EL/SMI/0295(Rev'0'))

S.No	Description of work	IA	IB	IC	TOH	IOH	POH
1	Clean the Antenna mounted on the roof top and verify the antenna Connectors.	√	√	√	√	√	√
2	Check the tightness of all Connectors on CCU, DIU, BIU Units and on BD panel.	√	√	√	√	√	√
3	Check all the pneumatic connections for leakges & conditions of pressure sensors.	√	√	√	√	√	√
4	Check the tightness of Notch Encoder fitted on the SMGR Manual drive inside the machine room (Applicable to conventional loco only).	√	√	√	√	√	√
5	Check the touch functionality of the DIU and calibrate if required.						
6	Observe the synchronization of lead and remote locomotives with notch/TE/BE/Speed reference (if available in shed).	√	√	√	√	√	√
7	Check all the functions of DPWCS for its normal working.	√	√	√	√	√	√
8	Check the status of GPS receiver in the status screen of DIU (During GPS verification the antenna mounted on roof top of the locomotive should be visible to sky).	√	√	√	√	√	√
9	Check the speedometer input by moving the locomotives after grouping.						
10	Verify the NSN switch functionality by pressing the NSN button for 02 seconds and verify the NSN progress message or crossed 500 meter Board message on DIU. Press the NSN cancel button in DIU for cancelling the NSN function. Verify this operation from both DIU.	√	√	√	√	√	√
11	Verify the Emergency switch functionality from both DIU.	√	√	√	√	√	√
12	Update the wheel diameter of loco in software of DPWCS.	√	√	√	√	√	√
13	Downloading of logged data & clearing of memory.	√	√	√	√	√	√
14	Check the grouping and various working models of lead/ remote loco (if available in shed)	√	√	√	√	√	√
16	Visual inspection of PCBs for its healthiness and suitable cleaning with brushed and do conformal coating.	x	x	x	√	√	√
17	Check the battery of CPU cards/ radio and replace if required.	x	x	x	√	√	√
18	Cleaning of air filters of BIU, heat sinks of all modules.	x	x	x	√	√	√

19	Replacement of panel gaskets in IOH schedule.	x	x	x	√	√	√
20	Replace all the churning fans of DPWCS during IOH.	x	x	x	√	√	√
21	Check continuity and IR values for all the Data/ Electrical cables.	x	x	x	√	√	√
22	Do calibration test of Electronic Pneumatic valve of BIU.	x	x	x	√	√	√
23	Do calibration of sensors.	x	x	x	√	√	√

XIV. Maintenance activities during major/ minor schedules of CHT (Loco) (Ref: RDSO SMI No. RDSO/2017/EL/SMI/0317 Dt: 18.10.2017)

S.N	Activities	IA	IB	IC	TOH	IOH	POH
1	Check the tightness of nuts & bolts at both the termination, do tight if required.	√	√	√	√	√	√
2	Check the tightness of earthing shunt, do tight if required.	√	√	√	√	√	√
3	Clean grey modules with wet cotton cloth. Let the modules dry.	√	√	√	√	√	√
4	Check ET2 air gap and earth connection, do tight if required.	√	√	√	√	√	√
5	Check for the condition of rubber bush sealing point at the roof plate, re-seal/ replace if required.	√	√	√	√	√	√
6	Check for tightness of nuts & bolts of roof top plate, SS cable support device, do tight if required	√	√	√	√	√	√
7	Check the tightness of earthing lead, do tight if required.	√	√	√	√	√	√
8	Check for the tightness of nuts & bolts of cable support, do tight if required.	√	√	√	√	√	√
9	Check tightness of A1, flange, do tight if required.	√	√	√	√	√	√
10	Check tightness of transformer lead, do tight if required.	x	x	x	√	√	√
11	Check the transformer lead support device fitment, tight it if required.	x	x	x	√	√	√
12	Ensure the turret is full of oil for this, lose the vet to and let the oil come out, release the air trapped in turret oil whenever the turret filled with oil. Tight the vent and remove the oil by cloth.	√	√	√	√	√	√
13	Clean complete cable head termination system with dry cloth inside LOCO.	√	√	√	√	√	√
14	Avoid to open CHT from bushing fitted with turret top cover.	√	√	√	√	√	√
15	While opening roof please make sure that no sharp edge towards CHT.	√	√	√	√	√	√
16	Opened CHT (if not avoidable) must be kept in dust free environment.	√	√	√	√	√	√
17	Must make sure the use of silicon grease recommended by respective OEMs at stress cone area of separable connector at the time of re- fixing of CHT.	x	x	x	√	√	√
18	Check for tightness of nuts & bolts at both ends of copper plate point.	√	√	√	√	√	√
19	Check for proper earthing of roof top termination.	x	x	√	√	√	√

20	Check the wear & tear of self bonding tape and silicon tape at earthing terminals and outdoor crimp connector.	x	x	x	√	√	√
21	Check for the earthing of vertical receptacle point.	x	x	√	√	√	√
22	Wipe out the old silicon grease of vertical receptacle inside and bushing converter with dry cloth and apply new grease.	x	x	x	√	√	√
23	Check cleaning of cable adaptor with dry cloth and apply silicon grease.	x	x	x	√	√	√
24	Check tightness of SS clamp on vertical receptacle bushing end.	x	x	√	√	√	√
25	Clean complete CHT with dry cotton cloth.	√	√	√	√	√	√

Apart from above, the Reliability action Plan No. RDSO/2017/EL/TC/0142(Rev. '0'), Dated 09.01.2018 should be followed.

Annexure – 3.01 B

B. 3 Phase Electric Locomotives:

Minor & Major schedule activities of three phase electric locomotives to be followed as per ref: RDSO Letter No. EL/3.1.35/16, Dated: 07.02.2012 is enclosed as annexure.

I. MINOR SCHEDULE ACTIVITES

SN	Equipment	IT	IA/IB	IC
A.	**LOCO BODY**			
1	**BODY STRUCTURE**			
i.	Check the body structure for damage. Repair any damage found.	√	√	√
ii.	Check the body structure for evidence of corrosion. Repair defects requiring attention.	X	√	√
iii.	Check for leaks around roof hatches, doors and windows. Rectify any faults found.	X	X	√
2	**EXTERIOR FINISH**			
i.	Wash the exterior of the locomotive. Remove all dirt & debris. (For coaching locos - once in 10 days)	√	√	√
ii.	Wash the exterior of the locomotive. Remove all dirt & debris. (For Freight locomotive)	X	√	√
iii.	Check the various louvre panels to ensure they are clean & free from debris. To remove dirt, wash vents with detergent/water solution and thoroughly cleaned with a stiff, non- metallic brush.	X	√	√
iv.	Inspect the locomotive and bogie for chips, scratches or other damage to the paint. Repair the paint as necessary.	X	X	√
v.	Check and adjust, if necessary, the rail guard height.	√	√	√
vi.	Check cattle guard fasteners for breakage & tightness. Special attention be given to cattle guard base.	√	√	√
3	**DRAFT GEAR AND COUPLERS**			
i.	Liberally apply general-purpose grease to the face of the centre buffer coupler at the end of the Locomotive.	√	√	√
ii.	Check the intactness of the CBC bottom support plate bolts.	√	√	√
iii.	Check the knuckles against crack by DPT.	X	X	√
iv.	Check knuckle for wear.	X	√	√
v.	Check intactness and functioning of CBC operating handle.	√	√	√
vi.	Check visually the striker casting of CBC assembly.	√	√	√
vii	Check for working of CBC , Lock and unlock it ,locking arrangement , working of TC.	√	√	√
4	**BUFFERS**			
i.	Check buffers for any crack visually of the flange and intactness of foundation bolts, check nuts and split pins (4nos. each),	√	√	√
ii.	Liberally apply general purpose grease to the face of the buffers at the ends of the Locomotive. Also smear grease on the buffer head plunger.	√	√	√
iii.	Conduct RDPT of Buffers to detect crack / flaws.	X	X	√
iv	Check and measure the buffer height and buffer length.	X	√	√
5	**DOORS AND STEPS**			
i.	Check external door locks for correct operation and for damage.	√	√	√

ii.	Lubricate external door hinges with general-purpose oil. Wipe away excess oil from around hinges. Apply a small amount of general-purpose grease to the lock.	√	√	√
iii.	Examine the door seals for damage. Replace as required.	X	√	√
iv.	Remove the tread plate and clean the drainage channels. Check and adjust, if necessary, the door-operating rod.	X	X	√
6	**LOOKOUT GLASS & SIDE WINDOWS**			
i.	Clean any built up dirt and debris from the channel below the cab-sliding window. Clear the sliding window channel drains hole in the door opening.	√	√	√
ii.	Clean look out glass with detergent/water solution.	√	√	√
iii.	Examine windscreens and side windows for cracks and scratches. Renew if damaged.	√	√	√
iv.	Examine all wind screens and side windows for leaks. Remove wind screen/ window and re-seal, if leaks appear.	X	√	√
v.	Check the condition of the windscreen guard grills. Rectify any faults found. Tighten the windscreen guard grill retaining bolts.	X	√	√
vi.	Check the condition of the sliding window lip seal. Replace, if required.	X	√	√
vii.	Ensure proper functioning of blind installations.	√	√	√
7	**WASHER / WIPER**			
i.	Check the operation of windscreen wipers using the manual handles. Rectify any fault found.	√	√	√
ii.	Check the condition of windscreen wiper blades. Replace if required.	√	√	√
iii.	Check the wiper and parallel arm assembly for wear and damage. Replace the arm or any part if there is excessive wear or damage.	X	X	√
iv.	Check the water level in the reservoir at No.1 and No.-2 end. Top up if required. Check wipers for proper operation	√	√	√
v.	Clean the washer nozzle jet.	X	X	√
vi.	Check for damage of air and water pipes	X	√	√
vii.	Examine all components for wear, looseness scoring and cracks, renew any defective components.	√	√	√
viii	Check seat-mounting points for integrity and ensure fixing or fully tightened.	X	√	√
B1	**UNDERFRAME**			
8	**SANDING EQUIPMENTS**			
i.	Refill sand in all sand boxes.	√	√	√
ii.	Visually check the condition and alignment of sanding pipes.	√	√	√
iii.	Check sanding gear for correct operation for both direction of travel.	√	√	√
iv.	Check exhaust nozzle for wears or damage. Replace if necessary.	√	√	√
v.	Inspect the sand box lid seals for wear or damage. Replace if required.	√	√	√
vi.	Check the foundation bolt of the sander nozzle	√	√	√
9	**BATTERY BOX**			
i.	Visually inspect the battery box for any external hits and damages. If required-repair.	√	√	√
ii.	Visually check the hanging supports of battery box intactness of bolts, nuts,welding workouts and any other damage to L- plate of hanging support	√	√	√
iii.	Ensure proper provisioning of inter battery packing spacers.	X	√	√

iv.	Check the condition of the door seal, door lock and replace if any damaged or faulty. Test the operation and security of the locking handles and rectify if faults found. Apply a small amount of a suitable lubricant to the locking handle pivots.	X	√	√
v.	Apply grease to the battery box sliding mechanism and check freeness of operation.	X	X	√
vi.	Boost charging for 4-5 hours at 150V and with maximum current setting of 40A (SMI No. RDSO/PE/SMI/TL/0046-2012 Rev '1' dt. 15.07.13)	X	X	√
B2.	**BOGIE AND RUNNING GEAR**			
10	**SUSPENSION**			
i.	Examine the primary and secondary springs for signs of damage, cracks and broken end visually with torch light and tapping by a hammer & replace, if necessary.	√	√	√
ii.	Examine different types of dampers for oil leakage and intactness of fasteners and end fittings.	√	√	√
iii.	Proper torque of all fasteners related to suspension arrangement and mounting of equipments in underframe.	X	X	√
iv	Check the condition of various Spheriblock in the primary and secondary suspension arrangement and of various equipments mounted in the underframe like axle guide link, traction motor and its support arm, gear case support arm for their healthiness and replace, if necessary.	√	√	√
11	**TRACTION BAR**			
i.	Check and maintain Traction bar as per RDSO Special Maintenance Instruction No. RDSO/2009/EL/0259 Rev '0' Dated 09/12/2009	√	√	√
ii.	Check the well being and presence of the safety sling.	√	√	√
iii.	Check the push /pull rod pivot heads for damage.	√	√	√
iv.	Examine the traction link assembly for signs of damage. Any defective item should be renewed.	√	√	√
v.	Check the fastener at the traction ends and those retaining the traction rod for security. If a fastener is loose, it must be renewed and tightened to the specified torque. Ensure intactness of the locking plate.	√	√	√
vi.	RDPT of traction bar at end (flange) portion & V-Ring housing flange.	X	√	√
vii.	Examine limit chain and links for wear, corrosion or damage	√	√	√
viii.	Inspect the safety slings, pins and R clips for wear and damage.	√	√	√
ix.	Check Aclathan / Vulkollon ring against any crack or shifting.	√	√	√
12	**BOGIE FRAME AND BRAKE GEAR**			
i.	Maintenance practices, replacements of items, other related repairing of bogie frames components and modifications in the PBU/TBU should be done as per RDSO's SMI No. RDSO/2007/EL/SMI/0251 (Rev. '0') dated:01/01/2008 which has been issued vide letter no. EL/3.1.35/2 dated 4.01.08.	√	√	√
ii.	Check the brake rigging for loose, damaged or worn out parts. Rectify as required.	√	√	√
iii.	Examine the bogie frame, transom beam & yaw damper base for signs of crack/damage.	√	√	√
iv.	Examine all bogies mounted equipments (Including earthing straps) for signs of damage and security of fastening.	X	√	√
v.	Inspect the rubber bumps for damage deterioration. Replace if required.	X	√	√

vi.	Inspect the brake rigging rotation points and component contact surfaces. Rectify any faults found.	X	√	√
vii	Check the brake cylinder piston stroke.	X	√	√
viii	Check the TBU/PBU for air leakage.	√	√	√
ix.	Test Loco Brake Power. Refer RDSO's Maintenance Instruction No. RDSO/ELRS/MI/0003 Rev.('0')	√	√	√
x.	Inspect the bogie body safety pin eyehole at the bogie frame for wear or cracks.	X	X	√
xi.	Check the pneumatic pipeline systems for leakage.	√	√	√
xii.	Maintain the vertical & lateral clearances (Primary & secondary). Refer RDSO's technical circular no. ELRS/TC/0082 (Rev.'0').	X	√	√
xiii.	Check the earthing shunts provided on bogie and body.	√	√	√
xiv.	Check intactness or axle box cover bolts.	√	√	√
xv.	Inspect brake gear for any worn out loose, damaged, hanging or dragging parts. Confirm intactness.	√	√	√
xvi.	Test for correct operation of the brake cylinder actuator unit.	√	√	√
xvii.	Check the proper tightness of parking brake & service brake pneumatic pipes.	√	√	√
xviii.	Check the external hitting marks & physical damage on the brake cylinder actuator unit.	√	√	√
xix.	Check the condition of parking brake cylinder bellows. If damaged, replace them.	X	√	√
xx.	On parking brake cylinder pulling spindle & ring should be intact.	√	√	√
xxi.	Check proper functioning of parking brake & service brake cylinder.	√	√	√
xxii.	Check the operation (manual releasing) of the parking brakes	√	√	√
xxiii	Check the bogie isolating cock, should be in proper position.	√	√	√
xxiv	Check the wear of scrubber blocks, replace if required. (WAP5 only)	√	√	√
Xxv	Maintenance of Traction Motor support plate and bogie nose to Prevent crack/breakage of Traction Motor support plate (Holder for Traction motor suspension) should be done as per RDSO's SMI no. RDSO/2011/EL/ SMI/0269 (Rev.'0') dtd. 18.05.11.	X	X	√
xxvi	Maintenance of conventional type brake rigging on WAP7 locos.	To be done as stipulated in RDSO Modification sheet No. RDSO/2009/EL/ M S/0381 dated 7-9-09 and RDSO letter EL/3.1.35/2(3 phase) dated 20-10-11		
13	**WHEEL SET AND AXLE BOX**			
a)	Examine all the wheels visually for following defects.			
i.	Cracks: if any, requires replacement.	√	√	√

ii.	Flats: Length 40mm or more requires re-profiling.	√	√	√
iii.	Cavities: Isolated cavities of length 15mm or more or multiple cavities of length 10mm or more and less than 50mm apart require re-profile/ replacement.	√	√	√
iv.	Metal builds up Height 1mm. or above and length 50mm or more requires re-profiling. For length less than 50mm., remove the build up with hand tools.	√	√	√
v.	Scoring and Grooving: Circumferentially around the wheel tread due to action of brake blocks require re- profile/replacement.	√	√	√
c).	Measure and record the wheel diameters and tread profile. Take any corrective action if required. Refer RDSO's Tech. Circular no. ELRS/TC/0083 (Rev."0").	X	√	√
d)	Disconnect the electrical cable from the earth return unit. Remove the earth return unit from the axle. Examine the bearings and rear sealing position for signs of grease leakage or deterioration.	X	X	√
e)	Check the axle for any cracks with the help of ultrasonic flaw detector. At the same time visual inspection should be done.	X	X	√
f)	Check the temperature of axle boxes. The axle boxes which are running warm or reported to have higher temperature in comparison with others shall be attended on priority by physically opening of axle box cover and outer angle ring. The suitable maintenance shall be done either in-situ or by dismantling the axle box. WAP7 locomotives should be monitored especially.	√	√	√
g)	Check the earth brushes length and replaces it if required.	√	X	√
h)	Check the intactness of axle box cover bolt & ensure the availability of earth return shunt on axle box to body, bogie to body.	√	√	X
i)	Greasing to be done in suspension tube at NDE side. (WAP7&WAG9)	X	X	√
j)	It is reiterated that the existing maintenance practices for axle boxes in vogue e.g. dust free environment, proper use of cleaning agent and avoiding intermixing of components between different OEMs shall be ensured.			
14	**TRANSMISSION COUPLING (WAP5 ONLY)**			
i.	Check the alignment of transmission coupling	X	√	√
ii.	Check for any sign of oil leakage from the membrane & replace, if necessary.	√	√	√
iii.	Check for intactness of fasteners of various sub parts of transmission coupler	√	√	√
14a	**GEAR CASE (WAP5 ONLY)**			
i.	Externally clean the gear case	X	√	√
ii.	Inspect the gear box for any external hitting.	√	√	√
iii.	Inspect the gear case for any sign of oil leakage from pinion, intermediate gear and main gear labyrinth and gear case joints and body.	√	√	√
iv.	Check the level of oil in the gear case and fill to the requirement.	√	√	√
v.	Check the intactness and tightness of the oil filling cap in the top and bottom half of gear case.	√	√	√
vi.	Check the gear case sight glass for clear visibility of oil.	√	√	√
vii.	Check for the presence of protection cross, over gear case sight glass to avoid damage due to external hitting.	√	√	√
viii.	Visually check the gear case support bracket for gear case support arm mounting for development of any crack	√	√	√

ix.	Visually check intactness of all fastners of gear case	√	√	√
x.	Ensure proper torquing at prescribed torque of all fastners of gear case	X	√	√
xi.	Ensure proper sealing of magnetic drain plug with main gear labyrinth bolt with proper sealing wire. Check for any oil leakage from magnetic drain plug.	√	√	√
xii.	Visually check the gear case oil colour and replace the dirty/badly discoloured oil in gear cases, if required.	X	√	√
xiii	Hurth coupling 1&2 (For WAP 5 locos only): Check for any abnormality for any damage in star point, leakage of oil or damage to membrane. Check closely the intactness and proper condition of bolts and nuts.	√	√	√
14b	**GEAR CASE (WAP7/WAG9/WAG9H)**			
i.	Externally clean the gear case & its gauge glass. Inspect for any signs of oil leakage and any external hits/damage. Verify integrity of gauge glass protective cover.	√	√	√
ii.	Check the oil level in the gauge glass and top up if required. Ensure intactness of the drain plug along with its sealing. Check its tightness.	√	√	√
iii.	Check for any breakage of bolt and replace.	√	√	√
iv	Check for intactness of all fastners of gear case	√	√	√
v	Tighten all gear case fastners at prescribed torque	X	√	√
vi	Check the oil level in the gear case and fill to the requirement	√	√	√
C.	**POWER SUPPLY**			
15	**PANTOGRAPH**			
i.	Visually examine the entire head structure of the pantograph including horn, wear stripes & support assemblies for crack. Replace any defective items.	√	√	√
ii.	Non-destructive testing like DPT of critical pantograph sub- equipments like support assembly be done	X	X	√
iii.	Check for any bent or bowed pans, leakage in operating cylinder & proper functioning of dampers & pan springs.	√	√	√
iv.	Check that the pan head locking pins springs are in place and secure. Check that the head moves freely on its mounting pins attached to the apex frame. If movement is not free, check that the head is not twisted, the side beam are not bent/twisted & mounting pins are not loose or bent.	√	√	√
v.	Check tightness of the shunt connecting screws. When a loose screw is found the shunt should be disconnected from the head &/or the pantograph frame, the mating surface cleaned & the shunt reconnected with new screws.Check all shunts for frayed strands and renew any shunt in which 25% or more of the strands are frayed.	√	√	√
vi.	Examine for any cracks on the body & the bow assembly.	√	√	√
vii.	Check for proper operation – raising & lowering & adjust the raising & lowering time if required.	√	√	√
viii.	Check and adjust the contact force with the help of 9 kg mass.	X	X	√
ix.	Lubricate all grease points using grease gun.	X	X	√
x.	Clean foot mounting insulators & check for any cracks, chipping off etc. Apply specified grease and polish with a soft lint free cloth.	√	√	√
xi.	Check the dampers of pantograph for any oil leakage.	X	√	√
xii.	Check the pneumatic pipeline on roof for any air leakage with soap solution.	X	√	√
16	**ROOF EQUIPMENT**			

i.	Examine the insulators (VCB insulator, pantograph insulator, high voltage bushing insulator, surge arrester ,primary voltage transformer insulator etc.) for cracks, burning and damage. Renew defective item.	√	√	√
ii.	Clean the porcelain insulators, voltage transformer insulator, surge arrestor insulator, Apply specified grease and polish with a soft lint free cloth.	√	√	√
iii.	Examine the roofline conductors for defects/looseness at joints.	X	√	√
iv.	Examine the roof isolation switch for signs of defect/ proper connection.	X	√	√
v.	Check the roof for any foreign material such as wire / cloth pieces.	√	√	√
vi.	Check the tightness of roof bolts and roof joint support clamp.	X	√	√
vii.	Potential transformer secondary connection to be checked after opening cap.	X	X	√
17	**VCB**			
a.	Remove the bottom cover and check that the control air and electrical connection are tight. Ensure that there is no leakage from pressure regulator.	X	X	√
b.	**Insulator**			
i.	Clean the insulator with soft, clean & dry cloth (Do not use cleaning products based on fluorated or chlorated compounds or sodium metasilicate)	√	√	√
ii.	Check insulator for cracks, chips, flash marks etc. If damaged in service, the insulator must be renewed.	√	√	√
iii.	Smear the insulators with the specified grease and Polish with soft lint free cloth.	X	X	√
c.	**Connection for Earthing Isolator.**			
i.	Check for damage to connection of the earthing isolator	X	√	√
ii.	Cleaning & greasing, if necessary.	X	X	√
d.	**H.V Connection.**			
i.	Check the tightening torque 70Nm.	X	√	√
e.	**VCB fixing Screw.**			
i.	Check the torque of fixing screw tightening torque 70Nm.	X	X	√
f.	**Earthing Switch**			
i.	Check that when operating the arm of VCB earthling Switch, the contacts make proper contact on both sides	X	√	√
ii.	Check that copper braid is undamaged and properly Connected.	X	√	√
g.	**Earthing Connection.**			
i.	Check the earthing connection tightening torque 70Nm.	X	√	√
ii.	Maintenance of earthing system in 3-phase locomotives type WAP5, WAP7 & WAG9 (As per RDSO/2007/EL/SMI/248 Rev.'0' dtd. 22.11.2007)	√	√	√
h.	**Pneumatic Circuit.**			
i.	Check the sealing of connectors, flexible pipe, regulator, air tank etc.	X	√	√
i.	**Auxiliary Switch.**			
i.	Check drive screw for breakage or other damage.	X	X	√
ii.	Check the parts of control rod and stay bolt for any deformation.	X	X	√
iii.	Check the cables and lugs for broken cables, lugs looseness.	X	X	√
iv.	Securing of auxiliary blocks and support (Tightening torque-1.2Nm)	X	X	√
v.	Check the working order of each auxiliary contacts.	X	X	√
j.	**Pressure Switch.**			
i.	Check the tightness of pneumatic connection.	X	X	√
18	**HARMONIC FILTER**			

i.	Examine the roof-mounted resistor for any signs of damage or overheating or presence of foreign materials and clean debris away from the resistor.	√	√	√
ii.	Check electrical connections are secure.	X	√	√
iii.	Clean the filter resistor and its insulators.	X	X	√
iv.	Visually inspect the contact tips of contactors for signs of arcing damage. Repair / replace the defective parts.	X	√	√
v.	Visually inspect the capacitor elements inside the cubicle, checking for signs of damage.	X	√	√
vi.	Perform functional checks ensuring the main and Aux. Contacts operate correctly.	X	X	√
19	**MAIN TRANSFORMER**			
i.	Read off the oil level on the gauge situated on the conservator. Top up the oil as necessary and check for any signs of leakage. Clean the gauge with dry cloth.	√	√	√
ii.	Inspect the colour of the silica gel. If it is pink, reactivate silica gel by heating in a shallow open pan with bottom of wire/mesh at a temperature of 1000C approximately for two to three hours when the crystals should have regained original blue tint.	√	√	√
iii.	Examine the H.V. bushing for signs of damage, burning etc. Replace if defective.	X	√	√
iv.	Examine the flanges of the pipe couplings and flexible hose that link the transformer and conservator.	√	√	√
v.	Check the availability of hosepipe over the oil pipe compensators.	X	√	√
vi.	Check the main TFP and its protection cover for any damage, crack & oil leakage. Also refer instructions contained in RDSO's letter no. EL/3.2.1/3-Ph dated 30.07.09 for arresting oil leakages cases."	√	√	√
vii.	Check the oil leakage from TFP bushing.	X	√	√
viii.	Check the deformity of TFP drain cock protection cover guard if deformed replace it	√	√	√
ix.	Perform the sample test on transformer oil. Check specific value of BDV, moisture and acidity and condition monitoring of loco transformer by Dissolve Gas Analysis. (RDSO/SMI/138 & OEM Doc. Dt. 27th Nov. 1995).	X	X	√
x.	Check visually the transformer foundation bolt and Nylock Nut for proper locking.	X	√	√
xi.	Check the earthing cable.	√	√	√
xii.	Clean and visually inspect the insulator and connection of transformer and converter for crack & flashed mark.	X	√	√
xiii.	Visually inspect the condition of oil cooling metallic pipes, check for leakage / damage & check all fixing clamps.	X	√	√
D.	**PROPULSION SYSTEM**			
20	**TRACTION CONVERTER**			
i.	Check the oil level indicator situated on the conservator (Expansion Tank). If the oil is below the minimum mark-top up with the specified oil. Check for any signs of leakage.	√	√	√
ii.	Visually examine Oil pipe joints for leaks, loose or missing screws and correct as necessary.	√	√	√
iii.	Examine the two flange joints for leaks, loose or missing screws. Check gaskets/oil seals, if dismantling is required.	√	√	√

iv.	Examine all electrical equipment of traction converter for signs of dirt, corrosion, damage etc. Remove all dust/dirt deposits from the connection insulators.	X	√	√
v.	Check the cable connection of Sichem connectors of differential amplifier provided below SR oil pump.	X	√	√
vi.	Clean the isolating blade and spring contact of earthing switch. Lightly lubricate with the specified grease.	X	X	√
vii.	Clean DC link capacitors by blowing after opening side cover. Check that there is no sign of leakage from the capacitors.	X	X	√
viii.	Clean resonance circuit capacitor.	X	X	√
ix.	Cleaning by Vacuum cleaner.	X	X	√
x.	Check the tightness of SR electronics PCB.	X	X	√
xi.	Ensure sealing of incoming cable gland of control card rack to avoid dust entry.	X	X	√
xii.	Check the condition of silica gel. If pink replace with dried silica gel.	√	√	√
xiii.	BDV and DGA test of converter oil to be done.	√	√	√
xiv.	Check the ventilation fans of traction converters	X	X	√
21	**TRACTION MOTOR**			
i.	Examine all traction motors for signs of damage, dents or other defects caused by ballast. Check air outlets are not obstructed in any way.	√	√	√
ii.	Check traction power cables, speed sensor and temperature sensor cables and ensure that they are not chamfered or damaged in any way.	√	√	√
iii.	Lubricate the both end bearings using a grease gun with specified grease.	X	X	√
iv	Tightness of both end cover bolts of Traction Motor.	X	√	√
v.	Check the intactness of the junction box cover and bolt	X	√	√
vi.	Check the condition of bearing by seeing the grease, which comes out from grease inlet. Check the condition of grease too.	X	X	√
vii.	The locking plate arrangement of support plate, if not available please provide.	√	√	√
viii.	Check the condition of traction motor spheriblocks and torque arms, fastners for their intactness. Replace if required.	√	√	√
ix.	Check the condition of speed pulse generator unit on TM (NDE) for any grease ingress.	X	X	√
x.	Check the suspension tube bearing grease (NDE end) & do the greasing. (FOR WAG9 /WAG9H/WAP7)	X	X	√
xi.	Open TM junction box at body side and check the tightness of connections.	X	√	√
xii.	Check the condition of bellows and replace if required	X	√	√
xiii	Checking of grease metal content during schedules, whenever grease available.	X	X	√
xiv	Replacement of WAP7 gear case Oil with 460 RR of IOC in the earliest schedule available.	√	√	√
E	**AUXILIARY SYSTEM**			
22	**AUXILIARY CONVERTER CUBICLES ELECTRONIC RACK**			
i.	Clean the dust by vacuum cleaner.	X	X	√
ii.	Check the working of ventilation fans of auxiliary converters.	X	√	√
iii.	Check the tightness of connections of control cards.	X	X	√
23	**BATTERIES**			
i.	Check electrolyte and top up when necessary to prevent level dropping below specified level.	X	√	√

ii.	Remove any dirt deposits or electrolyte spilling from around batteries.	X	√	√
iii.	Check specific gravity of electrolyte & Individual cell voltage	X	√	√
iv.	Clean & check tightness of electrical connections and apply white petroleum jelly.	X	√	√
v	Ensure proper packing of inter batteries.	X	√	√
vi	Check the healthiness and tightness of control wire giving feedback of battery voltage to the electronics.	X	√	√
24	**LIGHTS**			
i.	Check lighting units for physical damage, tightness of fixings and connections, particularly look for signs of overheating or burning. Replace bulbs/tubes, which have failed.	X	√	√
ii.	Clean all internal light unit diffusers, bulbs or tubes and reflectors.	X	√	√
iii	Clean the glasses of the headlight lamp and marker light.	√	√	√
iv	Ensure that there is no entry of water through head light lamps.	X	√	√
v	Check for crack or breakage of the aluminium casing of headlight beams.	X	√	√
vi	Check the proper operation of flasher light ,marker light (red & white), headlight, cab lights, disc light, m/c. room light.	√	√	√
25	**OIL COOLING UNIT CASING WITH RADIATOR**			
i.	Remove all dust, dirt and debris from the radiator chamber via the machine room access cover. (By using vacuum cleaner).	X	√	√
ii.	Clean radiator with hot water jet.	X	√	√
iii.	Measure air delivery before and after cleaning of radiator.	X	√	√
iv.	Measure vibrations of oil cooling casing using vibration analyser and take appropriate action	X	√	√
v.	Visually check the casing and support arrangement for oil pumps on the casing for any sign of crack of the damage	√	√	√
vi.	Check that all the foundation bolts of the casing mounted on to the radiator are intact.	X	√	√
vii.	Tighten the front foundation bolts of casing mounted on to the radiator	X	X	√
viii.	Visually check the conservator tank along with its gauge glass for any sign of crack / damage / oil leakage.	√	√	√
ix.	Visually check the oil cooler radiator for any oil leakage/external damage.	√	√	√
26	**OIL CIRCULATING PUMPS (SR & TFP)**			
i.	Visually examine all the four oil pumps for any oil leakage / any abnormal sound and take needful action.	√	√	√
ii.	Check the electrical connections of all four oil pumps	X	X	√
iii.	Check the mechanical support fasteners of all four oil pumps		√	√
iv.	Measure the current of all four oil pumps.	X	X	√
27	**All Auxiliary Blowers and Motors**			
i.	Check all the auxiliary motors for any abnormal sound and proper functioning.	X	√	√
ii.	Measure the current of all auxiliary motors	X	X	√
iii.	Visual examination / RDPT of impeller of OCB.	X	√	√
iv.	Check tightness of foundation bolts of all auxiliary motors.	X	√	√
v.	Check the electrical connections of all auxiliary motors.	X	X	√
vi.	Check the condition of all flexible hoses connected with various auxiliary blowers and replace, if required.	X	√	√
vii.	Check tightness of SB and cable connections at terminal box.	X	√	X
viii.	Greasing of all motors with recommended grease	X	X	√

ix.	Ensure that the terminal covers of various auxiliary motors are intact and water tight. Special attention needs to be given to main compressor motor cable layout and water tightness of its entry point into the motor terminal.	X	√	√
28	**ROOF AND SIDE BODY FILTERS**			
i.	Thoroughly clean all roof and side body filters with water jet.	X	√	√
29	**AUXILIARY TRANSFORMER 1000V/415V**			
i.	Check that all connections are secure and there is no physical damage.	X	X	√
ii.	Clean all dirt and dust deposit by means of blowing out, brushing with a non-metallic brush or by rubbing with a cloth.	X	X	√
30	**SB1 & 2, HB1 & 2 AND FB PANEL / CUBICLE**			
i.	Clean the various equipments fitted inside the SB, HB & FB cubicle.	X	X	√
ii.	Ensure tightness of various electrical connections in SB, HB & FB cubicles.	X	√	√
iii.	Ensure tightness of various MCBs in SB & HB cubicle.	X	√	√
iv.	Visual examination of various EPCs & EMCs fitted inside FB cubicle and ensure that there is no leakage and they are functioning properly.	X	X	√
v.	Check the tightness of various PCB cards in central electronics.	X	X	√
vi.	Check the RC input filter circuit for any abnormality and measure the resistance value.	X	X	√
vii.	Ensure that the various support plates of SB, HB & FB cubicle are healthy and intact.	√	√	√
viii.	Ensure that various foundation bolts SB, HB & FB cubicle are intact and tight.	X	√	√
ix.	Ensure the healthiness/proper functioning of rotating switch 152, 154 and 237.1 on its various locations.	X	√	√
x.	Ensure proper functioning of thermostat of central electronics	X	X	√
xi	Check visually for any abnormality in SB, HB & FB cubicle	√	√	√
31	**Fire Detection Unit**			
i.	Clean the pipeline air inlet holes with soft non-metallic brush and vacuum cleaner.	X	√	√
ii.	Calibrate the FDU and set voltage at test point zero 0 + 50 mV.	X	√	√
F	**AIR SUPPLY AND PNEUMATIC SYSTEM**			
32	**COMPRESSOR**			
A.	**MAIN COMPRESSOR**			
i	Check the pressure build up timing of each compressor independently in pre-inspection and take needful action during inspection.	X	√	√
ii.	Feel the vibrations of the compressor in pre-inspection and taken needful action during inspection.	√	√	√
iii.	Check for any external damage / abnormal sound / proper functioning of the compressor.	√	√	√
iv.	Check the complete compressor support brackets for their healthiness.	√	√	√
v.	Visually examine the compressor mounting resilient blocks and take needful action.	X	√	√
vi	Visually examine the various interconnecting pipelines and its support clamps of the compressors for their healthiness / air leakage.	√	√	√
vii.	Cleaning of input air filter.	X	√	√
viii	Clean the primary oil filter.	X	√	√
ix	Clean the breather assembly	X	√	√
x.	Cleaning of inter cooler / after cooler assembly.	X	√	√

xi.	Drain the inter cooler / after cooler assembly and also observe its discharge and take needful action.	X	√	√
xii	Greasing of main compressor motor bearing.	X	X	√
xiii.	Ensure healthiness / intactness of various protection guards of compressor.	√	√	√
xiv.	Check the condition of the coupling between compressor & motor	X	√	√
xv.	Visually check the compressor fan blade for their healthiness	√	√	√
xvi.	Check the oil level in the compressor and top up as per requirement.	X	√	√
xvii.	Carry out the inspection of each type of compressor in line with recommendation of respective manufacturer.	X	√	√
xviii	NRV and unloader valves fail due to ingress of Carbon which extracted from CP. So, One cycle dismantling, checking and cleaning of NRV and unloader to be ensured in all type of 3- phase locomotives.	X	√	√
B.	**Aux. Compressor (CPA)**			
i.	Clean the CPA externally.	X	√	√
ii.	Clean Suction Air filter.	X	√	√
iii.	Check oil level and condition of oil and top up if required with the oil specified (Servo Press 150).	√	√	√
iv.	Clean commutator of CPA motor. Check carbon brush and its holding assembly and replace worn out / defective carbon brushes and associated equipments.	X	√	√
v.	Check connection tightness.	√	√	√
vi.	Check tightness of all nut bolts, foundation bolts.	√	√	√
vii.	Measure and record time & pressure of the auxiliary compressor	X	√	√
33	**AIR DRYER**			
i.	Inspect the air dryer for any damage and its mounting for any damage, crack in mounting plate, intactness of fastners. Check for any hit mark on main reservoir and drain cock. Check for any air leakage in the air dryer-CP pneumatic pipeline.	√	√	√
ii.	Check the integrity of the welding of the hanging support.	√	√	√
iii.	Check humidity indicators for blue colour. White indications means the air dryer is not operating effectively. Desiccant shall be changed, if needed.	X	√	√
iv.	Replace desiccant if found to be contaminated with either water or oil.	X	√	√
v.	Testing of air dryer for proper functioning to be done as per Technical Circular no. RDSO/2011/EL/TC/0108, Rev.'0' dtd. 7.3.11 for testing of air dryers and its efficacy on electric locomotives in Electric Loco Sheds/Workshops has been issued to Railways vode letter no. EL/3.2.19/1 dated 7.3.11.	√	√	√
vi.	Check the correct operation of purge valve.	√	√	√
vii.	Check for proper position of the air dryer angle cocks.	√	√	√
34	**E-70 BRAKE SYSTEM**			
a.	**Auto Drain Valve**			
i.	Check for proper functioning of the valve.	X	√	√
ii.	Check for any damage due to any external hitting.	√	√	√
b.	**BRAKE CONTROLLER (AUTO AND DIRECT)**			
i.	Check the functioning of driver's direct air brake & automatic train brake.	√	√	√
ii.	Check the free movement of the brake controller.	√	√	√

iii.	Perform repeated application and release of brakes with both auto and direct brake controller from both cabs and ensure that BP & BC pressure build-up & drop is proper on the gauge. Ensure by physically going to individual main and parking brake cylinder that their operation is smooth and without air leakage.	√	√	√
c.	**PNEUMATIC PANEL**			
i.	Visually inspect the pneumatic panel noting any sign of air leakages and rectify accordingly.	√	√	√
ii.	Clean the pneumatic panel externally.	X	√	√
iii.	Check for correct position of the cut out/isolating cock.	√	√	√
iv.	Check all the cable connections for looseness or deficiency of cleats. If any inspection section is to be informed	X	X	√
v.	Ensure provisioning and proper functioning of RS gauge on pneumatic panel.	X	√	√
d.	**BRAKE ISOLATING COCKS**			
i.	Check for correct operations of BP & FP angle cocks. Check the condition of BP/FP pipe, cock & isolating handle for any hit mark or crack.	√	√	√
e.	**BRAKE HOSES.**			
i	Examine the brake hoses at the ends of the locomotive to make sure that they are not chafed or damaged. Check coupling cocks for correct operation.	√	√	√
f.	**EMERGENCY EXHAUST VALVE**			
i.	Test for correct operation.	√	√	√
g.	**AIR RESERVOIR**			
i.	Blow down and drain the reservoir until exhaust of complete water and oil. Check all drain cocks are closed on completion.	√	√	√
ii.	Check for any hit mark on main reservoir & drain cock	√	√	√
	Ensure intactness / tightness of main reservoir foundation bolts.	√	√	√
iii.	Measure and record the MR leakage and ensure it to be within prescribed limit.	X	√	√
iv.	Check the rubber gasket at the inspection cover of air reservoir for any damage/leakage.	X	√	√
h.	**PRESSURE REGULATOR**			
i.	Check the pressure regulator operates correctly	X	√	√
i.	**THROTTLE VALVE**			
i.	Overhaul the throttle valve and change the rubber parts.	X	X	√
j.	**IN LINE FILTER**			
i.	Remove the filter element and clean thoroughly.	X	X	√
k.	**HORN & HORN SWITCH**			
i.	Check condition of horn handle for any damage. Check for proper operation of horn.	√	√	√
ii.	Check the condition of horn boots and replace if required	X	√	√
iii.	Remove the horn & horn switch and Overhaul. Replace the diaphragm of horn.	X	X	√
l.	**ANGLE COCKS.**			
i.	Check all angle cocks for proper operation	√	√	√
ii.	Ensure proper functioning of BP & FP angle cocks of both cabs in open and close position with the help of dummy having calibrated BP/FP gauge. Check the angle cock and flexible holes of BP & FP for any air leakage	√	√	√
iii.	Measure and record BP & FP leakage.	X	√	√

iv.	Ensure proper colour code of all the angle cocks.	√	√	√
m.	**BRAKE ELECTRONICS**			
i.	Check the tightness of the brake electronics control cards holding screws.	X	√	√
n.	**PIPE LINES AND CLAMPS.**			
i.	Check all the pipes for leakage of damage. Check all the clamps for any damage and looseness.	X	√	√
35	**BRAKE BLOCK**			
i.	Inspect the brake blocks for wear. If it is below the minimum limit, replace the complete locomotive set brake block.	√	√	√
ii.	Check the brake block key security.	√	√	√
iii.	Check for the wear of the brake pads and replace if required (for WAP5 only)	√	√	√
iv.	Check and adjust the clearance of brake pads/blocks from the wheel disc (for WAP5 only)	√	√	√
v.	Check the condition of brake caliper, its pin and bushes and availability of locking split pin. Check the condition of brake pad and security of brake pad/block keys, replace if required (for WAP5 only).	√	√	√
vi.	Check the condition of brake disc. for any decolourisation or chipping off or any other external damage. (for WAP5 only)	√	√	√
vii.	Check the intactness of brake disc bolts.(for WAP5 only)	√	√	√
G	**INTERIOR**			
36	**INTERNAL DOORS**			
i.	Lubricate machine room door hinges with a general purpose oil. Wipe away excess oil from around hinge.	X	√	√
37	**INTERNAL DOOR LATCHES**			
i.	Check door latches / locks for correct operation and damage.	X	√	√
38	**CUBICLE DOOR LOCKS**			
i.	Check all security locks are effective clean Kaba locks using specified cleaner.	X	√	√
39	**DOOR SEALS**			
i.	Check the condition of the door seals and replace if torn or damaged.	X	X	√
40	**CAB FLOOR**			
i.	Clean the cab floor with a suitable cleaning agent.	√	√	√
41	**BLINDS**			
i.	Clean the blind material.	√	√	√
ii.	Check for roller mechanism fitted to the blinds for correct operation.	X	X	√
42	**Driver's seat**			
i	Examine all components for wear, looseness scoring and cracks, renew any defective components.	√	√	√
ii	Check seat-mounting points for integrity and ensure fixing for fully tightening.	X	√	√
43	**CAB EQUIPMENT**			
a.	**Master Controller**			
i.	Calibrate the angle transmitter	X	X	√
ii.	Grease Camshafts, seats under control handles and other moving parts if stiff to operate or dry of lubricant.	X	X	√
iii.	Check that the contacts are operating correctly by the camshaft and adjust if necessary.	X	X	√
iv.	Check that the rollers are free to rotate and all wiring is sound and secure. Operate handles and ensure interlock functions correctly.	X	X	√

v.	Ensure that caps have been provided to cover the auxiliary contacts.	X	X	√
vi.	Check the absolute value of transmitter.	X	X	√
vii.	Check the tightness of the fasteners & cable connection.	X	X	√
b.	**Driver's Desk**			
i.	Clean the surfaces of the driver's desk with a soap solution and cloth, taking care not to allow water to enter electrical cubicles.	X	√	√
ii.	Clean the dust filter on the buzzer using a soft brush without using the pressure / compressed air.	√	√	√
iii.	Ensure that transparent rubber caps provided over the push buttons of driver desk.	√	√	√
iv.	Check the switches, lamps and gauges on driver's desk, their tightness and clean.	√	√	√
v.	Check correctness of reading of BP, FP, MR, BC & AFI gauges.	√	√	√
vi.	Clean the battery, OHE and TE/BE meters in both cabs and check for zero error	X	√	√
vii.	Check Battery voltage with normal, on load and note charging voltage and current charge battery if low.	√	√	√
viii.	Check the working of the Emergency Push Button Switch for correct operation.	√	√	√
ix.	Check the proper functioning of all the gauges of the driver desk BP: (i) Normal (ii) with 7.5 mm hole FP: (i) Normal (ii) with 7.5 mm hole MR: (i) Mainline MR leakage without application of SA-9 (ii) Mainline MR leakage with application of SA-9	√	√	√
c.	**Cab Heater and Crew Fan**			
i.	Check the cables & examine the cab heater on position.	X	√	√
ii.	Check the working of cab heater/blower and crew fan.	√	√	√
d.	**Speedometer**			
i.	Check & adjust wheel dia. accordingly to actual wheel dia.	X	X	√
ii.	Check for proper display of date, time, km. earned. Adjust the clock time if necessary.	√	√	√
iii.	Check for any damage to the memotel & pulse generator, protection guard of PG, cable and couplers	√	√	√
iv.	Open the PG from axle box cover & check intactness of the fork bolt with the fork	X	X	√
v.	Read the data from memory card for proper working	X	√	√
44	**Key interlocking**			
i.	Check all keys are present & the complete system is operational.	√	√	√
45	**Fire Extinguisher**			
i.	Ensure availability of fire extinguishers and ensure that it is not expired.	√	√	√
ii.	Check the condition of CO2 gas cylinder, its regulator and pressure gauge in both cabs. Check the CO2 gas pressures. Refill if necessary	X	√	√
iii.	Clean pipeline by compressed air and check that there should not be any leakage.	√	√	√
46	**OIL LEAKAGE IN MACHINE ROOM / CLEANING OF MACHINE ROOM.**			
i.	Visually inspect the machine room for any signs oil leakage from traction converter, transformer, D.C. Link, and series resonant circuit capacitors and other electrical equipment and carefully clean the same.	√	√	√

ii.	Clean the complete machine room with the air pressurized supply and vacuum cleaner to remove all the dust particles.	X	√	√
iii.	Clean fire detection pipeline air intake holes with soft non- metallic brush & vacuum cleaner.	X	√	√
iv.	Ensure the intactness / firmness of cable connection of Sichem couplers of differential amplifiers provided below SR oil pump.	X	X	√
47	**SCHEMATIC NUMBER OF VARIOUS COMPONENTS**			
i.	Ensure that schematic numbers of various equipments are intact. To be provided in case of deficiency.	X	√	√
H.	**GENERAL**			
i.	Carryout detail checks on any unusual occurrences reported by drivers in the loco log book and the same should be relayed to the shed through TLC.	√	√	√
ii.	The DDS of the loco to be thoroughly examined and needful action be taken.	√	√	√
iii.	Ensure proper functioning of vigilance control device	√	√	√
iv.	Ensure proper functioning of auto flasher light, marker light and head light	√	√	√
v.	Air delivery measurement in 3-phase locomotive to ascertain proper cooling and pressurization of Machine Room. (As per RDSO/2009/EL/ SMI/0255 Rev.'0', dtd.08.05.2009)	X	√	√
vi	Working of ACP	√	√	√
vii	Working of VEF	√	√	√

II. MAJOR SCHEDULE ACTIVITIES

MAJOR OVERHAUL SCHEDULE FOR WAP5, WAP7, WAG9 & WAG9H LOCOMOTIVES					
SN	**Activity**	**Ref.**	**MOH**	**IOH**	**POH**
A	**LOCO BODY:**				
1	**Roof bow fasteners:** Remove the converter and pantograph roof hatches, then check the security of the roof bow fasteners. Tighten the fasteners if necessary.	M+R, Vol. D1	√	√	√
	Check the tightness of roof bolts and roof joint support clamps.		√	X	X
2	**Roof hatch gaskets:** Replace the gaskets around the pantograph and converter roof hatch.	M+R, Vol. D1	X	√	√
3	**Roof hatch rubber seals:** Replace the rubber seals around the pantograph and converter roof hatches, and the roof beam. Visually check the cab roof GRP caps for any damage/crack and condition of its fixing rivets	M+R, Vol. D1	X	√	√
4	**Body Structure**				
	Check the body structure for damage. Repair any damage found.		√	√	√
	Repaint the loco body with PU paint (complete exterior & interior) as per RDSO letter no. EL/0.2.1(paint) dated 22-4-2010 and replace decals (stickers)		X	√	√
	Dismantle all the equipment/gauge from the driver's desk panel A, B, C and D. Repaint the cab interior with PU paint.		√	√	√
	Check the condition of fiber body above buffer and CBC coupler and change if required.		√	√	X
	Replacement of fiber body above buffer and CBC coupler.		X	X	√
	Check for leaks around roof hatches, door & window. Rectify fault found.		√	√	√

5	**Exterior Finish**	M+R, Vol. D1			
	Wash the exterior of the locomotive to remove all dirt and debris (For coaching locos - once in 10 days)		√	√	√
	Wash the exterior of the locomotive to remove all dirt and debris (For Freight locos)		√	√	√
	Check the body structure for chips, scratches, evidence of corrosion or other damages to paint. Repair the paint as necessary.		√	√	X
	Remove the SS wire mesh, louvers and inertial filter of M/c rooms and traction motor blower. Thoroughly clean with pressurised hot water jet. Replace SS wire mesh if torn or damaged. Replacement of seals involved in fitment of side body and roof filters.		√	√	√
	Check the various louver panels to ensure they are clean and free from debris. To remove dirt, Wash vents with detergent/ water solution and thoroughly clean with a stiff non-metallic brush.		√	√	√
	Check the condition of sanding pipe & proper alignment of sand pipe, adjust if required.		√	√	√
6	**Flexible hoses and couplings:**	M+R, Vol. D1			
	Examine the brake hoses at the end of the locomotive to make sure that they are not chafed or damaged.		√	√	√
	Replace all pneumatic hoses.		X	√	√
	Replace the hoses between – a) the bogie frame connection and the brake cylinders and b) the locomotive under frame and bogie		X	√	√
	Check coupling cocks for correct operation		√	√	√
7	**Draft gear & couplers:**	M+R, Vol. D1			
	Replace complete CBC assembly including draft gear.		X	X	√
	Dismantle, inspect for any damage or excessive wear.		√	√	X
	Clean and check transition coupling by RDPT for any flaw/crack		√	√	X
	Check condition of Draft gear, Overhaul as prescribed or replace if necessary.		X	√	X
	Remove and replace the striker block wear plate.		X	√	X
	Check the knuckle by RDPT for cracks.		√	X	X
	Replace knuckle, clevis, clevis pin and yoke pin.		X	√	X
	Check the intactness of CBC bottom support plate and liners		√	√	√
	Liberally apply general-purpose grease to the face of the CBC at the end of locomotives. Check for proper operation.		√	√	√
8	**Buffers:**	M+R, Vol. D1			
	Thoroughly clean. Check for sign of excessive stroke		√	√	√

	Check for cracks on the foundation through RDPT.		√	√	X
	Replace the buffers along with fasteners with new one.		X	X	√
	Replace all rubber rings of the buffers.		X	√	√
	Check if buffers are spinning and repair as necessary.		√	√	X
	Check buffer height and adjust buffer length as required.		√	√	√
	Liberally apply general purpose grease .to the face of the buffers at the ends of the locomotive, threads, and buffer shaft. Also smear grease on the buffer head plunger.		√	√	√
9	**Cattle guard:**	M+R, Vol. D1			
	Check for any damage/bend/breakage. Change, if required		√	√	X
	Replace cattle guard along with fasteners with new one		X	X	√
	Check and adjust clearances of rail guard from rail level.		√	√	√
	Check cattle guard fasteners for breakage.		√	√	√
	Check cattle guard base and repair/change as required.		√	√	√
10	**Doors & Steps:**				
	Inspect cab door latch, lock, hinges and catch assembly for correct operation and damage. Repair any fault found.		√	√	√
	Lubricate hinges, latch and locks with general- purpose oil. Wipe away excess oil from around hinge.		√	√	√
	Check the condition of the door seals and replace if torn or damaged.		√	X	X
	Replace door seals and any other worn out part.		X	√	√
	Check the condition & intactness of foot step. Replace if required.		√	√	√
11	**Washer and Wipers:**	M+R, Vol. D1 & SD Vol.F1			
	Overhaul the wind screen wiper/washer system including overhauling of wiper motor and washer pump.		√	√	√
	Check the water level in the reservoir at No.1 and No. 2 end of locomotive and top up, if required		√	√	√
	Clean the washer tank and washer jet nozzle,		√	√	√
	Check for proper functioning of wiper/washer system. Rectify fault founds		√	√	√
	Check Wiper motor driver shaft seal, wiper arm, pneumatic and water hoses and wiper blade and other components for wear, looseness, scoring and cracks, renew if any defects.		√	X	X
	Adjust the position of wiper arm.		√	√	√
	Replace wiper motor driver shaft seal, wiper arm, pneumatic and water hoses, wiper blade and idler shaft assembly.		X	√	√
	Check seat mounting points for integrity and ensure fixing or fully tightened		√	X	X
12	**Wind screen and windows:**	SD Vol.F1			

	Clean with detergent/water solution & Check for any cracks etc on the windscreen and window glasses and if required replace the glasses.		√	√	√
	Replace all Front Lookout Glass and Side Glass with new one.		X	X	√
	Check and rectify the windscreen guard grills. Tighten the windscreen guard grill retaining bolts.		√	√	√
	Clean dirt and debris from the channel below the cab-sliding window. Clear the sliding window channel drain hold in the door opening.		√	√	√
	Examine all windscreens and side windows for leaks. Remove wind screen/window and re-seal if leaks appear.		√	√	√
	Check the condition of seals of cab window, sliding window, Splash shield, windscreen shield and rubber flap on the cab side window drainage channel outlet. Replace if required.		√	√	X
	Replace the seals of cab window, sliding window, Splash shield, windscreen shield and rubber flap on the cab side window drainage channel outlet.		X	X	√
13	**Pivot Post:**				
	Check Pivot post for any crack RDPT (WAP5).		√	√	√
	Check the of pivot post after complete disassembly for any crack by RDPT.		X	X	√
B1	**Under frame:**				
14	**Sanding equipments:**	M+R, Vol. D1& SD Vol.F12			
	Empty the sandbox, steam clean and inspect for any corrosion. Repair any corrosion found and then repaint.		√	√	√
	Fill the sand in all sand boxes		√	√	√
	Overhaul the sand trap & injector valves and clean sander nozzle.		√	√	√
	Replace sander hosepipe and seal in the sand box lids.		√	√	√
	Check exhaust nozzles for wear or damages. Replace if necessary.		√	√	√
	Check sanding gear for correct operation for both direction of travel.		√	√	√
	Check the security of the sand box fasteners. Tighten the fasteners if necessary.		√	√	√
	Check the security of the support beam and hose fasteners. Tighten the fasteners if necessary.		√	√	√
	Check/tighten/replace all fasteners.		√	√	√
	Visually check the condition and alignment of sanding pipes.		√	√	√
	Measure the rate of sand flow at each wheel. Adjust the sanding valve if the flow is not within specification.		√	√	√
15	**Battery Box:**	M+R, vol. D2, SD Vol. F10			

	Visually Inspect the battery box for any external hits and damages. If required repair the battery box.		√	√	√
	Overhauling of the battery box.		√	√	√
	Check the integrity of the welding hanging support for any cracks/damage through RDPT. Repair if required		√	√	√
	Open the battery box cover and pull out the battery tray. Apply grease to the battery box sliding mechanism and check its free movement on the slide way. If required – Repair.		√	√	√
	Clean the battery acid from the battery box and tray		√	√	√
	Ensure proper locking of the battery tray in the battery box.		√	√	√
	Replace all fasteners of battery boxes with new one		X	X	√
	Check the condition of the door seal, door lock and replace if any damaged or faulty. Test the operation and security of the locking handles and rectify if faults found. Apply a small amount of a suitable lubricant to the locking handle pivots.		√	√	√
	Ensure intactness of the protection guards.		√	√	√
	Remove all oil, grease and other residue from the side way and screw mechanism.		√	√	√
	Replace the battery box ventilation hose.		X	X	X
	One cycle of discharge / charge till first IOH. Discharge by current setting rate (40A) for 5 hours or upto 0.8V/cell and charging with its maximum level i.e. With 150V constant voltage charging for 10 hours with 40A current limit (SMI No. RDSO/PE/SMI/TL/0046-2012 Rev '1' dt. 15.07.13)		√ (till first IOH)	X	X
	Two cycles discharge/ charge to assess the capacity of Battery to be done in IOH and every MOH thereafter as per para No. 40.0 of (SMI No. RDSO/PE/SMI/TL/0046-2012 Rev '1' dt. 15.07.13)		X	√	X
B2	**Bogie and running gear:**				
16	**Suspension**	M+R, Vol. D1 & SD Vol. F1			
	Examine the primary and secondary springs for sign of damage, cracks etc.		√	√	X
	Measure primary and secondary springs characteristic/ parameter.		X	√	X
	Replace primary and secondary springs with new ones.		X	X	√
	Ensure pairing of springs.		X	√	√
	Check the secondary spring seat for crack		X	√	√
	Examine different type of dampers for oil leakage and damage to the end fittings like spheriblocks etc. Overhaul/replace on condition basis.		√	√	X
	Replace the dampers with new one		X	X	√
	Check compensating plate and replace insulating bases of secondary suspension (WAP5).		X	X	√
	Maintain the vertical & lateral clearances (Primary & secondary).	T2,D1, Drg.1,2 & 3.	√	√	√

17	**Spheriblocks**				
	Replace the spheriblocks of axle guide rod, gear case support arm, traction motor and traction motor support arm (WAP5).		X	√	√
	Replace the spheriblocks of axle guide rod, and traction motor support arm (WAP7/ WAG9/WAG9H).		X	√	√
	Check condition of Spheriblock of all types of dampers. Replace if required.		√	√	X
	Critically check the spheriblock base plate for any crack.		√	√	√
	Testing of spheri blocks of gear case support arm of WAP5 and traction motor support arm in WAP5/WAP7/WAG9/WAG9H loco in accordance with maintenance and repair manual		√	X	X
	Visual checking of other spheriblocs (WAP5/WAP7/WAG9/ WAG9H)		√	X	X
18	**Traction link**	M+R, Vol. D1			
	Check the intactness/security of the safety cables		√	√	√
	Check the push / pull rod pivot head for damage any sign of crack with RDPT.		√	√	X
	Clean and examine the traction link assembly for any sign of damage/crack/defect etc defective items should be renewed.		√	√	X
	DPT of housing should be done in every inspection for detection of cracks.		√	√	√
	Replace the traction link assembly along with housing with new one		X	X	√
	Check the intactness of fasteners between traction rod and pivot head at bogie and body end for security. If fasteners are loose it must be renewed and tightened to the specified torque. Check intactness of locking plate		√	√	√
	Inspect the safety sling, pins and R- clip for wear or damaged.		√	X	X
	Provision of additional safety sling on brake lever of WAP7 Locos as per SMI No. RDSO/2006/EL/SMI/244 (Rev. '0') dated: 02/04/2007. Besides the above, the continuous and close monitoring of brake hangers having the gap less than 13 mm with bogie frame shall be done. The other maintenance practices, checking and testing of TBU/PBU should be done as per the OEMs maintenance manual and instructions.		√	√	√
	Replace the safety sling, pins and R- clips.		X	√	√
	Check the condition of link rod locating spigots on the pivot head. Replace the pivot head if the spigot worn or damaged (WAP5 only).		√	√	√
	Examine limit chain and links for wear, corrosion or damage		√	X	X
	Check all connections of fasteners and cables carefully and lowering and connections of loco body.		√	X	X

	Replace all FS all steel Lock Nuts opened for lifting of locos at mentioned locations. a. Secondary Dampers (Yaw, Vertical, horizontal) b. Primary Dampers top side. c. Traction link d. Gear Case Support arm		√	√	√
	Check intactness/security of inner and outer retaining ring, bolt, plate and ensure it tightness at required torque 80Nm for outer ring, 60Nmfor inner ring bolt.		√	√	√
	Measure the Inner dia of pivot head .If it is more then 251.50n mm replace it.		X	√	√
	Check Aclathan/vulkaollan ring against any crack or shifting.		√	X	X
	Replace the Aclathan/ volkollan rings, tab washers.		Alternate MOH	√	√
	Replace all fasteners of volkollan ring retaining plate		X	X	√
	RDPT of gear case support arm, traction motor support arm and axle guide link to be done and replace if found defective.		√	√	√
	The replacement of elastic ring, use of fasteners and their tightening, replacement of 10.9 property class bolt with 8.8 class etc shall be done as per latest RDSO's SMI No. RDSO/2009/ EL/SMI/0259 (Rev '0') of oct, 2009.		√	√	√
19	**Bogie Frame and brake Gear:**	M+R, Vol. D1			
	Maintenance practices, replacements of items, other related repairing of bogie frames components and modifications in the PBU/TBU should be done as per RDSO's SMI No. RDSO/2007/EL/SMI/0251 (Rev. '0') dated: 01/01/2008 Which has been issued vide letter no. EL/3.1.35/2 dated 4.01.08.		√	√	√
	Check the pneumatic pipeline system for leaks.		√	√	√
	Clean the bogie assy. Remove all build up dirt and debris.		√	√	√
	Examine the bogie frame for sign of damage.		√	√	√
	Measure the alignment of bogie frame. Correct any misalignment.		X	X	√
	Remove all components from bogie frame. Thoroughly clean with water jet. And visually inspect the bogie frame, particularly brackets, webbing and bump stop for sign of wear/ damage/ cracks. Rectify any fault found.		X	X	√
	Overhaul the bogie frame. Remove all items from the bogie frame and clean the frame in an alkaline tank. -Make a thorough visual inspection of the bogie frame for cracks, damage or evidence of fatigue. -Use a non-destructive technique to check the frame. -Measure the bogie-frame. Check for squareness and levelling. Repair the bogie frame as required. -Remove all traces of debris and rust. Repair any damage. Then repaint the bogie frame to specification.		X	√	√

	Examine all bogies mounted equipments (including earthing straps) for sign of damage and security of fastening		√	√	√
	Check the earthing shunts provided on bogie and body.		√	X	X
	Inspect the lateral bump stops (in secondary suspension)for damage or deterioration. Replace if required.		√	√	X
	Replace all lateral bump stops (in secondary suspension) with new		X	X	√
	Inspects the safety pin eyehole at the bogie frame for wear or cracks. Ring weld the hole, then ream to the correct diameter if required		√	√	√
	Measure the suspension ride height. Replace the spring or compensating plate as required.		X	√	√
	Check the brake rigging for loose, damaged or worn parts. Rectify as required		√	√	√
	Replace all pins, bushes and pads of brake rigging with new one		√	√	√
	Inspect the brake rigging rotation points and components contact surface. Rectify any fault found.		√	√	√
	Overhaul the brake caliper (for WAP5 only)		X	√	√
	Check the brake cylinder piston stroke.		√	√	√
	Remove and overhaul the brake cylinders.		X	√	√
	Check the brake cylinder for leakage and adjust the brake shoe.		√	√	√
	Inspect the condition of various links (spheriblocks) and its rubber parts. Replace if required.		√	X	X
	Check against crack on TM holding plate bracket by RDPT.		√	√	√
	Maintenance of Traction Motor support plate and bogie nose to Prevent crack/breakage of Traction Motor support plate (Holder for Traction motor suspension) should be done as per RDSO's SMI no. RDSO/2011/EL/SMI/0269 (Rev."0") dtd. 18.05.11.		√	√	√
	Replace all rubber components, hoses , pins, bushes and fasteners on the bogie.		X	√	√
	Replace safety sling of brake hanger of WAG9/WAP7 locos		√	√	√
	Maintenance of conventional type brake rigging on WAP7 locos.	To be done as stipulated in RDSO Modification sheet No.RDSO/2009/EL/MS/0381 dated 7-9-09 and RDSO letter EL/3.1.35/2(3 phase) dated 20-10-11			
20	**Wheel set:**				

	Examine all the wheels for cracks, flats, cavities, scoring or grooving. Reprofile/ replace if required.		√	√	√
	Measure and record wheel diameter, root wear, flange wear and total tread wear, road gauge. Take corrective action accordingly. Reprofile/replace if required.	T3	√	√	√
	Check the earth brush length and replace it, if required.		√	√	√
	Check the condition of lubricating grease, inner racers, rollers and cages. Sample the lubricants and analyze for contamination/ metal content. Replace the bearing along with its accessories if worn or damaged. Re lubricate serviceable bearings using new grease then replace the seal.		X	X	√
	Dismount the axle boxes		X	√	√
	Replace roller bearing unit CRU 150/SKF, BC2- 0067A along with its accessories (WAP7/ WAG9/WAG9H).		X	Cond basis	√
	Replace roller bearing unit SKF 16394578A along with its accessories (WAP5).		X	Cond basis	√
	Check the condition of brake disc for discoloration, chipping or any other damages (WAP5 only)		√	√	√
	Overhaul the brake disk. Measure its wear to verify it is within limits. Check tightness of the bolts (WAP5 only).		√	√	√
	Replace fasteners of brake discs with new one		X	X	√
	Greasing to be done in axle tube at NDE side.	T1	√	X	X
	MSU overhauling (as per SMI 300 dt. 02.11.16)		x	√	√
21	**Axle:**	M+R, Vol.D1			

	Check the axle for bend. Measure the diameters, and examine the condition of the journals, seats, fillets and transitions on the axle. Rectify any defects or replace the axle if damaged bent or out of specification		X	√	√
	Disconnect the electrical cable from the earth return unit remove the earth return unit from the axle. Examine the bearings and rear sealing position for signs of grease leakage or discoloration.		√	√	√
	Test the axle for surface and sub-surface defects using a non-destructive technique (USFD). Replace the axle if cracked, defective or damaged		√	√	√
	Check all journals on the axle are concentric to the wheel bearing journals. Replace the axle if not within specification		X	√	√
	Check the axle end caps for wear on the wheel bearing seal surface and other defects. Replace the end caps if worn or damaged		√	√	√
	Measure the diameters and profile of the axle labyrinth rings. Replace the end caps if worn or damaged		X	√	√
	Greasing of Axle Box Bearings for WAP7 and WAG9 locomotives.(As per RDSO/2007/EL/SMI/0246 Rev.”0”dtd. 17.01.08) As mentioned in the above SMI, the procurement of bearings with axle boxes and other components from OEMs must be ensured.		√	X	X
22	Axle box (except bearing):	M+R, Vol.D1			
	It is reiterated that the existing maintenance practices for axle boxes in vogue e.g. dust free environment, proper use of cleaning agent and avoiding intermixing of components between different OEMs shall be ensured.		√	√	√
	Measure the wear of carbon brush and see it does not go below the grooved line		√	√	√
	Clean the axle box and adjacent part.		√	√	√
	Check the intactness of the earth return path on each wheel set		√	√	√
	Visually inspect the axle boxes for wear of damage. Pay particular attention to the guide rod mounts and limit stops. Replace the axle box if defective		√	√	√
	Test the axle box for surface and sub-surface defects using a non-destructive technique. Pay particular attention to the spring seats and guide rod mounting points. Replace the axle box if cracked or defective		X	√	√
	Check intactness of axle box cover bolts		√	X	X
	Replace the axle box O ring and cover bolts		√	√	√

	The axle boxes which are running warm or reported to have higher temperature in comparison with others shall be attended on priority by physically opening of axle box cover and outer angle ring. The suitable maintenance shall be done either in-situ or by dismantling the axle box. WAP7 locomotives should be monitored especially.		√	√	√
23	**Gear case/ Transmission**	M+R, Vol. D1 & SD Vol. F2			
	Inspect the gear case for any oil leakage. Inspect for any external hits/damage. Rectify if required.		√	√	√
	Overhaul the gear case.		X	√	√
	Examine the gear cases for defect on the body, mating surfaces, bearings seat and holes/ threads for various fasteners. Repair / replace, if required.		X	√	√
	Replace gear case oil with new one	T1	√	√	√
	Replace gear case oil with new one (460RR of IOC) in case of WAP7.		√	√	√
	Replace gear case bearing along with associate components with new one (for WAP5 only).		X	X	√
	Externally clean the gearbox gauge sight glass.		√	√	√
	Verify integrity of gauge glass protection cover.		√	√	√
	Check tightness of all Allen bolts, drain plug (with its sealing).		√	√	√
	Replace the gearbox oil seal / „O" rings.		X	√	√
	Check gear case fasteners for tightness at prescribed torque and for any brakeage.		√	√	√
	Check gear case TM fixing bolts (M 16C200). Torque with 205 Nm (for 8.8 grade)/300 Nm (10.9 grade) (WAP7 & /WAG9H).		√	√	X
	Replace all gear case fasteners and TM fixing bolts with new one.		X	X	√
	Replace drain plug washer and oil filling plug washer.		√	√	√
	Measure the PE-end bearing backlash. Check the condition of the bearings and replace, if required (WAP5).		√	√	√
	RDPT of axle guide rod, TM support arm and axle guide link (WAP5).		√	√	√
	RDPT of gear case leg portion.		√	√	√
	Check the tightness with torque wrench of oil filling cap. Tightened to 120 Nm.		√	√	√
	Replace the gauge glass oil seal .		√	√	√
	Ensure proper alignment of transmission coupling (for WAP5 only).		√	√	√
	Measure axial play of transmission coupling mounted on the pinion shaft of gear case (for WAP5 only).		√	√	√
	Replace Membrane of transmission coupling and its oil. Ensure proper tightness of various fasteners involved in various sub-parts of transmission couplings (for WAP5 only).	M+R, vol. D1& SD Vol. F2	√	√	√

	Replace TM support arm, Gear case support arm (for WAP5 only) & Axle guide rod.		X	X	√
	Check TM support arm, Gear case support arm (WAP5) & Axle guide rod by RDPT for crack.		√	√	X
24	**Gear - pinion:**	SD Vol.F2			
	Visually examine the main gear for any crack/defect. Replace, if required.		X	√	√
	Complete dimensional check of pinion and intermediate gear (for WAP5 only).		X	√	√
	Measure Base Tangent distance of Gear & Pinion and record.	L1	X	√	√
	Replace Bull Gear (WAG9/WAG9H & WAP7)		X	X	√
	Replace TM pinion (WAG9/WAG9H)		Cond. basis	√	√
	Replace TM pinion (WAP7)		X	√	√
C	**Power supply**				
25	**Pantograph**	SD Vol.F3			
	Thoroughly clean the insulators and remove any previous protective coating. Replace insulator if cracked/chipped etc.		√	√	√
	Apply specified grease and polish with a soap lint free cloth.	T1	√	√	√
	Examine the entire head structure of the pantograph including horn, wear strips and support assembly for cracks. Renew any defective items.		√	√	√
	Check that the pan head locking pins are in place and that the springs are secure. Check that the head moves freely on its mounting pins attached to the apex frame.		√	√	√
	Replace Panto strips.		√	√	√
	Overhaul the pantograph and throttle valve. Replace rubber parts and split pin. Apply prescribed lubrication on all grease point.	T1	√	√	√
	Overhaul the pantograph servomotor, Check condition of electrical shunts and replace if strands are frayed 25% or more. Check tightness of the shunt connecting screws.		√	√	√
	Replace the pantograph pneumatic hoses on the locomotive roof and in the machine room.		√	√	√
	Check the pantograph travel time. Adjust the travel time if necessary. Check and adjust contact force to 7 Kg.		√	√	√
	Check the damper of the pantograph for any oil leakage.		√	√	√
	Replace the damper		X	X	√

26	**Primary voltage Transformer:**	SD Vol.F4			
	Thoroughly clean the porcelain insulators. Replace if cracked/ chipped/burning etc. And apply specified grease and polish with a soft lint free cloth.	T1	√	√	√
	Examine the roofline conductor for defects / looseness.		√	√	√
	Replace the rubber cable conduit between transducer and terminal box and the roof cable duct.		X	√	√
	Check the connections for tightness after opening cap.		√	X	X
27.	**Roof Insulators:**	M+R, Vol. D1			
	Thoroughly clean and remove any previous protective coating. Examine for any cracks/chipping and replace as necessary. Recoat with the specified coating.		√	√	√
28.	**Primary current transformer resistor:**	M+R, Vol. D1			
	Visually inspect the primary current transformer resistor for evidence of overheating.		√	√	√
	Measure the impedance of the primary current transformer resistor. Replace the resistor if damaged or defective or not within specification.		X	√	√
29.	**High voltage bushing insulator:**	M+R, Vol. D1			
	Thoroughly clean and remove any previous protective coating. Examine for any cracks/chipping and replace as necessary.		√	√	√
	Examine for creepage /carbonisation. Recoat with the specified coating.		X	√	√
	Replace seal on the high voltage bushing.		X	√	√
	Tan delta test, one cycle in MOH also then onward in IOH.		*	√	√
30.	**Surge Arrester:**	M+R,			
		Vol. D1			
	Thoroughly clean and remove any previous protective coating. Examine for any cracks / chipping and replace as necessary. Recoat the insulators with the specified coating.		√	√	√
	Clean the surge arrestor; examine the damage, cracks etc. Renew if damaged		√	√	√
31.	**Roof line conductors:**	M+R, Vol. D1			
	Check for the intactness of the roofline conductors along with their connections.		√	√	√
	Examine the roof isolation switches for any signs of defect.		√	√	√

32.	**Main circuit breaker (VCB):**	SD, vol. F3 & M2			
	Overhaul the VCB as per OEM's Instructions & replace the items as per RDSO's SMI No ELRS/SMI/0236 and OEM's instructions. Travel characteristics of VCB . As per maintenance manual of respective manufacturer.		√	√	√
	Check the healthiness of Vacuum Switch Tube (VST). (Di-electric test 40kv for 10 sec),		√	√	√
	Check the closing & opening speed of VST. First after 3 years on new breaker & then every year.		√	√	√
	Measurement of main contact wear of Vacuum Switch Tube (VST) as per respective maintenance manual, first after three years on new breaker and then every year. Change the VST assembly with fully worn out contacts.		√	√	√
	Check the setting of pressure switch.		√	X	X
	Check closing time, opening time, EV On time & counter operation Electronic Control Unit.		√	X	X
	Maintenance of Air drier. (ELRS/SMI/137 dt.01.02.91).		√	√	√
	Lubricate toggle mechanism & airflow regulator rod.		√	X	X
	Ensure proper VCB base gasket on roof to avoid entry of rain water. As per maintenance manual of respective manufacturer.		√	√	√
	"Ensure settings of Pressure Switch & Pressure Regulator Valve fitted in BTIL make VCBs as per RDSO's letter no. EL/3.2.61/BT dtd. 23.05.11."		√	√	√
33.	**Main circuit Breaker Earthing switch:**	SD Vol.F3			
	Check the earth shunt and its tightness.		√	√	√
	Overhaul the earthing switch.		√	√	√
	Check that when overheating the arm of VCB earthing switch, the contacts make proper contacts on both sides, check that copper braided is undamaged and properly connected.		√	√	√
34.	**Harmonic Filter resistor:**	M+R, Vol. D1,			
		SD Vol. F3			

	Remove the protection grid and clean the filter resistor, roof mounted resistor, Insulators and ceramic components and check for any signs of damage. Remove all dirt and debris, then rise the filter resistor thoroughly in warm water. Check tightness of electrical connectors.		√	√	√
	Replace the cable glands and seal of the filter resistor junction box on the converter roof hatch.		X	√	√
	Replace the seal of the filter resistor		X	√	√
35.	**Main transformer connection**	M+R Vol. D1			
	Visually inspect the high voltage cable at the main transformer connection for damage or oil contamination. Replace the cable if damaged or if contaminated with oil.		√	√	√
36.	**Main transformer:**	SD Vol.F3			
	Visually inspect the electrical connections, earthing cable, bushing and insulators on the main transformer for cracks, chips and evidence of impact damage. Renew if defective. Clean the connectors and replace any damaged chipped or cracked insulators.		√	√	√
	Test oil sample for BDV, DGA, acidity and other lab tests. DGA to be done as per RDSO SMI (RDSO/SMI/138 & OEM Doc. Dt. 27th Nov. 1995).		√	√	X
	Conduct centrifuging of the oil (Use separate plant, the shell DIALA-DX oil should not be mixed with any other type of transformer Oil).		X	√	X
	Replace the oil.		X	X	√
	Check the oil level on the gauge situated on the conservator. Top up if required and any sign of leakage.		√	√	X
	Replace all sealing gaskets including tank cover gasket.		X	X	√
	Replace all rubberised cork sheet.		X	√	√
	Replace all TFP bushings rubber seals		X	√	√
	Carry out Insulation Resistance test and Tan delta test.		X	X	√
	Check Transformer foundation bolts and bushing nuts tightness with proper torque.		X	√	X
	Replace Transformer foundation bolts and bushing nuts. Tighten with proper torque.		X	X	√
	Prismatic level gauge –Clean the gauge with dry cloth to check for leaks.		√	√	√
	Replace the silica gel , in breather assembly.		√	√	√
	Examine the flanges of the pipe couplings and flexible hose that link the transformer and conservator.		√	√	√

	Maintenance of assembly of electrical terminal of traction winding bushing 2U1-2V1, 2U2-2V2, 2U3-2V3 & 2U4-2V4 in indigenously manufactured transformers type LOT 6500/7500 used in 3-phase drive locomotives type WAG9/WAP5.(RDSO/ ELRS/SMI/0228 dt. 13.08.02)		X	X	√
	Visually inspect the condition of oil cooling metallic pipes, check for leakage / damage & check all fixing clamps. Ensure instructions contained in RDSO's letter no. EL/3.2.1/3-Ph dated 30.07.09 for arresting oil leakages cases."		√	√	√
	Replacement of bushing gaskets during IOH inspection. (ELRS/TC/0076 dt. 17.09.2002).		X	√	√
	Ensuring tightness of stuchi coupling, base plate and conservator tank foundation bolt during overhauling as per OEM guidelines & present practices followed by shed.		√	√	√
	Maintenance of transformer oil in service. (RDSO/ELRS/ SMI/158 dtd. 19.01.95).		√	√	√
37.	**Primary Earthing cable and bracket:**	M+R Vol. D1			
	Disassemble the locomotive Primary Earthing System. Inspect and repair, if required, the earthing cable and bracket, earth contact plate, earth brushes, earth brush springs, earth cable glands etc. at the axle box, as prescribed.		√	√	√
	Check the security of the primary earth fasteners. Tighten the fasteners if necessary.		√	√	√
	Maintenance of earthing system in 3-phase locomotives type WAP5, WAP7 & WAG9 (As per RDSO/2007/EL/SMI/248 Rev."0" dtd. 22.11.2007)		√	√	√
D.	**Propulsion System**				
38.	**Traction Converter:**	SD Vol.F4			
	Remove the converter cubicles. Clean the dust and dirt thoroughly.		X	√	√
	Conduct a voltage test and measure the insulation resistance. This inspection tests the converter and the valve sets. Isolate fault if not within specification.		X	√	√
	Visually inspect the MUB resistor for evidence of overheating, bending of resistor tapes, discoloration of the resistors or its case, or burn marks. Measure the impedance of the fault detection and MUB resistors. Replace the MUB resistor assembly if damaged or defective or not within specification.		X	√	√
	Visually inspect the traction converter earthing resistors for signs of overheating.		√	√	√
	Replace any resistor that is damaged or defective.		√	√	√
	Clean the series resonant and DC link capacitors& Inspect for any signs of oil leakage, bulging etc. Measure the values. Replace if not within permissible range.		X	√	√

	Check the security of the DC link and series resonant circuit capacitor bank electrical connections. Tighten the fasteners if necessary.		X	√	√
	Test the voltage indication and current transducer. Replace, if required.		X	√	√
	Overhaul the pre-charging and main contactors. Replace the rubber parts.		**	√	√
	Replace Contact tips of Electro-pneumatic and Electro-magnetic contactors.		X	X	√
	Check and clean the isolation slack /blade and spring contacts of earthing switch and lubricate. Check its connections for tightness and intactness.		√	√	√
	Check the cable connection of Sicem connectors of differential amplifier provided below SR oil pump.		√	√	√
	Ensure sealing of incoming cable gland of control card rack to avoid dust entry.		√	√	√
	Drain the oil and conduct centrifuging the oil.		X	√	X
	Test oil sample for BDV, DGA and other lab tests.		√	√	X
	Check the oil level indicator situated on the conservator (Expansion Tank). If the oil is below the minimum mark-top up with the specified oil. Check for any signs of leakage.		√	√	X
	Replace the oil	T1	X	X	√
	Replace the silica gel in breather assembly.		√	√	√
	Examine all pipe/flange joints for any leaks, looseness or missing screws. Correct if necessary.		√	√	√
	Examine all electrical equipment of traction converter for signs of dirt, corrosion, damage etc. Remove all dust/dirt deposits from the connection insulators.		√	√	√
	Replace the air-cooling hoses, seals on the traction converter doors (WAG9/WAG9H).		2nd MOH	√	√
	Replace the air cooling hoses, seals on the traction converter doors (WAP5/WAP7)		X	√	√
	Check condition of gaskets/oil seals, if dismantling is required.		√	√	X
	Clean the area by lightly blowing any dirt deposit		X	X	√
	Check the capacitors for oil leakage or any abnormality		√	√	√
	Overhauling of Earthing switch		X	X	√
	Visual inspection of bush		√	√	√

	Failure improvement of Valve set in Power Converter of electric locomotives.(As per RDSO/2007/EL/SMI/0247 Rev."0" dtd.21.11.2007)		X	√	√
39.	**Traction Motor:**	M+R Vol. D1, SD Vol.F5			
	Check that the air outlets are not obstructed and no debris or foreign material is left inside the frame Examine all traction motor for sign of damage caused by ballast.		√	√	√
	Check the intactness of the junction box cover and bolts.		√	√	√
	Remove the junction box cover and check that no water has enter the junction box and that the connections are tight with no flash over		√	√	√
	Check the tightness of the fasteners for the TM spheriblocks.		√	√	√
	Check the condition of the end shields bolts & tighten if required.		√	√	√
	Every 200000 Km lubricate the DE/NDE TM bearings using a grease gum with specified grease and specified quantity.	T1	√	X	X
	Remove the traction motor from the locomotive and overhaul.		X	√	√
	Dismantle the TM, Examine for hit marks /damages, Clean the stator and rotor with wet process as per technical instruction HTAT 620409. Check condition of rotor stamping for any deformation, crack, looseness, overheating, mark etc.		X	√	√
	Replace TM bearings (DE+NDE) along with Outer/inner labyrinth pins and accessories after 1,000,000 Km and re lubricate.		X	√	√
	Replace traction motor end plate 0-rings and the gaskets on the terminal box.		X	√	√
	Replace the traction motor bellows.		X	√	√
	Replace the helical inserts of junction box.		X	X	√
	After reassembly, check TM Jn. box TM cables, speed sensor and temperature sensor cables for their condition and replace, if necessary. Make sure there can not be water leakage through Jn. box. Ensure correct tightness of all bolts. Check sensor cable earthing at 42 locations as identified by CLW.		X	√	√
	Test the traction motor support arm using a non-destructive technique. Replace the arm if damaged or defective.		X	X	√

	Checking of terminal connection of Traction motor by opening terminal box.		√	√	√
	Checking of TM temperature sensor &speed sensor wiring crimping for any abnormality		√	√	√
	Check the condition of Speed Pulse generator unit on TM (NDE) for any grease		√	√	√
	Check condition of TM cables from TM Jn. Box on the locomotives under frame for any damage to strands		√	√	√
	Replace Suspension tube bearing.		X	X	√
	Replace the gasket of temperature sensor		X	√	√
	Modification in fixing arrangement of temperature sensor fitted on Traction Motor type 6FRA6068. (AS per RDSO/2007/EL/MS/0350 Rev.”0”, dtd.01.11.07)		X	√	√
	Testing of “Weigand” speed sensor fitted with Traction Motor in WAG9, WAG9H, WAP7 and WAP5 locomotives. (As per RDSO/2008/EL/SMI/0252 dtd. 01.05.2008)		X	√	√
	Modification of Bellows and its mounting arrangement of existing traction motors. (As per RDSO/2009/ELRS/MS/0373 Rev.”0”, dtd. 06.03.2009)		√	√	√
	DPT/MPT test to be conducted for direction of cracks on holder plate of TM type 6FRA 6068. Visual checking for cracks/damage to be done		√	√	√
	Checking of grease metal content during schedules, whenever grease available.		√	√	√
	Replacement of WAP7 gear case Oil with 460 RR of IOC		√	√	√
40.	**VCU bus station and Electronics of Power Converter & Auxiliary Converter:**	SD Vol. F4, F8, F16, F17.			
	Visually check physical damage and insulation defects		√	√	√
	Check for loose fixing of any connection		√	√	√
	Check the tightness of all parts and cards		√	√	√
	Check the tightness of couplers.		√	√	√
	Replace the back-up batteries in the vehicle control unit bus station diagnostic and communication computers, DIA, DDA1 & 2		X	√	√
	Replace the seals in the UIC socket.		X	X	√
	Reload the software to the vehicle control unit bus station computer EPROMs.		X	X	√
	Examine the UIC Socket at both ends of the locomotive to make sure the covers operate freely. Inspect electrical contacts and if necessary blow clean with an air line.		√	X	X

	Replacement of the instrument cooling fan.		X	√	√
	Ensure working of instrument cooling fan.		√	√	√
	Check setting of temperature sensor in VCU.		X	√	√
	Visually check all the cards for any capacitor leakage. Blow the cards and remove any dirt.	T4	X	√	√
	Check the power supply for any hot spot or puncture electrolyte capacitor on electronic rack. Replace if leakage observed.		√	√	√
	Measure dB loss of Fiber-optic cable of SR. Clean, if required.		X	√	X
	Blow the Gate Units of SR to remove any dirt.		√	√	√
	Replace all Fiber-optic cable of SR, including spares. Confirm loss within limits.		X	X	√
	Clean Heat Exchangers at the back of the electronic rack.		X	SR only	√
	Rehabilitation of following cards: Rehabilitation of following cards are required to be undertaken as per RDSO guidelines No EL/G/2008/01 Rev.1 with latest amendment. SR Electronics: NS/AS controller (PPA988B02) GTO Optical pulse card (AFB635B08) Single board computer (PPB622B01) Digital I/O board (URB177D15) Power supply(KUA915B01) Gate unit GVA587A01 Gate unit power supply (KYA924D01) Single conditioning card (UAB630A36) Single conditioning card(UAB630A91) Single conditioning card(UAB630A93) BUR Electronics: Power supply aux. con. (KUC153A01) VCU Electronics: Display computer board(PPB908A01) Digital I/O board (URB512D15) Power supply VCU (KUB921A01) Diagnostic computer (PPB624A01) Single board computer (PPB622B01)		X	IOH or 6 years whiche ver is later	POH or 12 years whiche ver is later
	Improvement in reliability of LWL cards (AFB635 A01) and bus coupler cards (UFB660 A01 & UFB701 A01) of three phase locomotives by testing QFBR-1478C & 2478C transmitter & receivers. (As per RDSO/2009/EL/SMI/0255 Rev.”0”, dtd.08.05.2009)		√	√	√
	Handling and cleaning of PCB as per RDSO guideline.(ELRS/ TC/0091 dated 13.02.06)		√	√	√

E.	**Auxiliary System**				
41.	**Auxiliary converter:**	SD Vol. F8, F17			
	Check the working of air deflectors/fans		√	√	√
	Inspect the cubicle with respect to mechanical and electrical integrity. Check all fixings for security and tightness and all wiring are secured and insulations are not damaged, burnt or eroded. Visually inspect all components for physical damage.		√	√	√
	Check the security of bolted terminals and mechanical mounting of large components of Aux. rectifier (GG module) and Aux. inverter (WRE module). Remove dust and dirt from insulating and heat convection surface.		√	√	√
	Check the condition of gasket of DC link capacitor bank. Replace if damaged.		√	X	X
	Replace gasket of DC link capacitor bank.		X	√	√
	Replace contact tips of EMC.		X	X	√
	Check the condition of gaskets of WRE, GG and battery charger module. Replace if damaged.		√	√	X
	Replace gasket of WRE, GG and battery charger module.		X	X	√
	Knife contactor (female) position on its base plate in WRE module (1, 2, 3&4) and (3, 4, 5&6) in GG. modules to be ensured.		√	√	√
	Check the value of DC link capacitance bank, it should be 18 mF. Remove dust deposits on the terminal insulators of the capacitors by blowing brushing with a metallic brush or by rubbing with a cloth.		√	√	√
	Check the tightness & proper fitment of 3 phase couplers of Aux. Converter		√	√	√
	Remove auxiliary converter cubicle, clean inside the auxiliary converter cabinets using a vacuum cleaner. Remove all traces of dust, dirt and debris from the components, cubicle walls and floor.		X	X	√
	Check all modules foundation gaskets. Replace, if required.		√	X	X
	Overhaul the contactors in the auxiliary converters 1,2 & 3 and replace the contact tips		X	√	√
	Clean the reactors and transformers in the auxiliary converter cabinets using compressed air. Remove all traces of dirt, dust and debris.		√	√	√
	Clean all dirt and dust deposit from the terminal side of the phase reference transformer and Auxiliary surge arrester insulator. Cleaning is by means of blowing out bushing off with a cloth.		√	√	√
	Visually inspect the insulators in the auxiliary converters (BUR) 1,2 & 3 for damage. Replace any damaged insulator.		√	√	√

	Replace the seals on the auxiliary converter cabinets and equipment modules.		X	√	√
	All EP contactors, re-grouping contactors, MOV to be checked and replace, if found defective		√	√	√
42	**AUXILIARY TRANSFORMER**				
	Check that all connections are secure and there is no physical damage		√	√	√
	Clean all dirt and dust deposit by means of blowing out brushing with a non-metallic brush or by rubbing with a cloth.		√	√	√
43.	**Battery:**	M+R, vol. D2, SDVol.F 10			
	Clean all the dust and dirt deposits or electrolyte spillage from around the batteries and their connections		√	√	X
	Overhaul the battery as per OEM's instructions.		X	√	X
	Apply petroleum jelly to terminals after checking tightness.		√	√	X
	Check the electrolyte level and top up if required		√	X	X
	Check the capacity of battery. If more than 80%, replace electrolyte. If less than 80%, replace battery set.		X	√	X
	Replace battery set.		X	X	√
	Check the condition of the door seal, door lock and replace if any damaged or faulty. Test the operation and security of the locking handles and rectify if faults found. Apply a small amount of a suitable lubricant to the locking handle pivots.		√	√	√
	Measure & record the following: -Specific gravity of the electrolyte -Individual cell voltages		√	√	√
44.	**Lights**	M+R, Vol. D3			
	Check lighting units for physical damage, tightness of fixing & connections, particularly look for signs of overheating or burning. Replace bulbs/tubes which have failed.		√	√	√
	Inspect the condition of, check for proper operation of and clear cab illumination light assembly, desk illumination light assembly, Machine room illumination light assembly and their covers. Replace, if necessary		√	√	√
	Inspect the condition of and check for proper operation of head light assembly, Marker light assembly, Flasher light assembly		√	√	√

	Clean the headlight, Marker light, glasses and flasher light dome.		√	√	√
	Replace headlight lamp		√	√	√
	Replace the head light gasket, head light seals between head light retaining ring and head light housing, Marker light rubber gasket and its 'O" rings and the flasher light gasket, between flasher light and loco roof.		X	√	√
	Clean all internal light unit diffusers, bulbs or tubes and reflectors.		√	√	√
	Apply silicon sealant if required to ensure their is no water leakage from possible entry points of head light, Flasher light and Marker light.		√	√	√
45	**Oil cooling piping:**	M+R, Vol. D1			
	Replace the 'O' rings in the main transformer and main converter oil pipes.		X	√	√
	Check all pipe joints and flange for oil leakage/Sweating, loose & missing screws and correct as necessary.		√	√	√
46	**Oil cooler radiators:**	SD, Vol. F10			
	Examine flange joint for sign of cracks, oil leakage and loose/ missing screws.		√	√	√
	Vacuum clean the radiator chamber via the machine room access cover and then clean the radiator by high pressure hot water jet. Check that the radiator is not blocked.		√	√	√
47	**Oil cooling pumps:**	SD Vol.F3			
	Overhaul the transformer and traction converter oil cooling pumps.		X	√	√
	Checking of bearing condition by SPM/Noise and changing on condition basis		√	X	X
	Replace the bearings and O rings.		2nd MOH	√	√
	Checking of oil flow		√	√	√
48.	**Oil cooler blower:**	M+R, Vol. D2, SD Vol.F10			
	Remove and clean the oil cooler blower filter duct. Remove all traces of dirt, duct and debris.		√	√	√
	Clean the oil cooler blower fan impeller. Remove all traces of dirt, dust and debris.		√	√	X
	Remove the air cone from the oil cooler blower filter panel. Remove all dirt, debris and obstructions.		√	√	√

	Check for abnormal noise and measure vibration level on OCB before and after inspection.		√	√	√
	Air velocity measurement of OCB to be taken before and after inspection.		√	√	√
	Conduct RDPT of Impeller and check for unbalancing		√	√	X
	Replace the Impeller of oil cooler blower		X	X	√
	Check the condition of Rubber bellows of OCB duct to TM Scavenger Blower. If damaged, replace it.		√	√	√
	Check the condition of roof filter & OCB duct gasket if damaged - replaced		√	√	√
	Check the condition of rubber hosepipe and clamps. Replace if damaged. Check the tightness of clamps.		√	√	√
	Check the condition of the filter screen, inspect for cracks or damage. Rectify any faults found.		√	√	√
	Check the security of the bolts around the duct flanges. Check all flanges on the ducting for cracks around the hoses. Rectify any fault found.		√	√	√
	Remove any build up of dirt and foreign material from around the filter screen.		√	√	√
49.	**Oil cooler blower motor**	SD Vol.F10			
	Checking of bearing condition by SPM/Noise and changing on condition basis		√	X	X
	Overhaul the oil cooler blower motor. Replace the bearings along with associate components & grease.	T1	2nd MOH	√	√
	Remove all dust and dirt from motor body using a vacuum cleaner and soft non- metallic brush.		√	√	√
	Conduct RDPT of motor foundation brackets.		√	√	√
	Securing of motors cables.		√	√	√
	Check Current & Voltage of OCB Motor		√	√	√
50.	**Oil cooler blower seals:**	M+R, vol. D2, SD Vol. F10			
	Replace the seals between the oil cooler blower & the filter duct, between the oil cooler blower filter & the pantograph roof hatch on the oil cooler blower unit, between the oil cooler blower & machine room floor, on the oil cooler blower filter & ducting and on the oil cooler blower inspection door (WAP5/ WAP7)		X	√	√

	Replace the seals between the oil cooler blower & the filter duct, between the oil cooler blower filter & the pantograph roof hatch on the oil cooler blower unit, between the oil cooler blower & machine room floor, on the oil cooler blower filter & ducting and on the oil cooler blower inspection door (WAG9/ WAG9H)		2nd MOH	√	√
	Check the seal between the filter screen and pantograph roof hatch. If necessary conduct a water test. Replace the seal if any leakage occurs.		√	X	X
51	**Machine room blower:**				
	Remove the fan impeller from the machine room blower and clean. Remove all traces of dirt, dust and debris. Check the impeller by RDPT		√	√	√
	Remove and clean the machine room blower filter duct. Remove all traces of dirt, dust and debris.		√	√	√
	Check the condition of hoses and clamps. Replace if required.		√	√	X
	Check for abnormal noise.		√	√	√
	Remove the fly screen and louvers and clean them. Rectify any fault found		√	√	√
	Remove any build up of dirt and foreign material from around the louvred and filter panel. Also remove any obstruction from the louvered panel		√	√	√
	Check the security of the bolts around the duct flanges and tighten, if required.		√	√	√
	Check all flanges on the ducting for cracks around the bolt hoses. Rectify any faults found.		√	√	√
	Check the condition of the bleed pipe between the scavenge duct and filter duct. Tighten the clamps, if necessary and replace the hose if deterioration is evident.		√	√	√
	Air delivery measurement in 3-phase locomotive to ascertain proper cooling and pressurization of Machine Room. (As per RDSO/2009/EL/SMI/0255 Rev."0", dtd.08.05.2009)		√	√	√
52.	**Machine room blower seal:**	M+R, Vol.D2			
	Replace the seals of machine room blower filter, plenum & duct, if found any leakage.		√	X	X
	Check the conditions of the transition duct seal, the louver, the plenum box and the flexible duct. Repair/Replace if any faults found.		√	√	√

	Replace the seals of machine room blower filter, plenum & duct, inspection door, blower filter & ducting and between the machine room blower and machine room floor, between the machine room blower filter and filter duct and the machine room blower filter duct seal and wear plate (WAP5/WAP7).		X	√	√
	Replace the seals of machine room blower filter, plenum & duct, inspection door, blower filter & ducting and between the machine room blower and machine room floor, between the machine room blower filter and filter duct and the machine room blower filter duct seal and wear plate (WAG9/ WAG9H).		2nd MOH	√	√
53.	**Machine room blower motor:**	SD Vol.F10			
	Securing of motors cables.		√	√	√
	Remove all dust and dirt from motor body using a vacuum cleaner and soft non- metallic brush.		√	√	√
	Checking of bearing condition by SPM/Noise and changing on condition basis		√	X	X
	Overhaul the machine room blower motor. Test the machine room blower motor start-up capacitors. Replace the capacitor if not within specification. Replace the drive and non-drive end bearings along with associate components & grease.	T1	2nd MOH	√	√
	Measure and record motor current.		√	√	√
	Conduct RDPT of motor foundation brackets.		√	√	√
54.	**Traction motor blower motor:**	SD Vol.F10			
	Securing of motors cables.		√	√	√
	Remove all dust and dirt from motor body using a vacuum cleaner and soft non- metallic brush.		√	√	√
	Checking of bearing condition by SPM/Noise and changing on condition basis		√	X	X
	Overhaul the traction motor blower motor. Replace the drive and non derive end bearings along with associated components & grease.	T1	2nd MOH	√	√
	Measure and record motor current.		√	√	√
	Conduct RDPT of motor foundation brackets.		√	√	√
55	**Traction motor blower:**				

	Remove the fan impeller from the traction motor blower and steam clean. Remove all traces of dirt, dust and debris. Check the impeller by RDPT		√	√	√
	Remove and steam clean the traction motor blower filter duct. Remove all traces of dirt, dust and debris.		√	√	√
	Clean the duct from the traction motor blower to the bellows in the machine room floor.		X	√	√
	Check for abnormal noise.		√	√	√
	Remove any build up of dirt and foreign material from around the louver and filter panel. Also remove any obstruction from the louver panel drain holes.		√	√	√
	Check the conditions of the seal plate, flexible duct and plenum box and the louver. Repair/Replace as required		√	√	√
	Check the condition of the bleed pipes between the scavenge duct and filter duct. Tighten the clamps or replaced the hose if required		√	√	√
	Check the security of the bolts around the duct flanges and tighten as required.		√	√	√
	Check the flanges on the ducting for cracks around the bolt holes. Rectify any faults found.		√	√	√
	Vibration and air velocity measurement of TM blower to be taken before and after inspection		√	√	√
56.	**Traction motor blower seals:**	M+R, Vol.D2			
	Check the traction motor blower filter, plenum, wear plate.		√	X	X
	Check the seals on the traction motor blower filter and ducting, between the traction motor blower and machine room floor, on the traction motor blower inspection covers, between the plenum box and body side panel. Replace the seal if any leakage occurs.		√	X	X
	Replace the traction motor blower filter, plenum, wear plate and duct seals (WAP5/WAP7)		X	√	√
	Replace the traction motor blower filter, plenum, wear plate and duct seals (WAG9/ WAG9H)		nd 2 MOH	√	√
	Replace the seals on the TM blower filter & ducting (WAP5/ WAP7)		X	√	√
	Replace the seals on the TM blower filter & ducting (WAG9/ WAG9H)		nd 2 MOH	√	√
	Replace the seals between the TM blower & machine room floor and between the plenum box and body side panel(WAP5/ WAP7)		X	√	√

	Replace the seals between the TM blower & machine room floor and between the plenum box and body side panel (WAG9/ WAG9H)		2nd MOH	√	√
	Replace the seals on the TM blower inspection cover (WAP5/ WAP7)		X	√	√
	Replace the seals on the TM blower inspection cover (WAG9/ WAG9H)		nd 2 MOH	√	√
57.	**Traction motor & oil cooler blower scavenger motor:**	SD Vol.F10			
	Securing of motors cables.		√	√	√
	Remove all dust and dirt from motor body using a vacuum cleaner and soft non- metallic brush		√	√	√
	Checking of bearing condition by SPM/Noise and changing on condition basis		√	X	X
	Overhaul the traction motor and oil cooler blower scavenger motor. Replace the drive and non-drive end bearings along with associate components & grease.	T1	nd 2 MOH	√	√
	Measure and record motor current.		√	√	√
	Conduct RDPT of motor foundation brackets.		√	√	√
58.	**Machine room blower scavenger motor:**	SD Vol.F10			
	Securing of motors cables.		√	√	√
	Remove all dust and dirt from motor body using a vacuum cleaner and soft non- metallic brush		√	√	√
	Checking of bearing condition by SPM/Noise and changing on condition basis		√	X	X
	Overhaul the machine room blower scavenger motor. Test the machine room blower motor start up capacitor Replace it if not within specification. Replace the drive and non drive end bearings along with associate components & grease.	T1	nd 2 MOH	√	√
	Measure and record motor current.		√	√	√
	Conduct RDPT of motor foundation brackets.		√	√	√
59.	**Machine room blower scavenger:**	M+R, Vol.D2			
	Remove the machine room blower scavenger fan impeller, inlet cone and housing. Steam clean the parts, removing all dirt, dust and debris. Visually inspect for erosion, corrosion, damage or cracks. Check the impeller by RDPT		2nd MOH	√	√
	Replace the flexible duct between the machine room blower scavenger motor and filter.		2nd MOH	√	√
	Clean the ducts and scavenge system ducting.		√	√	√
	Replace the equaliser hoses between the machine room blower scavenger motor and the filter (WAP5/WAP7)		X	√	√
	Replace the equaliser hoses between the machine room blower scavenger motor and the filter (WAG9/ WAG9H)		2nd MOH	√	√

	Check the condition of equaliser hoses between the machine room blower scavenger motor and the filter		√	X	X
	Check the condition of rubber hoses and replace, if required.		√	X	X
	Replace the rubber hoses		X	√	√
	Measure air velocity of scavenge blower.		√	√	√
	Check tightness of foundation bolts.		√	√	√
	Replace the seals and gaskets on the machine room blower scavenger ducting (WAP5/WAP7)		X	√	√
	Replace the seals and gaskets on the machine room blower scavenger ducting (WAG9/ WAG9H)		nd 2 MOH	√	√
	Check the condition of seals and gaskets on the machine room blower scavenger ducting		√	X	X
60.	**Traction motor and oil cooler blower scavenger duct:**	M+R, Vol.D2			
	Clean the traction motor and oil cooler blower scavenger ducting. Remove all dirt and dust from inside the duct.		X	√	√
	Adjust the slip joint between the TM Scavenge and oil cooler blower duct.		√	√	√
	Check tightness of foundation bolts		√	√	√
61.	**Traction motor and oil cooler blower scavenger:**	M+R, Vol. D2, SD Vol.F10			
	Remove the traction motor and oil cooler blower scavenger fan impeller, inlet cone and housing. Steam cleans the parts, removing all dirt, dust and debris. Visually inspect the impeller for erosion, corrosion, damage or cracks. Check the impeller by RDPT.		√	√	√
	Clean the ducts and scavenge system ducting.		√	√	√
	Replace the hoses at the oil cooler blower filter scavenger boxes (WAP5/WAP7)		X	√	√
	Replace the hoses at the oil cooler blower filter scavenger boxes (WAG9/ WAG9H)		2nd MOH	√	√
	Check the condition of hoses at the oil cooler blower filter scavenger boxes (WAG9/ WAG9H)		√	X	X
	Replace the equaliser hoses between the TM & oil cooler blower scavenger & the filter (WAP5/WAP7)		X	√	√
	Replace the equaliser hoses between the TM & oil cooler blower scavenger & the filter (WAG9/ WAG9H)		nd 2 MOH	√	√
	Check the condition of equaliser hoses between the TM & oil cooler blower scavenger & the filter (WAG9/ WAG9H)		√	X	X

	Check the condition of rubber hoses and replace, if required.		√	X	X
	Replace the rubber hoses		X	√	√
	Measure air velocity of scavenge blower.		√	√	√
	Replace the seal at the oil cooler blower scavenger duct slip joint (WAP5/WAP7)		X	√	√
	Replace the seal at the oil cooler blower scavenger duct slip joint (WAG9/ WAG9H)		nd 2 MOH	√	√
	Check the condition of the seal at the oil cooler blower scavenger duct slip joint and replace, if required. (WAG9/ WAG9H)		√	X	X
	Replace the seals and gaskets on the TM and oil cooler blower scavenger ducting (WAP5/WAP7)		X	√	√
	Replace the seals and gaskets on the TM and oil cooler blower scavenger ducting (WAG9/ WAG9H)		2nd MOH	√	√
	Check the condition of seals and gaskets on the TM and oil cooler blower scavenger ducting (WAG9/ WAG9H)		√	X	X
	Check tightness of foundation bolts		√	√	√
62.	**Main compressor motor:**	SD Vol.F13			
	Overhaul the main compressor drive motor.		X	√	√
	Check for abnormal noise.		√	√	√
	Megger the motor in assembled condition		√	√	√
	Checking of bearing condition by SPM/Noise and changing on condition basis		√	X	X
	Replace the main compressor drive motor bearing along with associate components and grease.		2nd MOH	√	√
	Remove all dust and dirt from motor body using a vacuum cleaner and soft non- metallic brush		√	√	√
	Conduct RDPT of motor foundation brackets.		√	√	√
62. A	**In addition to above following RAPs to be followed for maintenance of Auxiliary machines as and when applicable.**				
	Fits and limits on bearings of auxiliary motors used on Electric locomotives.	RDSO/ELRS / SMI/16 issued vide letter no. EL/2.2.48/J2 dated 3.5.1978	2nd MOH	√	√
	Procedure for measuring the bearing clearances of a “free bearing” that is a bearing off the machine.	RDSO/ELRS / SMI/23 issued vide letter no. EL/2.2.48/J2 dated 7.5.1978).	2nd MOH	√	√

	Conditioning monitoring of bearings.	RDSO/ELRS / SMI/23 issued vide letter no. EL/8.11.12/ D B3, dated 20.07.1979).	2nd MOH	√	√
	Fitment of outer race of bearing in the bearing housing.	RDSO/ELRS / SMI/78issu ed vide letter no. EL/2.2.48 dated2.5.19 81	2nd MOH	√	√
	Testing/checking of new bearings for Auxiliary motors.	RDSO/ELRS / SMI/79 issued vide letter no. EL/2.2.48 dated 11.6.1981).	2nd MOH	√	√
	Procedure for impregnation of stator auxiliary motors.	RDSO/ELRS / SMI/86 (Rev.1) issued vide letter no. EL/3.2.70 dated 29.11.2000).	2nd MOH	√	√
	General guidelines to follow for balancing of rotor and blower impellers.	RDSO/ELRS / SMI/152 issued vide letter no. EL/3.2.70/J3 dated 15.12.1992	2nd MOH	√	√
	Detection of rotor bar and end ring cracks on Arno converter and auxiliary motors by “Search coil and motor tester”.	RDSO/ELRS / SMI/163 issued vide letter no. EL/3.2.11 dated Nov.94).	2nd MOH	√	√
	General guidelines to follow for balancing of rotors and cooling blower impellers in position. (Ref..	RDSO/ELRS / SMI/199 issued vide letter no. EL/3.2.70 dated 01.04.1998)	2nd MOH	√	√
63	**Cab heater/Blower motor and crew fan motor:**	M+R, Vol.D3			

	Check the movement of blower motor		√	√	√
	Replace the bearing of cab heater Blower motor and crew fan motor along with associate components& grease.		X	√	√
	Overhaul the cab heater/blower motor and crew fan motor.		X	√	√
	Clean the heater blower switch.		√	√	√
64.	**Cubicles:**	SD, Vol. F3, F16			
	Visually inspect for physically damage and insulation defects. Check for loose fixings and connections, rectify if necessary. Visually inspect for damage, renew if necessary.		√	√	√
	Check tightness of connections of cable, 3-phase choke power contactor and knife contact connections (female).		√	√	√
	Clean all relays in SB1/2 & check for physical damage and tightness of all relays		√	√	√
	Check the circuit breakers for damage, loose fixing and connections. Rectify/renew if necessary		√	√	√
	Clean the capacitor bank and tighten the capacitor-mounting nut.		√	√	√
	Check for any looseness in connectors and ensure cap over the spare fibber optic cable in all the electronic racks		√	√	√
	Remove all dust particles using a soft brush or vacuum cleaner. Clean the surface of the control magnet using a cloth wet with alcohol.		√	√	√
	Check no excessive tension of terminals of capacitor or breakage of terminal.		√	√	√
	Check no cracks on body of voltage equalizing register and connections are intact. (Replace in case of crack found)		√	√	√
	Visually inspect the capacitor elements in the Harmonic Filter Cubicle for sign of damage. Check capacitance value is within permissible limit.		√	√	√
	Remove dirt particles from heat transfer faces, electrical connections and insulations material of Battery Charger.		√	√	√
	Overhauling of maximum current relay		√	√	√
	Overhauling of the minimum voltage relay		X	X	√
	Overhaul relay 89.2 in HB2 & 89.5 in HB 1		X	X	√

	Overhaul of the relay 126.5, 136.3, 136.4, 126.7/1, 218, 126, 89.7 and 78 in SB1 Cubicle		X	X	√
	Overhaul of the relay 126.7, 126.6, 211, 130.1, 48.2, 300.3/1&300.3/2 in SB2 Cubicle		X	X	√
	Clean, inspect & check all relays.		√	√	X
	Remove HB1, HB2, SB1, SB2 and filter cubicles and control electronics cubicles and blow out dirt and dust. Examine the cubicle frame for any signs of crack.		X	X	√
	All cubicle should be painted		X	X	√
	Overhaul the EM and EP contactors in different cubicles. Replace the rubber parts Check for any air leakage in EP contactor. Attend/Repair the contact tips of the main and auxiliary contacts.		**	√	√
	Replace contact tips of EP Contactors.		X	X	√
	Check tightness of couplers and other parts.		√	√	√
	Check the DI relay for wear on the contact tips. Replace the contact blocks if the tips are not within specification.		√	√	√
	Visually inspect the CEL unit.		√	√	√
	Overhaul the fire detection unit. Change the filter and check calibration. Calibrate the FDU and set voltage at test point zero 0+100mv.		√	√	√
	Clean Fire detection pipeline by compressed air and check that there should not be any leakage.		√	√	√
	Visually inspect the contact tips for signs of arcing damage. Repair/ Replace the defective parts		√	√	√
	Perform functional checks ensuring the main and Aux. contacts operate correctly.		X	√	√
	Remove the main and aux. Contactors and check the junction box connections for tightness of harmonic filter cable.		√	X	X
	Overhaul the CP contactor		√	X	X
	Replace the CP contactor		X	√	√
	Check all the contactors in HB1, HB2, SB1, SB2 and BUR2, MOV and Transorb.		√	√	√
65	**Cable Trench:**				
	Clean the cable trench inside the machine room and on the side wall channels.		X	√	√
F	**Air supply and pneumatic system:**				
66.	**Main compressors:**	SD Vol.F13			

	Clean externally with compressed air.		√	√	√
	Replace the oil.	T1	√	√	√
	Check for signs of oil leakages		√	√	√
	Check for any abnormal sound.		√	√	√
	Clean the air intake filter and cooling air flow paths		√	√	√
	Check intactness of air intake filter support clamps		√	√	√
	Overhaul the main compressor of M/s. Knorr & Elgi make & replace items as per overhauling kit.		√	√	√
	Overhaul the main compressor of M/S. SWIL/ D&M make & replace items as per overhauling kit. (WAP5/WAP7)		X	√	√
	Overhaul the main compressor of M/S. SWIL/ D&M make & replace items as per overhauling kit. (WAG9/WAG9H)		2nd MOH	√	√
	Replace suction air filter element		√	√	√
	Check tightness of Nut bolts of all Guards of CP. Check Fan.		√	√	√
	Clean the primary oil filter, change the secondary oil filter, clean the concentric valves and fit with new gaskets.		√	√	√
	Replace the main compressor mountings pads.		X	√	√
	Replace CP delivery pipe		√	√	√
	Replace copper Interconnecting pipes between intercooler and after cooler (WAP5/WAP7)		X	√	√
	Replace copper Interconnecting pipes between intercooler and after cooler (WAG9/WAG9H)		2nd MOH	√	√
	Overhaul the Inter cooler after cooler assembly & replace items as per overhauling kit.		X	√	X
	Replace the Inter cooler after cooler assembly		X	X	√
	Replace HP & LP cylinder and HP & LP concentric valves all make.		X	X	√
	Replace concentric valve kit.		X	√	X
	Clean the after cooler from the rear door		√	√	√
	Check the impeller housing for any external hits and breakages		√	√	√
	Check the oil pressure		√	√	X
	Overhaul oil pump.		X	X	√
	Clean and check the crank case breather		√	√	√
	Dismantle and overhaul the main compressor. Examine and inspect all components for wear/ damage.		√	√	√

	Replace the main element and the safety element of the air intake filter and other parts as prescribed in manual.		X	√	√
	Reassemble, fill with new compressor oil and test.		X	√	√
	Provision of rubber kits in all EP valves of Pneumatic panel.		√	√	√
67.	**Main compressor mounting and delivery hoses:**	M+R, Vol.D3			
	Inspect the compressor mounting points on the locomotive under frame for cracks, damage or other defects using RDPT. Rectify any faults found.		√	√	√
	Replace the main compressor resilient mountings.		X	√	√
	Inspect the CP mounting plate for any crack and check condition of CP security chain.		√	√	√
	Replace the delivery hose from the main compressor.		√	√	√
68.	**Auxiliary compressor:**	M+R, Vol. D3, SD Vol.F12			
	Clean the CPA externally and check tightness of connections.		√	√	√
	Replace the oil	T1	√	√	√
	Attend the valves, clean/replace air intake filter		√	√	√
	Check for tightness of Assembly and air leakage from pipe connection.		√	√	√
	Check for its proper build up of pressure in given time.		√	√	√
	Check settings of auxiliary compressor governor.		√	√	√
	Check the spring tension and size of carbon brushes of the MCPA. Adjust/replace as required.		√	√	√
	Clean commutator. Check carbon brush pig tails Holder and spring.		√	√	√
	Replace the delivery hose between the auxiliary compressor and brake frame.		√	√	√
	Overhaul the compressor.		√	√	√
69.	**Pneumatic Valves, Cocks and Filters:**	SD vol. F11 F12, F13, F14			

	Overhaul and test for correct operation of emergency exhaust valve, auto drain valve, check valve, D2 relay valve, brake protection valve, EBC/5 blending valve, throttle valve, anti spin valve, duplex check valve, feed valve, venturi check valve, flow measuring relay valve, anti compound check valve, double check valve, latch solenoid valves (parking brake), MR & CP safety valve. Change the defective parts. NRV and unloader valves fail due to ingress of Carbon which extracted from CP. So, Checking and cleaning of NRV and unloader to be ensured in all type of 3- phase locomotives.	As per OEM's sched ule	√	√	√
	Overhaul Emergency brake cock, Horn isolating cock, other isolating and drain cocks, air and oil filters etc. as per suppliers documentation.	As per OEM's schedule	X	√	√
	Overhaul all angle cocks.	As per OEM's schedule	√	√	√
	Check valves, D2 relay valve, auto drain valve: The unit must be thoroughly cleaned. Compressor part should be checked and any defective part renewed. Check the setting and operation of valves.		√	X	X
	Test the brake isolating cocks for correct operation. Check the condition of BP/FP pipe, cock & isolating handle for any hit mark or crack.		√	√	√
	Replace filter elements as prescribed /required. Check and adjust as required.		√	√	√
	Replace all rubber components (WAP5/WAP7)		X	√	√
	Replace all rubber components (WAG9/ WAG9H)		3rd MOH	X	√
70.	**Horn:**	M+R Vol.D1			
	Check the proper function of horn on LT & HT		√	√	√
	Check the condition of the horn handle for any damage.		√	√	√
	Check the condition of horn boots. Replace if required.		√	√	√
	Overhaul horn, horn switch and its valves.		√	√	√
	Replace horn gasket, other rubber parts and any other part as required		√	√	√
	Check for proper functioning.		√	√	√

MAJOR OVERHAUL SCHEDULE FOR WAP5, WAP7, WAG9 & WAG9H LOCOMOTIVES						
SN	**Activity**			**Ref.**	**MO H**	**IO H**	**PO H**
71.	**Brake Pneumatics:**			**M+R, Vol. D3, SD Vol. F11, F12, 13, 14**			
	Clean & Test the all pressure switches as part of the brake unit, check settings. Replace any faulty or defective switches. Check intactness of mounting bases.				√	√	√
	Overhaul all pressure switches				√	√	√
	S. N.	**Name of Pressure Switch**	**Schemat No.**		√	√	√
	1	Pantograph	130.4/2, 130.4/1		√	√	√
	2	Emergency brake	269.1		√	√	√
	3	Auxiliary compressor	172.4		√	√	√
	4	Parking brake	269.3		√	√	√
	5	Brake F.P.	269.42		√	√	√
	6	Vigilance control	269.5		√	√	√
	7	Flow indicator	269.41		√	√	√
	8	B.C. bogie pr. Switch	269.6, 26		√	√	√
	9	Main compressor	172.2		√	√	√
	10	Main compressor	172.3		√	√	√
	11	Low MR pressure.	169.4		√	√	√
	12	Direct brake pres. switch	269.2		√	√	√
	Check the tightness of the brake electronics control cards holding screws.				√	√	√
	Overhaul the pressure regulator and check for correct operation. Change all rubber parts as per OEM's kit.				√	√	√
	Overhaul KABA switch replace all rubber items as per OEM's kit.				X	√	√
	Overhaul TBU & PBU and replace parts as per overhauling kit (WAP7)				X	√	√
	Overhaul TBU & PBU and replace parts as per overhauling kit (WAG9/WAG9H)				2nd MOH	√	√
	Overhaul brake equipment module, including various other sub-modules. Replace rubber items as per OEM's kit. Test and adjust as per the test procedure. Ensure that there is not air leakage after removal of Kaba key lock.				X	√	√
	Overhaul the E-70 manifold assembly/CCB brake system and replace parts as per overhauling kit.				As per OEM's instructions		

	Remove the filter element of inline filter and clean thoroughly.		√	√	√
	Overhaul driver's brake controller and automatic brake controller. Replace parts as per overhauling kit. Test for correct operation		As per OEM's instructions		
	Clean the brake frame/pneumatic panel and check for any signs of air leakage.		√	√	√
	Check all the pipes for leakage or damage. Check all the clamps for any damage and looseness.		√	√	√
	Check all the cable connections of pneumatic panel for looseness or deficiency of cleats.		√	√	√
	Check the operation of the parking brakes.		√	√	√
	Replace brake activating mechanism (main cylinder & parking brake cylinder)		X	√	√
	Remove and thoroughly clean the Brake cylinder actuator unit. Test for correct operation		√	√	√
	DISTRIBUTOR: The unit must be thoroughly cleaned. Compressor parts should be checked and any defective parts renewed.		X	√	√
	Overhaul the distributor and change all rubber part.		√	√	√
72.	**Air dryer**	SD Vol.F12			
	Check for the proper position of the air dryer angle cocks		√	√	√
	Check for the correct operation as far as purging and timings are concerned. Refer		√	√	√
	Remove and overhaul the complete unit. Replace parts as per overhauling kit.		√	√	√
	Overhaul the twin tower air drier. Check for correct operation.		X	√	√
	Overhaul purge valve.		√	√	√
	Technical Circular no. RDSO/2011/EL/TC/0108, Rev.'0' dtd. 7.3.11 for testing of air dryers and its efficacy on electric locomotives in Electric Loco Sheds/ Workshops has been issued to Railways vide letter no. EL/3.2.19/1 dated. 7.3.11.		√	√	√
73.	**Air Reservoirs:**	SD Vol.F14			
	Ensure proper alignment of reservoir base. Check the condition of safety chain and its supports.		√	√	√
	Carry out external examination and tests.		X	X	√
	Blow down and drain the reservoir until clean of water and oil. Check all drain cocks are closed on completion.		√	√	√

74.	**Brake system:**	M+R, Vol. D3, SD Vol. F11, 14			
	Check the condition of brake caliper, its pin & bushes & availability of locking split pin check the condition of brake pad & security of brake pad/blocks keys, replace if required (WAP5 only).		√	X	X
	Overhaul brake caliper as prescribed. Replace brake pads, pins & bushes. Check and adjust		X	√	√
	clearances. Re-lubricate as prescribed.				
	Check for the wear of the brake pads and replace if required (WAP5 only)		√	√	√
	Check & adjust the clearance of brake pads/blocks from the wheel disc (WAP5 only)		√	√	√
	Check the condition of brake disc for any discoloration or chipping off or any other external damage (WAP5 only)		√	√	√
	Inspect the brake blocks for wear. If it is below the minimum limit, replace the complete locomotive set brake block.		√	√	√
	Check the brake block key security.		√	√	√
	Overhaul Tread cleaning device as prescribed. Replace the scrubber block (if worn out) and any other worn out component (WAP5 only).		X	√	√
	Overhaul the service brake cylinder adjuster units and parking brake cylinder adjuster units. Check for correct operation and tightness of pipes.		√	√	√
	Rehabilitation of tri plate panel of E-70 brake system of 3-phase locomotives. (As per letter no. 230-Elect/ TRS/92/2/6-Pt-1 dtd. 05.01.2009)		X	X	√
	Replacement of safety sling of break hanger		√	√	√
G	**Interior**				
75.	**Cab door and Machine Room door:**	SD Vol.F1			
	Inspect cab door latch, lock, hinges and catch assembly for correct operation and damage. Repair any fault found.		√	√	√
	Lubricate hinges, latch and locks with general- purpose oil. Wipe away excess oil from around hinge.		√	√	√
	Replace the door seals. Door window seal and any other worn out part.		X	√	√
	Check the condition of the door seals and replace if torn or damaged.		√	X	X
	Check cubical door security locks are effective, clean KABA locks using specified cleaner.		√	√	√
	Check integrity of door window, replace if required.		√	√	√

76.	**Cab interior:**	M+R, Vol.D3			
	Clean the cab with vacuum cleaner and soap solution.		√	√	√
	Clean the surfaces of the driver's desk with a soap solution and cloth. Taking care not to allow water to enter electrical cubicles.		√	√	√
	Clean the cab floor with a suitable cleaning agent.		√	√	√
	Clean & Inspect the blinds and repair if required.		√	√	√
	Check for roller mechanism fitted to the blinds for correct operation.		√	√	√
	Replace the Antiskid flooring.		√	√	√
	Repaint the cab from inside with PU paint		√	√	√
77.	**Drivers seat:**	SD Vol.F15			
	Check for proper functioning, looseness, scoring, and cracks and replace any		√	√	√
	broken/damaged parts as required.				
	Lubricate pedestal shaft.		√	√	√
	Replace the seat cover and cushion		√	√	X
	Rehabilitation of driver seat		X	√	X
	Replace the driver seat		X	X	√
	Check seat-mounting points for integrity and ensure fixings are fully tightened.		√	√	√
78.	**Cab. Equipment:**	M+R, Vol.D3			
	Check the accuracy of the pressure gauges and meters against a test gauge. Calibrate if possible otherwise replace if out of acceptabletolerance.		√	√	√
	Clean the battery, OHE and TE/BE meters in both cabs and check for zero error		√	√	√
	Check the operation of emergency push button. Operate push button and observe that the pantograph is lowered, and the emergency brake applied.		√	√	√
	Check the switches, lamps and gauges on driver's desk, their tightness and clean.		√	√	√
	Replace Vigilance, Sanders, PVEF pedal switches		X	√	√
	Replace BPFA, BLPR, ZPRD, BLDJ, ZPT, BPVR, BPVG.		X	√	√
	Replace cab activation switch.		X	√	√

	Overhaul the foot pedal switch.		√	X	X
	Verify that all appropriate lamp illuminate and indicators display correct readings. Renew bulbs / indicators if necessary		√	√	√
	Remove panels A, B, C and D and Cab SBs and clean thoroughly.		√	√	√
	Check the condition of CO2 gas cylinder and its regulator and pressure gauge provided in both cabs, Refill CO2 cylinders if empty.		√	√	√
	Overhaul the fire Extinguisher.		√	√	√
	Clean pipeline of fire extinguisher by compressed air and check for air leakage.		√	√	√
	Internal Clock Time Setting		√	√	√
	Checking of Red LED status of FBV/FLG Card		√	√	√
	Analysis of DDS of locos		√	√	√
	Clean the heater ventilator; Replace the cab heater flexible duct. Examine the cab heater on position.		2nd MOH	√	√
	Overhaul the crew fan, ventilation fan and cab heater. Replace any damaged parts.		√	√	√
	Clean the heater switch and polish contacts.		X	√	√
	Ensure that schematic numbers of various equipments are intact. To be provided in case of deficiency.		√	√	√
79.	**KEY INTERLOCKING:**	SD, D3			
	Check all keys are present and the complete system is operational.		X	X	√
80.	**Buzzer:**	SD Vol.F16			
	Clean the dust filter on the buzzer using a soft brush. Remove all traces of dust and dirt. Do not apply pressure to the filter or use compressed air.		√	√	√
81.	**Master controller:**	SD Vol.F16			
	Overhaul the master controller. Grease cam- shaft, seats under control handles and other moving parts of Master controller and check for proper operation and recalibrate		√	√	√
	Check the absolute value of transmitter.		√	√	√
	Check the tightness of the fasteners & cable connection.		√	√	√
	Check that the contact is operating correctly by the camshaft and adjust if necessary.		√	√	√
	Check that the rollers are free to rotate and all wiring is sound and secure. Operate handles and ensure interlock functions correctly.		√	√	√

	Overhaul the reverser switch		√	√	√
	Calibration the angle transmitter.		√	√	√
	Ensure that caps have been provided to cover the auxiliary contacts.		√	√	√
82.	**Speedometer**	SD Vol.F16			
	Overhaul and recalibrate the MEMOTEL speedometer.		√	√	√
	Overhaul the master, slave & PG unit and calibrate		√	√	√
	Open the PG from axle box cover & check intactness of the fork bolt with the fork.		√	√	√
	Inspect Memotel and Pulse Generator and their couplers for any damage and proper fitment. Set the date, time and wheel diameter correctly.		√	√	√
	Check & adjust wheel dia. according to actual wheel dia.		√	√	√
83	**Machine room**				
	Visually inspect the machine room for any signs of oil leakage from traction converter, transformer, DC link and series resonant circuit capacitors and other electrical equipment and carefully clean the same		√	√	√
	Clean the complete machine room with the air pressurized supply and vacuum cleaner to remove all dust particles.		√	√	√
84	**Cyclonic filter**				
	Air cleaning of MR blower filter.		√	√	√
	Water cleaning of MR blower filter.		√	√	√
	Air cleaning of TM blower filter		√	√	√
	Water cleaning of TM blower filter		√	√	√
	Air cleaning of OC blower filter.		√	√	√
	Water cleaning of OC blower filter.		√	√	√

Apart from the following RDSO letter for maintenance activities, the following maintenance schedules of Traction converter(SR), Auxiliary Converter(BUR), Vehicle control unit(VCU) and Pneumatic System of M/s. KBIL & FTRTIL to be followed.

Maintenance Schedule of Traction Converter (SR) (Ref- RDSO SMI NO: RDSO/2016/EL/SMI/0294(Rev'0'))							
S.No	**Equipment**	**Maintenance schedule**					
		IA	**IB**	**IC**	**MOH**	**IOH**	**POH**
1	Check the oil level indicator situated on the conservator (Expansion Tank). If the oil is below the minimum mark, top up with the specified oil. Check for any sign of leakage and attend the same. The oil shall be made available by Railways free.	√	√	√	√	√	√
2	Visually examine oil pipe joints for leaks, loose or missing screws and correct as necessary.	√	√	√	√	√	√
3	Examine the flange joints for leaks, loose or missing screws. Check gaskets/ oil seals, and replace if required. Check the condition of stucchi coupling and manifold joints for sign of oil leakage and attend the same as per the need.	√	√	√	√	√	√
4	Examine all electrical equipment of traction converter for signs of dirt, corrosion, damage etc. Remove all dust/ dirt deposits from the connection insulators.	√	√	√	√	√	√
5	Check the cable connection of Sichem connectors of differential Amplifier provided below SR oil pump. Attention to Sichem connectors shall be done by Railways.	√	√	√	√	√	√
6	Clean the isolating blade and spring contact of earthing switch. Lightly lubricate it with the specified grease.	X	X	√	√	√	√
7	Clean the heat sink by vacuum cleaner.	X	X	√	√	√	√
8	Check the tightness of SR electronics PCB.	√	√	√	√	√	√
9	Ensure sealing of incoming cable gland of control card rack to avoid entry of dust/ dirt.	X	X	√	√	√	√
10	Check the condition of silica gel. If pink replace with dry silica gel.	√	√	√	√	√	√

11	BDV and DGA test of converter oil to be done and maintain the record for analysis purpose. Filter/ change the oil if required.	√	√	√	√	√	√
12	Check the ventilation fans of traction converters electronics for its satisfactory working. The fans shall be replaced if found defective.	√	√	√	√	√	√
13	Replacement of ventilation fans of traction converters electronics for its satisfactory working.	X	X	X	X	X	√
14	Remove the converter cubicles. Clean the dust and dirt thoroughly including electronic cards by blowing/ vacuum cleaner.	X	X	X	X	√	√
15	Visually inspect the MUB resistor for evidence of overheating; bending of resistor tapes, discoloration of the resistors or its case, or burn marks. Replace the MUB resistor assembly if damaged or defective or not within specified limit.	X	X	√	√	√	√
16	Measure the impedance of MUB resistors and attend/ replace accordingly.	X	X	X	X	√	√
17	Visually inspect the traction converter earthing resistors for signs of overheating. Replace any resistor that is damaged or defective.	√	√	√	√	√	√
18	Clean the Series Resonant and DC link capacitors and inspect for any sign of oil leakage, bulging etc. Measure the values and replaced if not within permissible range. Replace the capacitors if damaged/ defective or not within specified limit.	X	X	X	√	√	√
19	Check the DC link and series resonant circuit capacitor bank electrical connections. Tighten the fasteners if necessary. Change if found defective.	X	X	X	X	√	√
20	Test the voltage indicators and current transducer. Replace, if required.	X	X	X	X	√	√
21	Overhaul the pre-charging and main contactors. Replace the rubber parts and other item as per requirement as recommended by OEM.	X	X	X	X	√	√

22	Visual inspection of contact tips of Electro-pneumatic and Electro-magnetic contactors and replace if required.	X	X	X	√	√	√
23	Check and clean the blade and spring contacts of earthing switch and lubricate. Check its connections for tightness and intactness. Attend it if required.	X	X	X	√	√	√
24	Testing the BDV of the converter oil and if BDV value is not normal then oil to be centrifuged on condition basis.	X	X	X	√	√	√
25	Drain the oil from SR and conduct centrifuging of the oil.	X	X	X	X	√	√
26	Replace the converter cooling oil.	X	X	X	X	X	√
27	Replace the air-cooling hoses, seals on the traction converter doors.	X	X	X	X	√	√
28	Over hauling of Earthing switch.	X	X	X	X	X	√
29	Measure dB loss of Fiber-optic cable of SR. Clean, if required. In case the dB value is not within the specified limit then the fiber optic cable shall be replaced.	X	X	X	X	√	√
30	Blow the Gate units of SR to remove any dirt.	X	X	X	√	√	√
31	Visual inspection of bushing of transformer. Contractor shall only inspect and intimate Railways. Any attention to bushing shall be done by Railways.	X	X	X	X	√	√
32	Testing of gate unit on test bench as per TC/135. Replace if found defective.	X	X	X	X	√	√

Table 2: Maintenance Schedule of Auxiliary Converter (BUR)							
S.No	Equipment	Maintenance schedule					
		I A	I B	I C	MOH	IOH	POH
1	Check the working of ventilation fans of auxiliary convertrs and attend/ replace the same as per need.	√	√	√	√	√	√
2	Replacement of ventilation fans of auxiliary converters.	X	X	X	X	X	√
3	Clean the dust by vacuum cleaner without opening modules.	√	√	√	√	√	√
4	Check the tightness of connections of control cards and attend the same as per requirement.	√	√	√	√	√	√
17	Clean the reactors and transformers in the auxiliary converter cabinets using compressed air. Remove all traces of dirt, dust and debris.	X	X	X	X	√	√
18	Clean all dirt and dust deposit from the terminal side of the phase reference transformer and auxiliary surge arrester insulator. Cleaning is by means of blowing out and brushing off with a cloth.	X	X	X	X	√	√
19	Visually inspect the isnulators in the auxiliary converter (BUR) 1,2 & 3 for damage. Replace damaged insulators if found during check.	X	X	X	√	√	√
20	All re-grouping contactors, MOV to be checked and replace the same, if found defective.	X	X	X	√	√	√

Table 3: Maintenance Schedule of VCU							
S.No	Equipment	Maintenance schedule					
		I A	I B	I C	MOH	IOH	POH
1	Visually check physical damage and insulation defects.	X	X	X	√	√	√
2	Check the tightness of all PCB cards and connections.	√	√	√	√	√	√
3	Check the tightness of Fiber Optic Coupler.	X	X	X	√	√	√
4	Replace the back-up batteries in the vehicle control unit bus station diagnostic DIA.	X	X	X	X	√	√
5	Replace the seals in the UIC socket.	X	X	X	X	X	√
6	Reload the software to the vehicle control unit bus station computer EPROMs.	X	X	X	X	X	√
7	Examine the UIC socket at both end of the locomotive to make sure the covers operate freely. Inspect electrical contacts and if necessary blow clean with compressed air.	X	X	X	√	√	√
8	Ensure working of instrument cooling fan and replace if required.	√	√	√	√	√	√
9	Replacement of instrument cooling fan.	X	X	X	X	√	√

10	Check setting of thermostat in VCU and attend the same if required.	X	X	X	X	√	√
11	Visually check all the cards for any capacitor leakage. Blow the cards and remove any dirt.	X	X	X	X	√	√
12	Measure dB loss of Fiber-optic cables interfacing with traction and auxiliary converters. Clean, if required. In case the dB value is not within the specified limit then the fiber optic cable shall be replaced.	X	X	X	X	√	√
13	Clean Heat Exchangers at the back of the electronic rack.	X	X	X	√	√	√

IGBT Hotel Load Converter of WAP7 locomotive (Ref- RDSO SMI NO: RDSO/2016/EL/ SMI/0297(Rev'0'))

S.No	Equipment	Maintenance schedule					
		IA	IB	IC	MOH	IOH	POH
1	Fault log data download before schedules.	√	√	√	√	√	√
2	Check door gaskets for damages. If found damaged, change the same.	X	X	√	√	√	√
3	Replace all the gaskets of HLC covers.	X	X	X	X	√	√
4	Check the dust ingress into the HLC. Use a vacuum cleaner to clean.	X	X	X	√	√	√
5	Check the HLC main air entry for IGBT modules & magnetic components and clean the filter.	X	X	X	√	√	√
6	Check the cable tie wraps of the power cables. Check for sign of overheating.	X	X	X	X	√	√
7	Check functioning of the blowers and fans and replace in case of any abnormality	√	√	√	√	√	√
8	Measure the overall capacitance of each DC link and replace if needed. (12mF in case of M/s. Siemens make & 10.08 mF in case of M/s. Medha make HLC)	X	X	X	√	√	√
9	Change the bearings of main blower fan (for Siemens make HLC)	X	X	X	X	√	√
10	Check tightness of connection at input, output and control cables.	X	X	√	√	√	√
11	Check the power connection for color changes/ overheating and exchange the cables and sockets.	X	X	X	√	√	√
12	Check tightness of power cables.	X	X	√	√	√	√
13	Check the contacts of the pre- charging contactors. Check the arc quenching chamber of the contactor.	X	X	√	√	√	√
14	Check the contacts of the main contactors. Check the arc quenching chamber of the contactor	X	X	√	√	√	√

15	Check the contacts of the auxiliary contactors. Check the arc quenching chamber of the contactor.	X	X	√	√	√	√
16	Filter cleaning.	X	X	X	√	√	√
17	After schedule of inspection, erase FDP memory.	√	√	√	√	√	√
18	Check parameters of HLC in working conditions. Output voltage - 750V+/- 5, L-E voltage peak - less than 800V.	√	√	√	√	√	√
19	Replace the back-up battery of text display unit of HLC (for M/s. Siemens make only).	X	X	X	X	√	√
20	Chack the sealing of the cable entry into the panel (to stop the sust entry).	√	√	√	√	√	√
21	Check the earth connections of the panel.	√	√	√	√	√	√
22	Check the tightness of mounting/ fixation bolts with the loco body.	X	X	X	√	√	√
23	Check the connectors of the panel.	√	√	√	√	√	√
24	Check the door locks of the panel.	√	√	√	√	√	√
25	Check the healthiness of IV coupler & UIC couplers of the loco. Specially the IP protection and welding of UIC boxes.	√	√	√	√	√	√
26	Check the healthiness of UIC coupler wire of the loco.	√	√	√	√	√	√

Maintenance activities during major/ minor schedules of High Voltage with plug (Ref: RDSO SMI No. RDSO/2017/EL/SMI/0317 Dt: 18.10.2017)

S. No	Activities	IA	IB	IC	AOH	IOH	POH
1	Check for tightness of insulating plug by opening of cap tight the same if required and re-fix the cap both side of the cable.	√	√	√	√	√	√
2	Check the tightness of earthing lead, do tight if required.	√	√	√	√	√	√
3	Clean the high voltage cable and T-connector housing with dry cotton cloth.	√	√	√	√	√	√
4	Remove the oil around the T-connector housing, this place must be clean and dry	√	√	√	√	√	√
5	Avoid to open CHT from bushing checking of tightness is sufficient subject to there is no visual defect on T-connector.	√	√	√	√	√	√
6	Ensure that open high voltage cable with plug must be kept in dust free environment.	x	x	x	√	√	√
7	In any case of re-fixing of T-connector, please make sure that all parts of high vooltage cable with plug must be dust free, clean the stress cone area, T-connector housing and re-grease both of them before fixing.	x	x	x	√	√	√

8	Ensure, when re-fixing the high voltage cable, at first the alloy stud should be tight by hand, then align the cable thimble through T housing with the stud hand fitted in bushing after then insert the insulating plug and push it with revolving with hand pal (Hatheli), tight the same and fix the cap (semiconductor part of the T-connector)	x	x	x	√	√	√
9	Check the tightness of BIP with HV bushing placed on roof	√	√	√	√	√	√
10	Check the tightness of BIP with transformer bushing	√	√	√	√	√	√
11	Check the tightness of electro beam earthing lead at roof side and transofrmer side	x	x	√	√	√	√
12	Check the cleaning and greasing of Elbow	x	x	x	√	√	√
13	Check the cleaning and greasing of transformer bushing	x	x	x	√	√	√
14	Check the cleaning and greasing of HV bushing	x	x	x	√	√	√

Maintenance activities for Crown Gear coupling in WAP-5 Eletric locomotive (Ref- RDSO SMI No. RDSO/2017/EL/SMI/0310, Rev. '0')

S. No	Maintenance activity	IT	IA	IB	IC	TOH	IOH	POH
1	Cleaning of gear box side & TM side protruding sleeve and star portion of coupling.	x	√	√	√	√	x	x
2	Checking of tightness of hex head bolt of sleeve and nylock nut of star portions of both side.	x	√	√	√	√	x	x
3	Visual inspection for any abnormality and oil leakage from the coupling.	√	√	√	√	x	x	x
4	Free movement of star on either side to be checked. If not free top up oil suitably to achieve free movement. (axial movement upto + 35mm)	√	√	√	√	x	x	x
5	Check crack in complete spline portion of stars visually by taking loco movement.	x	√	√	√	x	x	x
6	DPT to be done on complete spline portion of stars by taking loco movement to check for crack.	x	x	x	√	√	√	√
7	Membrane to be checked and if damage occurs due to oil leakage, membrane should be replaced.	x	√	√	√			
8	Membrane to be chaged with new one and press fitted with cover.	x	x	x	x	√	√	√
9	Check the alignment of gear side and TM side coupling using steel ruler.	x	√	√	√	x	x	x
10	Damaged thread of sleeve and star bolts to be changed with new one.	x	x	x	x	√	x	x
11	DPT to be done on complete spline portion of stars after removing it from coupling.	x	x	x	x	√	√	√
12	Open star bolt to discouple GB & TM side coupling and remove both the stars (GB & TM side) to change the membrane.	x	x	x	x	√	x	x
13	O' ring to be changed with new one of both side of star.	x	x	x	x	√	√	√
14	Old oil to be flushed out and new fresh oil to be filled.	x	x	x	x	√	√	√

15	Cleaning of opened sleeve in position and removed star and checking for any crack/ damage by DPT. Refitment of star in coupling and joining of both GB/ TM side coupling.	x	x	x	x	√	x	x
16	Removal of complete coupling from loco and reassembly as per Vol-F-2 Section-6 of maintenance manual of WAP-5 locomotive.	x	x	x	x	x	√	√
17	Dimensions of TM & GB shaft should be checked, if any damage found in dimension & bending it should be replaced.	x	x	x	x	x	√	√
18	Sleeve bore of TM & GB side should be checked, if any variation found it should be replaced.	x	x	x	x	x	√	√
19	Sleeve & star should be checked properly, if any damage found it should be replaced immediately.	x	x	x	x	x	√	√
20	Check the alignment of gear side and TM side coupling as per RDSO instruction No. RDSO/2017/EL/SMI/309 Rev.0	x	x	x	x	√	√	√

Maintenance of Radiators of Oil Cooling Unit of 3- Phase Electric Locomotives.
(Ref- RDSO SMI No. RDSO/2017/EL/SMI/0287, Rev. '0')

S.N	Maintenance activity	IA	IB	IC	TOH	IOH	POH
A.	**Cleaning of Radiator Assembly of Oil Cooling Unit: (Note: The cleaning of radiator shall be carried out only after cleaning of filters of Oil Cooling Blower.)**						
1	Remove the cover of the service port of radiator.	√	√	√	√	√	x
2	Impurities adhering to the top of the cooler (flowerbuds, leaves etc.) should be removed with vacuum cleaner/compressed air. Cleaning of cooling air ducts (space in-between the fins of radiator) with compressed air (5 to 6 kg/cm2) should be done from the top of radiator downward. Whereas with industrial vacuum cleaner, cleaning may be done from top/ bottom both side.	√	√	√	√	√	x
3	The cooler should be sprayed with a recommended (e.g. Auco-Alu B made by Messrs. Auco, Gerwigstrasse 24-26, D-78234 Engen) OR NULON R40 OR Also clean AD-20 OR equivalent cold cleaning agent and left for 20 minutes. For spraying the cleaning agent, a chemical spray tank (Approx. 12 litre) should be used.	√	√	√	√	√	x
4	Rinse through the cooling air ducts (Space in- between the fins of radiator) as specified below with the aid of a high-pressure hot water jet cleaner (water temp. 650C-700C).	√	√	√	√	√	x
	i. Use a pencil shaped nozzle water jet. Alternatively, fan shaped water jet with adequate support plates to reduce the pressure to 3 to 4 kg/cm2 may also be used.	√	√	√	√	√	x

	ii. The operating pressure of the high-pressure cleaner should be approx. 3 to 4 kg/cm2.	√	√	√	√	√	x
	iii. Slowly & systematically clean with water jet (temp. 650C -700C) applied perpendicularly to the cooling fins (from top of the radiator) till dust/dirt/debris from the fins are removed.	√	√	√	√	√	x
	iv. Then blow compressed air (5 to 6 kg/cm2) vertically through cooling air ducts for drying the radiators.	√	√	√	√	√	x
5	Refix the cover on the service port.	√	√	√	√	√	x
6	Remove the radiator from locomotive.	x	x	x	x	x	√
7	Using Compressed air at pressure of 5 to 6 kg/cm2, clean each external air fin passage to remove all loose dust and dirt particles. This will help in cleaning the air passages and will increase the cooling performance of the radiator.	x	x	x	x	x	√
8	Prepare a solution in cleaning tank in concentration (about 5%) with cleaning agent as specified in SMI. Capacity of tank should be adequate so that whole radiator can be immersed.	x	x	x	x	x	√
9	Dip whole oil cooler radiator in tank & keep inside the tank for at least one hour duration.	x	x	x	x	x	√
10	Take out the radiator from Radiator cleaning tank. Clean the surface of the radiator fins with a water jet to remove all the collected dust and dirt. Ensure the water jet is at a pressure of 3 to 4 kg/cm2 to create the cleaning effect. Clean with water jet for 20 to 30 min depending on the condition of the radiator & till all the chemical is washed out.	x	x	x	x	x	√
11	After cleaning the radiator with water jet, drain the water from each passage of the radiator by using an air blower or fan. Ensure the blower covers the entire surface area and capable to drain out all the residues of water. If blower / fan is not available then use air pressure of about 5 to 6 kg/cm2 for this purpose.	x	x	x	x	x	√
12	The radiator shall be tested for leakage as mentioned in SMI.	x	x	x	x	x	√

Maintenance of filters of Oil Cooling Blower (OCB), Machine Room Blower (MRB) and Traction Motor Blower (TMB) for 3- phase Electric Locomotives. (Ref- RDSO SMI No. RDSO/2017/EL/SMI/0286, Rev. '0')

SN	Maintenance Activity	IA	IB	IC	TOH /MOH	IOH	POH
1	Cleaning of screens filter panel of OCB, TMB & MRB with a soft brush to remove foreign materials, duct dirt etc. Use compressed air (Pressure 3 to 4 kg/cm2) to clean filter panels. Clean the filter panel with hot water jet with suitable soap/solvent (Temp 650C to 700C).	√	√	√	√	√	√
	Note: The cleaning of the filter of OCB shall be done after removing roof OCB while keeping the OCB fitted on the roof during major schedule (TOH/MOH,IOH & POH) while in- situ cleaning shall be done in minor schedule (IA,IB & IC) taking due precautions to avoid accumulation of dust, dirt & moisture on radiator as well as OCB motor. Filter panel of TMB and MRB shall be removed from side wall for cleaning purpose. Compressed air cleaning should be started from the reverse side of normal air flow. Thereafter the filter shall be cleaned in normal direction of air flow. If air flow on radiator is not increasing more than 8 m/sec after in-situ cleaning, in that case OCB filter shall be cleaned after removing roof OCB while keeping the OCB fitted on the roof during minor schedule also.						
2	Cleaning of filter louvers of MRB and TMB with hot water jet (Temp 650C to 700C).	√	√	√	√	√	√
3	Filter duct wear plate of MRB and TMB should be checked and adjusted, if required.	√	√	√	√	√	√
4	Filter seal between filter and filter duct of OCB, MRB and TMB should be visually inspected for wear or damage. Replace if wear or damage found.	√	√	√	√	√	√
5	Seals of blower of OCB, MRB and TMB should be checked and replaced if damaged or deteriorated.	√	√	√	√	√	√
6	Checking the condition of half inch hose pipe provided at MRB & TMB filters for cracks/deterioration & replace if necessary.	√	√	√	√	√	√
7	Replacement of half inch hose pipe provided at MRB & TMB filters	x	x	x	√	√	√
8	Fasteners of blower fan and filter panel of OCB, MRB and TMB should be checked and tightened, if required.	x	x	√	√	√	√
9	Cleaning of Blower casing and impeller of OCB, MRB and TMB.	x	x	x	√	√	√
10	Filter panel flanges of OCB, MRB and TMB should be visually inspected for wear or damage. Replaced if wear or damage found.	x	x	x	√	√	√
11	Filter seal between filter panel and pantograph roof hatch of OCB should be checked for damage or deterioration. Replaced if damaged or deterioration found.	x	x	√	√	√	√

12	Filter panel of OCB is subjected to water leakage test. Rectify if leakage found.	x	x	x	√	√	√
13	Cleaning of filter duct along with scavenge duct of OCB/ TMB/MRB with hot water jet (Temp 650C to 700C).	x	x	x	x	√	√
14	Cleaning of blower fan impeller of OCB, MRB and TMB with hot water (Temp 650C to 700C).	x	x	x	x	√	√
15	Cleaning of Blower air cone of OCB with hot water (Temp 650C to 700C).	x	x	x	x	√	√
16	Cleaning of filter panel of OCB/TMB/MRB with hot water jet (Temp 650C to 700C).	x	x	x	x	√	√
17	Following seals are to be replaced: Between blower and filter duct of OCB, MRB and TMB Between blower filter and pantograph roof hatch of OCB On blower unit of OCB Blower filter, plenum, wear plate and duct of MRB and TMB	x	x	x	x	√	√
18	Following seals are to be replaced: Between blower and Machine Room floor of OCB,MRB and TMB Between blower filter and ducting of OCB, MRB and TMB Blower inspection door/cover of OCB, MRB and TMB Between Blower filter and duct of OCB, MRB and TMB	x	x	x	x	√	√
19	Replace filter media assembly consisting of Vortex tubes	x	x	x	x	x	√

Apart from above, the Reliability action Plan No. RDSO/2017/EL/TC/0142(Rev. '0'), Dated 09.01.2018 should be followed.

Annexure. 3.02

AIR BRAKE SYSTEM & PNEUMATIC VALVES
(Ref : CAMTECH/E/10-11/Trg-PN VALVES/1.0, January'2011)

1.1 INTRODUCTION

Various pneumatic brake systems are working on electric locomotives for brake application in locomotive and air braked trains as well as standard vacuum braked trains. The main brake systems on Indian Railways are IRAVB-2, IRAB-2, IRAB-9 and IRAB-10. For this purpose different types of pneumatic valves are used to perform various functions and controls in pneumatic circuits. These valves are arranged in various ways such as segregated pneumatic valves arrangement, mounted on Bi-plate/ Tri-plate panel/ CLW made pneumatic panel. This training package includes brief description of various pneumatic valves, their overhauling checks & testing procedures, maintenance tips, special features on rubber components etc.

1.2 IMPORTANT FEATURES OF AIR BRAKE SYSTEM

The important features of air brake system are as under:

1. Locomotives brakes may be applied with any desired pressure between the minimum and maximum, and this pressure will be automatically maintained in the locomotive brake cylinders against normal leakage from them and regardless of variation in piston travel, until released by the driver's brake valve.
2. The locomotive brakes can be graduated on and off with either the automatic brake valve (A9) or the independent brake valve (SA9).
3. It is always possible to release the locomotive brakes with the train brakes remained applied even when automatically applied to avoid skidding of wheel. The locomotive brakes, can, however, be called back again with the same level should the operating condition demand.
4. Maximum brake force in emergency, ensuring shortest possible stop distance.
5. Emergency brake application available at all automatic brake valves.
6. Multiple unit operation.
7. Break-in two features with traction power cut-off during both air braked and vacuum braked train control.

Besides the brake system pneumatic circuits are also designed for operation of the following ancillaries:

1. Loco controls including operation of pantographs.
2. Electro-pneumatic sanding.
3. Pneumatic horn.
4. Pneumatic wipers.

1.3 WORKING OF AIR BRAKE SYSTEM

The working principle of Air Brake System in brief is described as below:

At all times, the compressor supplies compressed air through the main reservoir to A-9 Auto Brake Valves, SA-9 Independent Brake Valves, MU-2B Valve, C2W Relay Valve and additional C2W Relay Valve.

1.3.1 BP Charging

In release position of the A-9 Automatic Brake Valve, which is used for controlling locomotive and train brakes, the main reservoir air flows to its regulating portion which is reduced to a pre-determined pressure of 5.0 kg/cm2. The regulated air pressure flow through the A-9 brake valve, MU-2B valve and

then to the control port of the additional C2W relay valve. The air brake pipe (BP) is charged rapidly through the additional C2W relay valve to 5.0 kg/cm2. The brake cylinder pressure exhausts through the C2W relay valve and thus releases the locomotive brake via the C2W relay valve.

1.3.2 Automatic Air Brake (By A-9)

1.3.2.1 Brake application

When it is desired to simultaneously apply the locomotive and train brakes, the Automatic Brake Valve A-9 is moved into the service brake zone permitting the control air pressure to drop at a service rate at the automatic brake valve exhaust port. This operates the additional C2W relay valve to reduce the brake pipe air at faster rate. The C3W distributor valve applies the train brakes through the C2W relay valve. The brakes are applied due to reduction of brake pipe pressure. After the desired brake pipe reduction has been made, the automatic brake valve and the additional C2W relay valve will lap. In lap position of the valves the brakes are held applied throughout the train until a further brake pipe reduction or charging is made and the A-9 brake valve and the additional C2W relay valve exhaust ports to the atmosphere are closed thereby stopping further reduction in the brake pipe pressure. At the C2W relay valve, the control pipe pressure will open the supply valve and permit the main reservoir air to flow to the brake cylinders until equalization is achieved across the diaphragm of the C2W relay valve. When equalization is achieved, the supply valve will be closed, cutting of the main reservoir supply air to the brake cylinder. In the event of a leakage in the brake cylinder, the diaphragm piston of the C2W relay valve will again move to allow the main reservoir supply air to recharge the brake cylinder to maintain the pressure at the desired level.

1.3.2.2 Brake Release and Recharge

To release the brakes after automatic brake application, the A-9 automatic brake valve is moved to release position thereby opening the inlet valve of the regulating portion of the A- 9 brake valve to supply air to the control pipe of the additional C2W relay valve, which in turn will operate and supply air at a faster rate to the brake pipe as described before. The increase in the brake pipe pressure operates the C3W Distributor valve, which connects the C2W relay valve to open the exhaust port. Thus the brake cylinder pressure will flow to the exhaust from the C2W relay valve exhaust port.

1.3.2.3 Emergency brake application

When it is desired to make the shortest possible stop, the automatic brake valve is moved to the emergency position, opening the air brake pipe directly to the atmosphere at the brake pipe vent valve. The rapid reduction in the brake pipe pressure operates the C3W distributor valve to quickly connect the regulated air pressure to the locomotive brake cylinders through the 24A double check valve and the C2W relay valve and also applies the brakes on the air-braked train. Release after emergency takes place in the same way as described under ‘Brake Release and Recharge’.

1.3.3 Air Brake (By SA-9)

The locomotives brakes may be operated independent of the train brakes at any time by proper movement of the SA-9 Independent brake valve handle. The SA-9 independent brake valve is connected through a double check valve to the C2W relay valve that controls the brake cylinder pressure build up.

1.3.3.1 Brake Application

If it is desired to apply the locomotive brakes only, the SA-9 independent brake handle is moved to the application zone. This allows the main reservoir supply air to flow through the double check valve, separating the two SA-9 independent brake valves, the independent application and release pipe and

through the double check valve to actuate the C2W relay valve which will supply air pressure to the brake cylinders in proportion to the brake valve handle movement.

1.3.3.2 Brake Release

To release the locomotive brakes, the SA-9 independent brake valve is moved towards the release position, venting the air in the brake cylinder control pipe to the C2W relay valve, at the independent brake valve, in proportion to the brake handle movements, thus allowing the C2W relay valve to connect the brake cylinder air pressure to exhaust at the C2W relay valve. Thus the locomotive brakes may be gradually applied or released with SA-9 independent brake valve without affecting the train brakes.

1.3.4 Air Flow Indicator

The air flow indicator adaptor has been provided at the main reservoir at inlet port 1 of additional C2W relay valve to indicate the brake pipe airflow conditions of the train. The flow indicator is pneumatically connected with air flow indicator adapter and provides an indication to the driver in case of train parting, alarm pulling and heavy leakage in the brake pipe or rear end brake application.

1.4 Operation of brakes on trailing stock equipped with air brake equipment

1.4.1 In 'release' position of A-9 automatic brake valve, main reservoir air flows to the regulating portion of automatic brake valve at a pre-determined pressure, normally 5kg/cm2. The additional regulated air pressure flows through MU-2B valve to the C-2 relay valve. This control pressure actuates C-2 relay valve which in turn connects main reservoir to brake pipe and charges the brake pipe and the connected system to the same pressure level through out the train. Any leakage in the train system is automatically compensated by this relay valve.

1.4.2 When the brake valve handle is moved to minimum reduction position, reduction of pressure in brake pipe by 0.2 to 0.5 kg/cm2 (3 to 8 PSI) is achieved and proportional application of brakes on loco and trains takes place. In full service position of the automatic brake valve handle, the BP pressure is reduced to 3.5 kg/cm2.

1.4.3 The A-9 automatic brake valve handle when placed in emergency position, vents brake pipe pressure-at a very fast rate to atmosphere to initiate an emergency brake application. Regression of power also takes place due to the actuation of RGEB pressure switch. Reduction in pressure in the brake pipe actuates the distributor valve on the loco and trailing stock to apply brakes.

1.4.4 The C-3-W distributor valve provided in the brake circuit, is connected to the brake pipe and responds to the variations of pressure in the brake pipe. It applies proportionate brake application on locomotive when train brakes are applied either through Automatic or Emergency brake valve. The C-3-W distributor has a built in Goods/Passenger changeover cock to regulate brake cylinder pressure depending on whether it is hauling Passenger or freight train.

1.4.5 32 mm feed pipe through-out the train is charged from the first two main reservoirs, through duplex check valve and feed valve set at 6.0 0.1 kg/cm2 and is used for filling auxiliary reservoirs of the trailing stock initially as well as after the air from these reservoirs has been consumed during braking. The main advantage of this additional pipe is to reduce the release and recharging time of the train after brake application.

1.4.6 When the driver feels that it is not necessary to apply brake on a loco, during automatic application the brake release pedal switch is pressed to release the loco brakes. The D-1 pilot air valve is energised to cut off automatic air brakes on the loco while train brakes remain applied on the trailing stock.

1.5 The operation of emergency brake

Valve D-1 provided in each cab, near the assistant driver's seat, directly connects the and air brake pipe to atmosphere thereby applying brakes on loco and trailing stock at the quickest possible rate. The circuit for auto regression of the loco power due to the actuation of H-5 relay air valve is also automatically made. This relay valve also regresses power if the BP pressure drops due to any reason.

1.6 Dynamic brakes

1.6.1 D-1 pilot air valve cuts off loco brakes.

1.6.2 While controlling train with dynamic brakes, if the dynamic brakes fails, brakes on the loco and train will be applied automatically.

1.7 Air flow indicator

1.7.1 Air flow indicator, a relay valve, one pressure switch and two flow indicator gauges (one in each cab) have been provided to give an indication of the air flow rate in the brake pipe of the train. Any abnormal increase in air flow in the brake pipe because of train parting, loco parting, alarm chain pulling, heavy leakage in brake pipe, guard van valve application or bursting of air brake pipe hose would give visual indication to the driver by air flow gauge needle and by glowing of a bulb in the cab. On getting the indication driver should apply brakes through A-9 automatic brake valve/D-1 air/ emergency valve depending upon the condition of the train and the emergency.

1.8 Multiple unit operation

1.8.1 When two or more locos are to be coupled together in multiple unit operation, the brake pipe, the feed pipe, , the main reservoir equalising pipe and brake cylinder equalising pipe hoses must be coupled between the locos, and the respective angle cocks shall be opened.

1.8.2 The compressors of the trailing locos would also be working during multiple operation. The automatic and independent brake valve handles in the trailing loco and on the unused cab of the leading loco shall be kept in 'Release' position and the isolating cocks provided near both brake valves should be closed.

1.8.3 MU-2-B valve provided to supply MR air F-1 selector valve should be kept in 'lead' in the leading loco and in 'Trail' position in the trailing locos. Isolating cock in the brake pipe charging line should be kept in lead position (open) in leading loco and trail position (close) in the trailing loco(s).

1.9 Gauges

There are five gauges in each driving cab. These gauges indicate BC, MR, FP, , Air Flow, BP pressures to the driver. Apart from these, one single pressure gauge is provided. near the panto reservoir.

1.10 General

1.10.1 The first two main reservoirs are provided with auto drain valve and the condensate is automatically drained off during the "cut out" and "cut-in" cycle of the compressor governor. All the other three main reservoirs are provided with manual drain cocks to drain off periodically the condensate collected in the reservoirs.

1.10.2 The main reservoir also supplies compressed air to auxiliaries such as wipers horns and sanders. The MR equalising pipe is charged from the main reservoirs through a duplex check valve set at 5.0-0.1 kg/crn2.

1.10.3 The main reservoir also supplies compressed air to electrical auxiliaries such as pantographs, tap changers, Board of gaduator etc At the time of initial energisation of loco or when there is insufficient pressure in pantograph reservoir to raise the pantograph, battery driven auxiliary compressor is operated to build up pressure in the pantograph reservoir and auxiliary circuit to energise the loco. The pantograph reservoir is protected against pressure leakage by a ball type isolation cock. One safety valve to cut out at 8.5 t 0.1 kg/cm2has been provided to safeguard the baby compressor from excessive pressure.

Note: Overhauling Checks and Tests as per CAMTECH/E/10-11/Trg-PN VALVES/1.0, January'2011.

1.11 Pneumatic test instructions of Electric locomotives as per RDSO report No: RDSO/2013/ EL/IR/0159, Rev '0' Dated: January'2013.

2.0 TROUBLE SHOOTING:

Sl. No	Operational Failure	Probable Cause of Failure
2.1	BP pressure – not charging	C3W DV or A-9 Brake Valve at fault.
2.2	BP Graduation in both and 'Release' and 'Application' Not possible	A-9 Brake Valve at fault
2.3	BP Pressure regulation – Not Possible	A-9 Brake Valve at fault.
2.4	Graduation in both BC 'Application' & 'Release' – Not Possible	A-9 Brake Valve / C2W Relay
2.5.i)	No Brake application by SA-9	No Main Res. supply to SA-9 MU-2B in Trail condition. C2W Relay Valve (BC) - Faulty.
2.5.ii)	No full / partial brake application taking place through A-9 B V.	BP Hose kinking prior to the panel
2.6.i)	Independent brake not releasing	C2W Relay Valve (BC) or SA-9 Brake Valve at fault.
2.6.ii)	Automatic Brake Valve not releasing	BP Hose Kinking prior to entry to the panel.
2.7	Independent pressure Regulation not possible.	SA-9 Brake Valve at fault.
2.8	No traction power cut – off during Emergency Brake Valve.	Power cut-off Pressure Switch needs adjustment or defective.
2.9	In MU2B – 'Trail' condition- BC equalizing – not charging in Trail Loco.	Port No.53 of F-1 Selector Valve not getting connected- cleaning required.
2.10	BC Overcharge – continuous leakage in additional C2W Relay Valve (BC)	C2W Valve faulty Mounting Gasket / 'O' Rings to be checked
2 .11	Feed Pipe – Not charging.	D24B Feed Valve at fault.
2 .12	Abrupt / slow overcharging of Feed Pipe	D24B Feed Valve at fault.
2.13	BC Pressure shoots up above setting pressure 3.5 kg./cm2	N-1 Reducing Valve needs to be adjusted or at fault
2.14	Over riding of Brake Valves- not possible by initiating brakes from A-9/ SA-9 – not possible.	Double Check Valve type 24A at fault of sticking in between
2.15	Dynamic Brake interlock is not working	Dynamic Brake Interlock Magnet Valve at fault.

3.0 TESTING PROCEDURE:

IRAB-9 Brake System is consisting of control equipment, valve and accessories only. While operating equipment is all mounted on the Driver's Cab to make it accessible to the Driver for subsequent brake operation. The equipment responsible for brake application and release are also kept in their respective position for subsequent use.

4.0 TESTING PREPARATIONS:

A-9 Automatic Brake Valve and SA-9 Independent Brake Valve should be absolutely in leak- proof condition. No exhaust leakage is permissible.

All the Valves and equipment should be maintained with correct operating features and no leakage is permissible through mounting surfaces with Panel otherwise test results may have to suffer causing other implications in the Brake System.

4.1 Testing arrangement of Panel of IRAB-9 Circuit / perform the following tests on Test Rack. Otherwise following tests may be carried out on Locomotive Brake Circuit. All the Pressure Gauges are to be calibrated after duration of use for 6 months interval. Tests are to be carried out with Calibrated Gauges only.

4.2 The test criteria to be followed in order to check the performance of IRAB-9 Brake System on Test Rig or on Locomotive Brake Circuit, should comply with the systematic tests as per Test Programme as per Annexure 1

ANNEXURE-1

TEST STANDARD OF TRIPLATE PNEUMATIC PANEL FOR IRAB9 & 10 BRAKE SYSTEM FOR ELECTRIC LOCOMOTIVE

TEST CLAU-SE NO	TEST DESCRIPTION	RESULT TO BE OBTAINED	RESULT OBTAINED
1.0	Leakage Test		
1.1	MR Leakage		
1.1.1	SA9 application, Note Pressure drop in gauge	≤0.3kg/ cm² in 4 minutes	
1.1.2	SA9 release & A9 to emergency Note pressure drop in gauge	≤0.3kg/cm² in 4 minutes	
1.2	BP Leakage		
	A9 in release position Partial brake application by Reducing BP by 0.6 kg/ cm² MU2B in trail position, note BP drop	≤0.7kg/ cm² in 5 minutes	
1.3	FP leakage		
	Note FP drop in gauge	≤0.7kg/ cm² in 5 minutes	
2.0	Limiting valve (N1) setting	2.5 0.1kg/ cm²	
3.0	A-9 Auto Brake Valve		
3.1	Full service application		
	BP stabilizing pressure Time for BC pressure to build up to 95%(2.4kg/ cm²) of max. Pressure	3.2 to 3.4 kg/cm²	
	- For passenger position - For Goods position	6 to 9 seconds 20 to 25 seconds	
	c) Max. BC pressure	2.5 kg/ cm²	
3.2	Release from full service		
	BP charging time to 5 kg/ cm² BC drop from max. to 0.4 kg/ cm²	2 to 4 seconds	
	-For passenger position - For Goods position	10 to 15 seconds 25 to 30 seconds	
3.3	Emergency application		
	a) Time BP dropped to zero	1 to 3 seconds	
	b) Time for BC built up to 95% (2.4kg/ cm² of max.)		
	-For passenger position - For Goods position	6 to 9 seconds 20 to 25 seconds	
	c) Max. BC pressure	2.5 kg/ cm²	
3.4	Release after emergency application		
	a) BP Charging time	3 to 6 seconds	
	b) BC dropped to 0.4 kg/ cm²		
	-For Passenger position	10 to 15 seconds	
	-For Goods position	25 to 30 seconds	

3.5	Minimum Reduction		
	a) BP Pressure	4.5 - 4.7kg/ cm²	
	b) BC Pressure	0.5 – 1.1kg/ cm²	
4.0	Control Reservoir Leakage	No leakage in 10mts.	
5.0	Propagation of BC pressure		
	a) BP Pressure 5.0 kg/ cm²	Corresponding of BC Pressure	
	4.5 kg/ cm²		
	4.0 kg/ cm²		
	3.5 kg/ cm²		
	b) BP Pressure 3.5 kg/ cm²		
	4.0 kg/ cm²		
	4.5 kg/ cm²		
	5.0 kg/ cm²		
6.0	Double Check Valve Test		
6.1	SA-9 in partial application	BC 2.0 0.1 kg/cm²	
	A-9 in application	BC 2.5 0.1 kg/cm²	
	A-9 to release position	BC 2.0 0.1 kg/cm²	
	SA-9 to release position	BC 0.0 0.1 kg/cm²	
6.2	A-9 to partial position	BC 2.0 0.1 kg/cm²	
	SA-9 to full application	BC 4.0 0.1 kg/ cm²	
	SA-9 to release position	BC 2.0 0.1 kg/cm²	
	A-9 to release position	BC 0.0 0.1 kg/cm²	
7.0	SA-9 Independent Brake Valve		
7.1	Application Position		
	a) Time for BC pressure to Build to 95% (3.8 kg/ cm² of max. Pressure	4 to 6 seconds	
	b) Max. BC pressure	4.0 0.1 kg/cm²	
7.2	Release from application		
	Time for BC pressure drop From 4.0 kg/ cm² to 0.4kg. cm²		
	Note BC pressure on gauge	8 to 12 seconds	
8.0	Loco Brake Release Switch		
	A-9 to emergency position		
	Energize Magnet Valve Note BC pressure drop	0.0 kg/ cm²	
	De-energize the Magnet Valve	2.5 kg/ cm²	
9.0	Emergency Brake valve Test		
	A-9 to release position Open cock BP (E3 cut off cock)		
	BP pressure drop to 2.5 kg/ cm²	2 – 4 seconds	
	Time for BC pressure to build up to 95% (2.4 kg/ cm²)of max. Pressure		
	-For passenger position	7 – 10 seconds	
	-For Goods position	12 –24 seconds	
10.0	Capacity test		
	Release Run Magnet Valve		
	a) BP pressure against 7.5mm diameter hole	Not below 4.4 kg/ cm²	
	b) De-energize release run magnet valve	2.5 to 3.5 kg/ cm²	

11.0	Air Flow Measuring Valve		
11.1	a) AFMV calibration test		
	b) Releasing on gauge		
11.2	AFMV Performance Test		
	a) Reading on Gauge	5 kg/ cm²	
11.3	Setting of pressure switch RGAF	Cut in 4.0kg/ cm² Cut out 3.5kg/ cm²	
	Lamp comes 'ON'	OK	
	Lamp comes 'OFF'	OK	
12.0	Brake Pipe Cut Off Cock		
	a) A-9 to emergency position		
	b) Close BP cut off cock on panel and move A9 to release position, note pressure	BP 0.0 kg/ cm² BC 2.5 kg/ cm²	
	Open BP cut off cock on panel and note pressure	BP 5.0 kg/ cm² BC 0.0 kg/ cm²	
13.0	Multiple Unit Operation		
13.1	MU2B to Lead Position		
	A-9 to emergency position		
	a) BP pressure	0.0 kg/ cm²	
	b) BC pressure	2.5 kg/ cm²	
	MU2B to Trail Position		
	a) BP pressure	0.0 kg/ cm²	
	b) BC pressure	2.5 kg/ cm²	
	A-9 to release position		
	a) BP pressure	0.0 kg/ cm²	
	b) BC pressure	2.5 kg/ cm²	
13.2	MU2B to Lead Position		
	A-9 to Release position		
	a) BP pressure	5.0 kg/ cm²	
	b) BC pressure	0.0 kg/ cm²	
	MU2B to Trail Position		
	A-9 to full service application In steps		
	a) BP pressure	5.0 kg/ cm²	
	b) BC pressure	0.0 kg/ cm²	
	A-9 to Emergency Position		
	a) BP pressure	Starts dropping	
	b) BC pressure	0.0 kg/ cm²	
	A-9 to release Position		
	a) BP pressure	5.0 kg/ cm²	
	b) BC pressure	0.0 kg/ cm²	
	SA-9 to release Position		
	a) BP pressure	5.0 kg/ cm²	
	b) BC pressure	0.0 kg/ cm²	
	SA-9 to full application		
	a) BC pressure	0.0 kg/ cm²	
	b) BP pressure	5.0 kg/ cm²	
	SA-9 to release position		

14.0	Setting of RGEB		
	a) Cut 'IN'	3.0 0.1 kg/ cm²	
	b) Cut 'OFF'	4.2 0.1 kg/ cm²	
15	Parting Between Locos		
15.1	Leading Loco (MU2B Lead) Brake Application by A9		
	a) BP Pressure	0.0 kg/ cm²	
	b) BC Pressure	2.5 kg/ cm²	
15.2	Leading Loco (MU2B)		
	Leading Loco (MU2B Lead) Brake Application by SA9		
	a) BP Pressure	0.0 kg/ cm²	
	b) BC Pressure	4.0 kg/ cm²	
	c) SA-9 to full application		
15.3	Trailing Loco (MU2B Trail)		
	a) BP pressure	5.0 kg/ cm²	
	b) BC pressure	0.0 kg/ cm²	
16.0	E3 Emergency Test		
	a) BP pressure	5.0 kg/ cm²	
	b) BC pressure raises to 2.3kg/cm		
	c) Leakage at Exhaust port of E3		
17.0	Setting of Pressure Switch P1		
	Cut 'IN'	4.8 0.1 kg/ cm²	
	Cut 'OUT'	4.5 0.1 kg/ cm²	
18.0	Setting of Pressure Switch P2		
	Cut 'IN'	4.7 0.1 kg/ cm²	
	Cut 'OUT'	4.4 0.1 kg/ cm²	
19.0	Testing of VEAD Magnet Valve		
	Energize Magnet Valve	Blast of air will come out from the port no. 24	
	De-energize Magnet Valve	No pr. at port 24	
20.0	Testing of RGCP Pr. Switch		
	Cut 'IN'	8.0 0.1 kg/ cm²	
	Cut 'OUT'	9.5 0.1 kg/ cm²	
21.0	Testing of SWC Pr. Switch		
	Cut 'IN'	0.2 0.1 kg/ cm²	
	Cut 'OUT'	1.0 0.1 kg/ cm²	

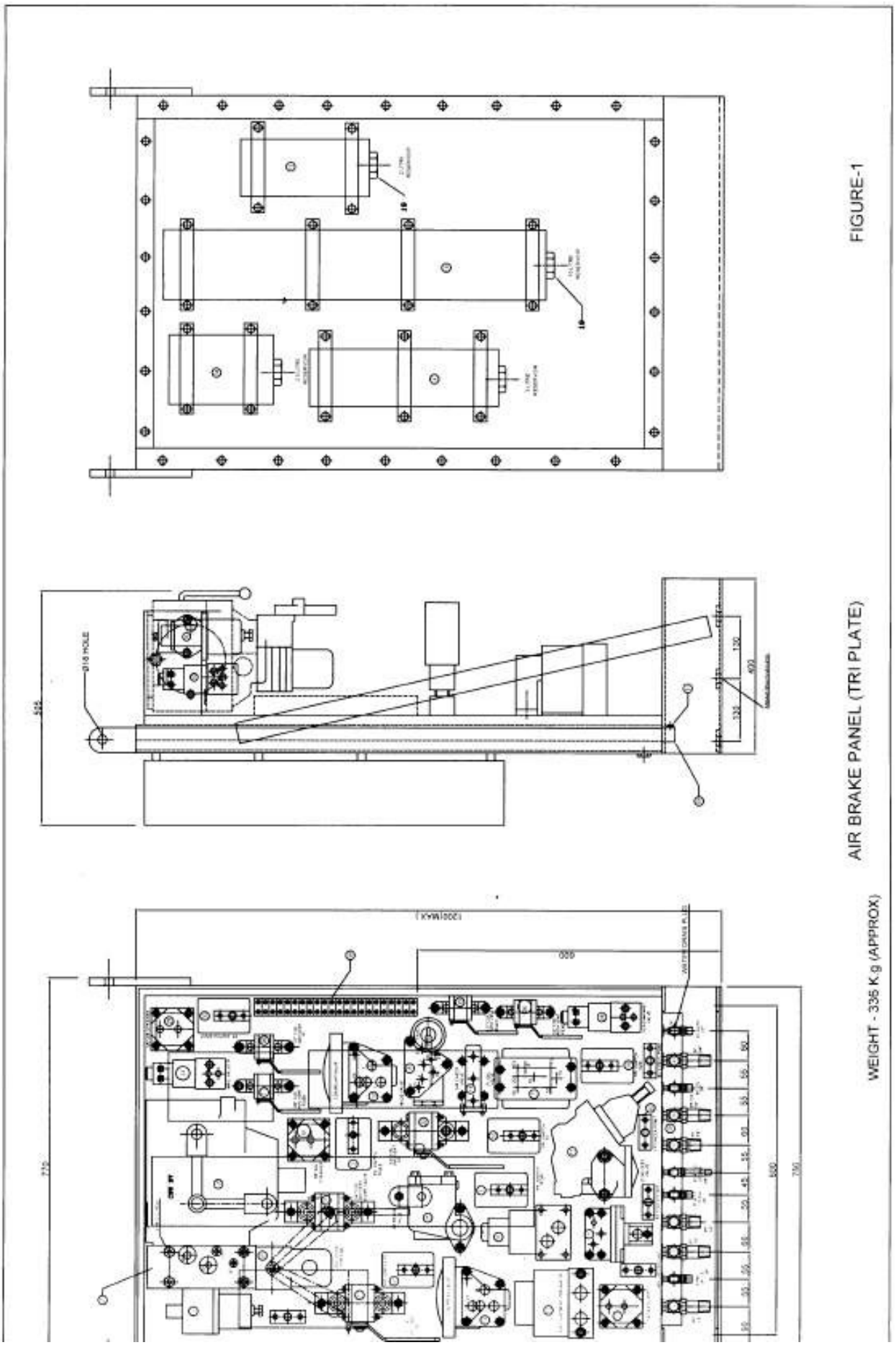
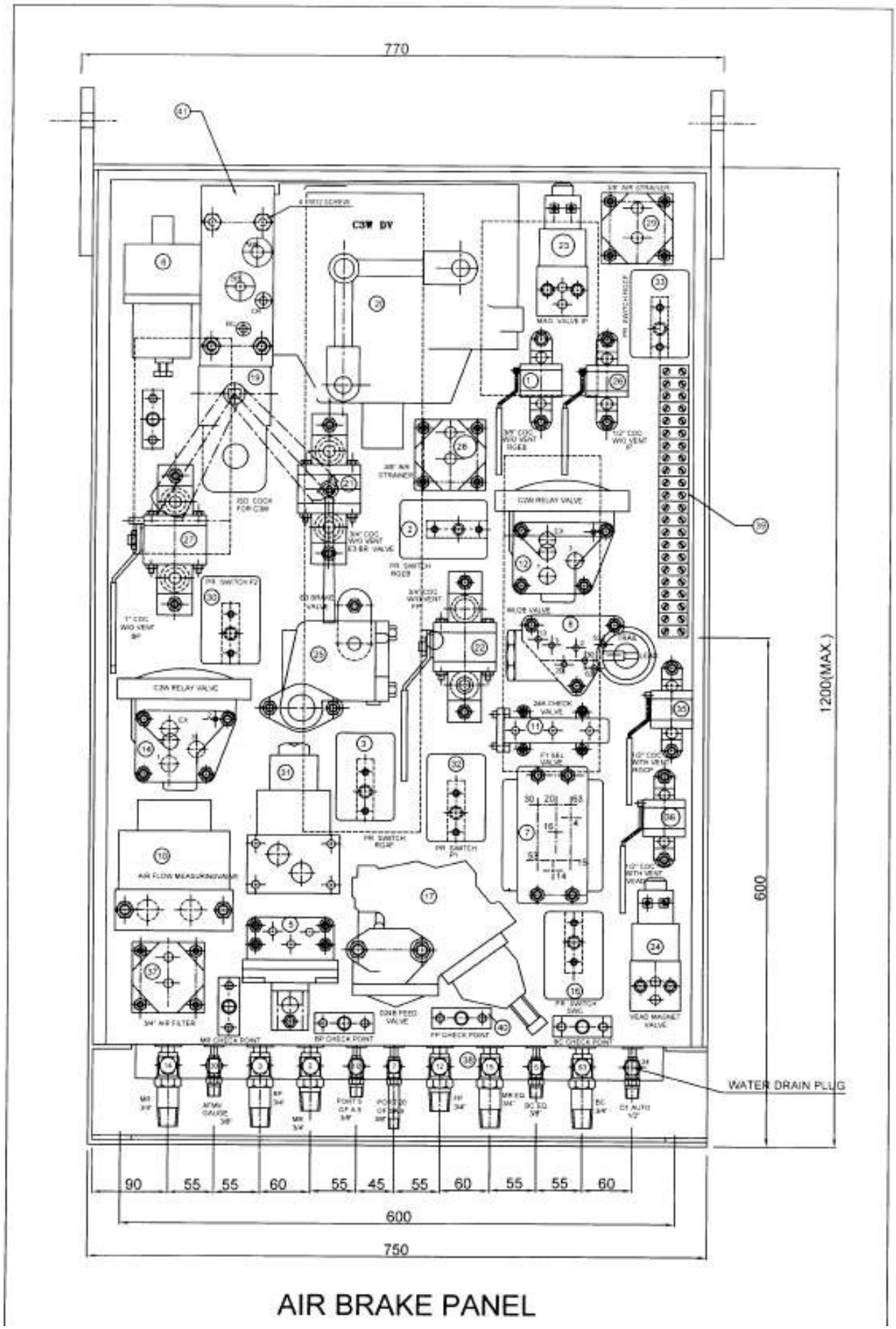


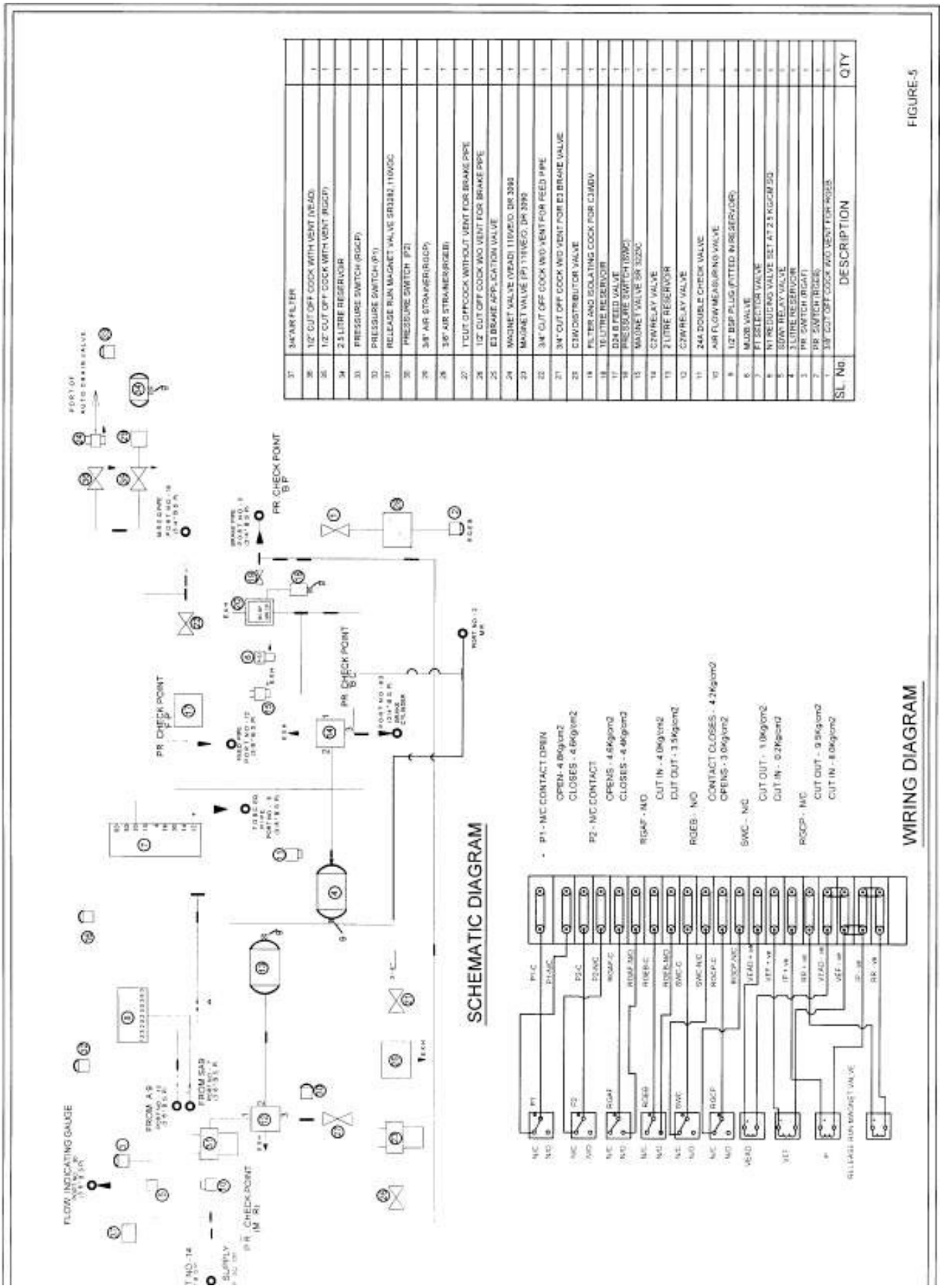
FIGURE-1

AIR BRAKE PANEL (TRI PLATE)

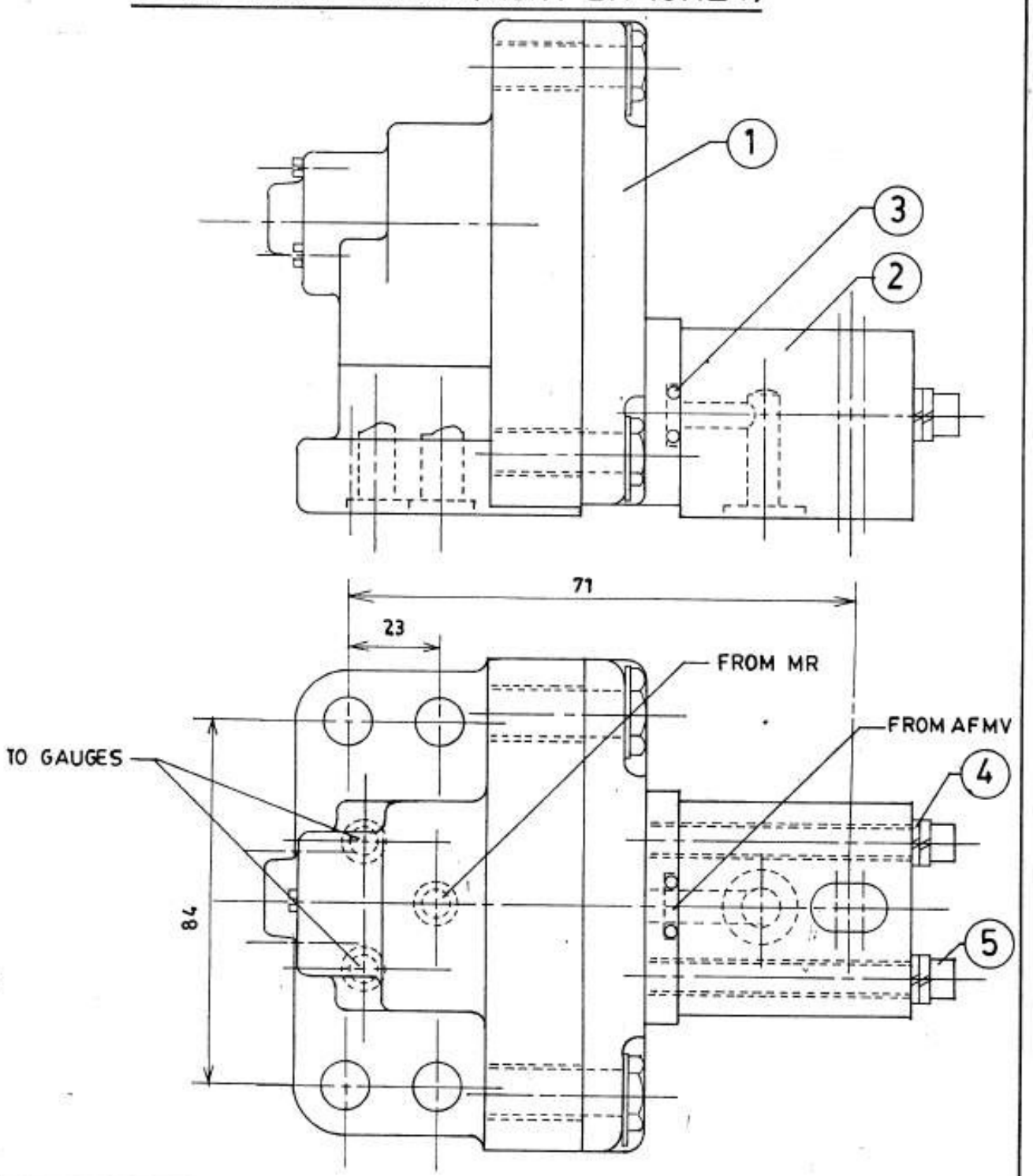
WEIGHT - 335 K.g (APPROX)



AIR BRAKE PANEL

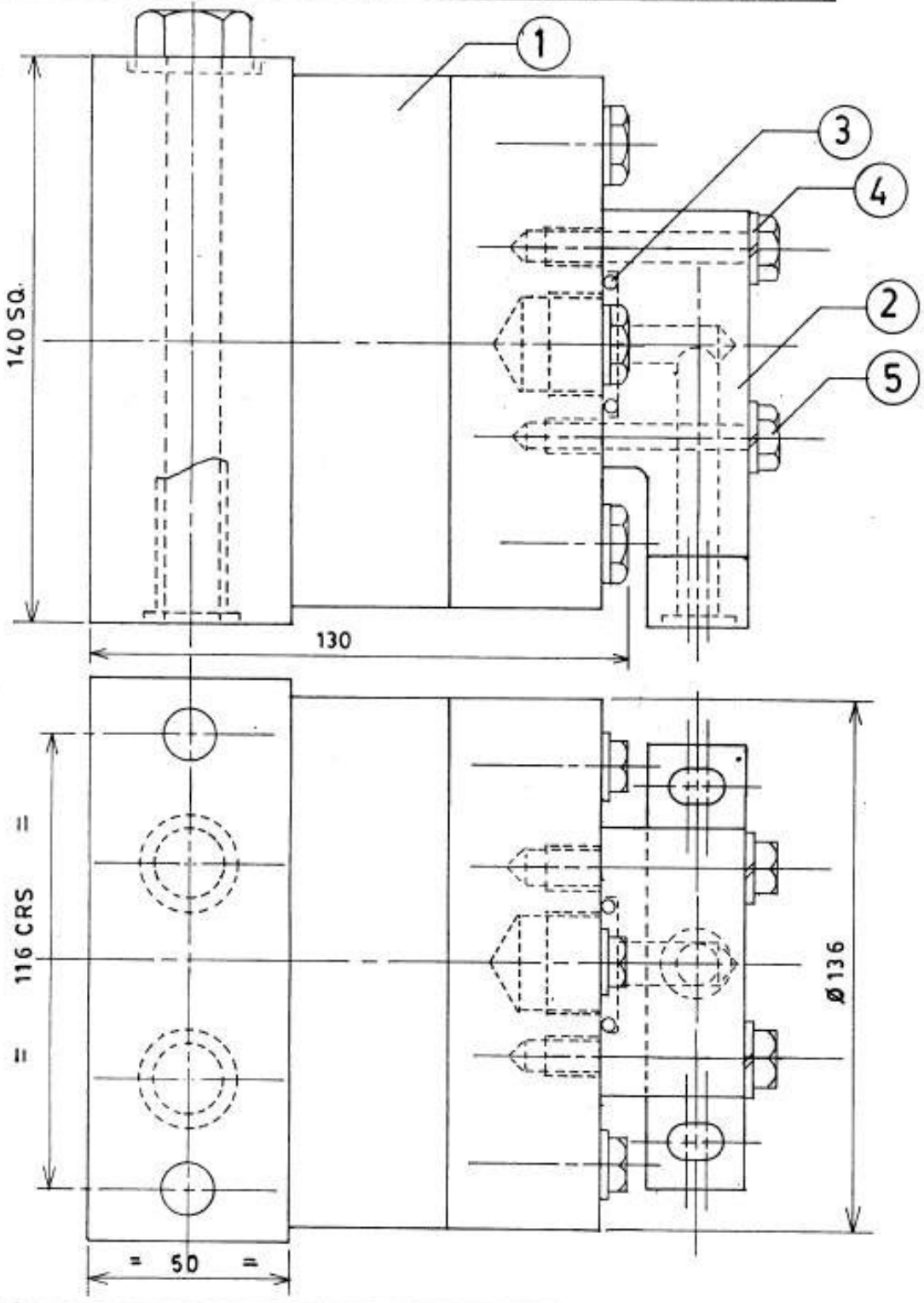

SCHEMATIC DIAGRAM
WIRING DIAGRAM
FIGURE-5
SL. No
DESCRIPTION
QTY
37 3/4"AIR FILTER 1
36 1/2" CUT OFF COCK WITH VENT (VEAD) 1
35 1/2" CUT OFF COCK WITH VENT (RGCP) 1
34 2.5 LITRE RESERVOIR 1
33 PRESSURE SWITCH (RGCP) 1
32 PRESSURE SWITCH (P1) 1
31 RELEASE RUN MAGNET VALVE SR3282,110VDC 1
30 PRESSURE SWITCH (P2) 1
29 3/8" AIR STRAINER(RGCP) 1
28 3/8" AIR STRAINER(RGEB) 1
27 1"CUT OFFCOCK WITHOUT VENT FOR BRAKE PIPE 1
26 1/2" CUT OFF COCK W/O VENT FOR BRAKE PIPE 1
25 E/D BRAKE APPLICATION VALVE 1
24 MAGNET VALVE (VEAD) 110V,E/D, DR 3393 1
23 MAGNET VALVE (P) 110V,E/D, DR 3393 1
22 3/4" CUT OFF COCK W/O VENT FOR FEED PIPE 1
21 3/4" CUT OFF COCK W/O VENT FOR E/D BRAKE VALVE 1
20 D3W DISTRIBUTOR VALVE 1
19 FILTER AND ISOLATING COCK FOR D3WDV 1
18 10 LITRE RESERVOIR 1
17 D2A B FEED VALVE 1
16 PRESSURE SWITCH (RSMC) 1
15 MAGNET VALVE SR 3229C 1
14 D2W RELAY VALVE 1
13 2 LITRE RESERVOIR 1
12 D2W RELAY VALVE 1
11 24A DOUBLE CHECK VALVE 1
10 AIR FLOW MEASURING VALVE 1
9 1/2" BSP PLUG (FITTED IN RESERVOIR) 1
8 MUDB VALVE 1
7 ET SELECTOR VALVE 1
6 N1 REDUCING VALVE SET AT 2.5 KG/CM SQ 1
5 SDAY RELAY VALVE 1
4 3 LITRE RESERVOIR 1
3 PR. SWITCH (RGAF) 1
2 PR. SWITCH (RGEB) 1
1 3/8" CUT OFF COCK W/O VENT FOR RGEB 1
P1 - N/C CONTACT OPEN
OPEN- 4.8Kg/cm2
CLOSES - 4.6Kg/cm2
P2 - N/C CONTACT
OPENS - 4.8Kg/cm2
CLOSES - 4.4Kg/cm2
RGAF - N/O
CUT IN - 4.0Kg/cm2
CUT OUT - 3.5Kg/cm2
RGEB - N/O
CONTACT CLOSES - 4.2Kg/cm2
OPENS - 3.0Kg/cm2
SWC - N/O
CUT OUT - 1.0Kg/cm2
CUT IN - 0.2Kg/cm2
RGCP - N/O
CUT OUT - 9.5Kg/cm2
CUT IN - 8.0Kg/cm2
PR. CHECK POINT BP
PR. CHECK POINT BC
PR. CHECK POINT IM
FLOW INDICATING GAUGE
FROM SAP
FROM A.R
SUPPLY

SDW1 RELAY VALVE (WITH BRACKET)

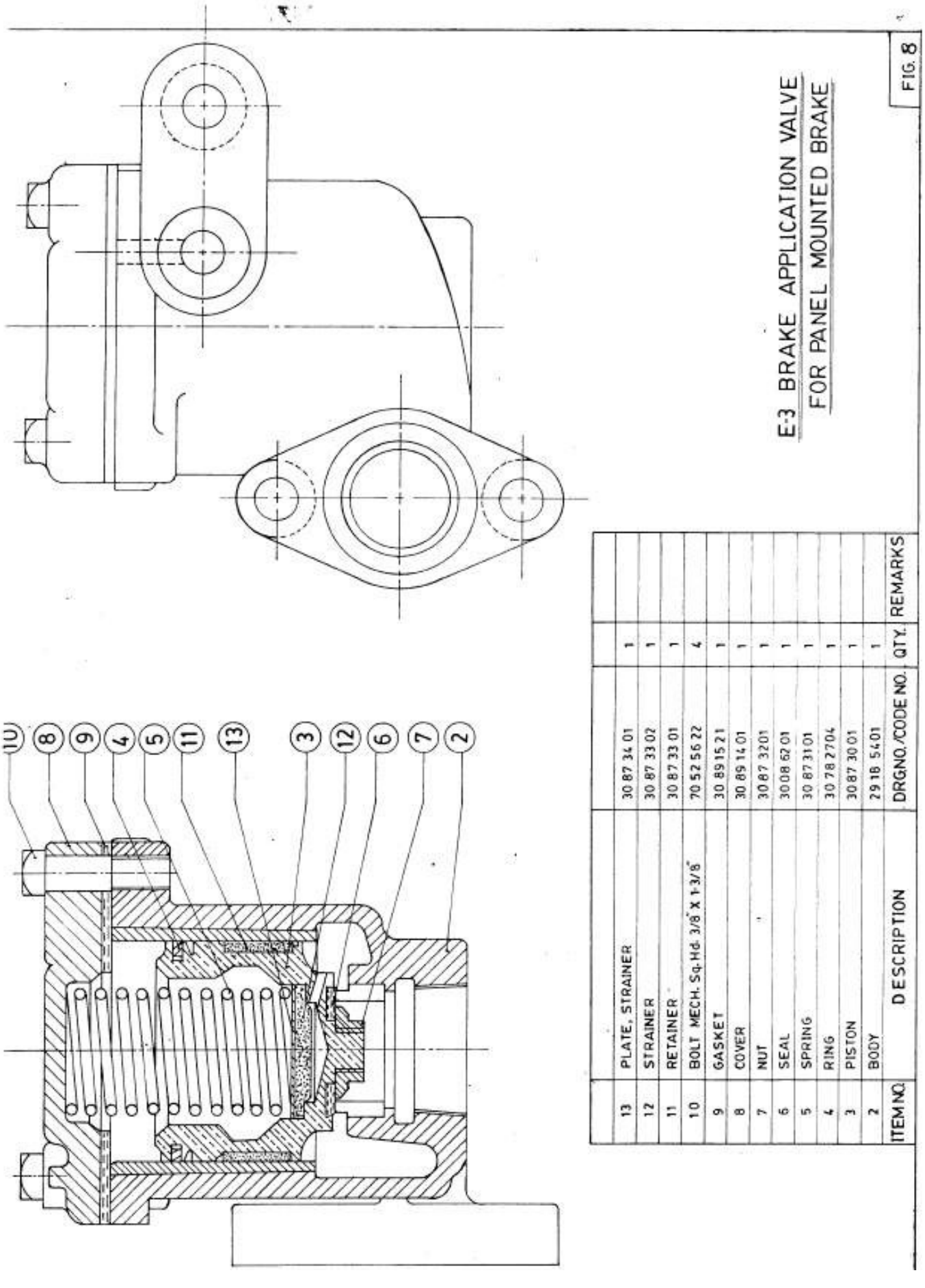


ITEM NO.	DESCRIPTION	DRG./CODE NO	QTY.	REMARKS
5.	SOCKET HD. CAP SCREW M6X55Lg.	70080655	2	
4.	SPRING WASHER M 6 B	71510601	4	
3.	'O' RING	—	1	SUPPLIED BY SD TECHNICAL
2.	BRACKET	29172501	1	
1.	SDW1 RELAY VALVE	29194801	1	

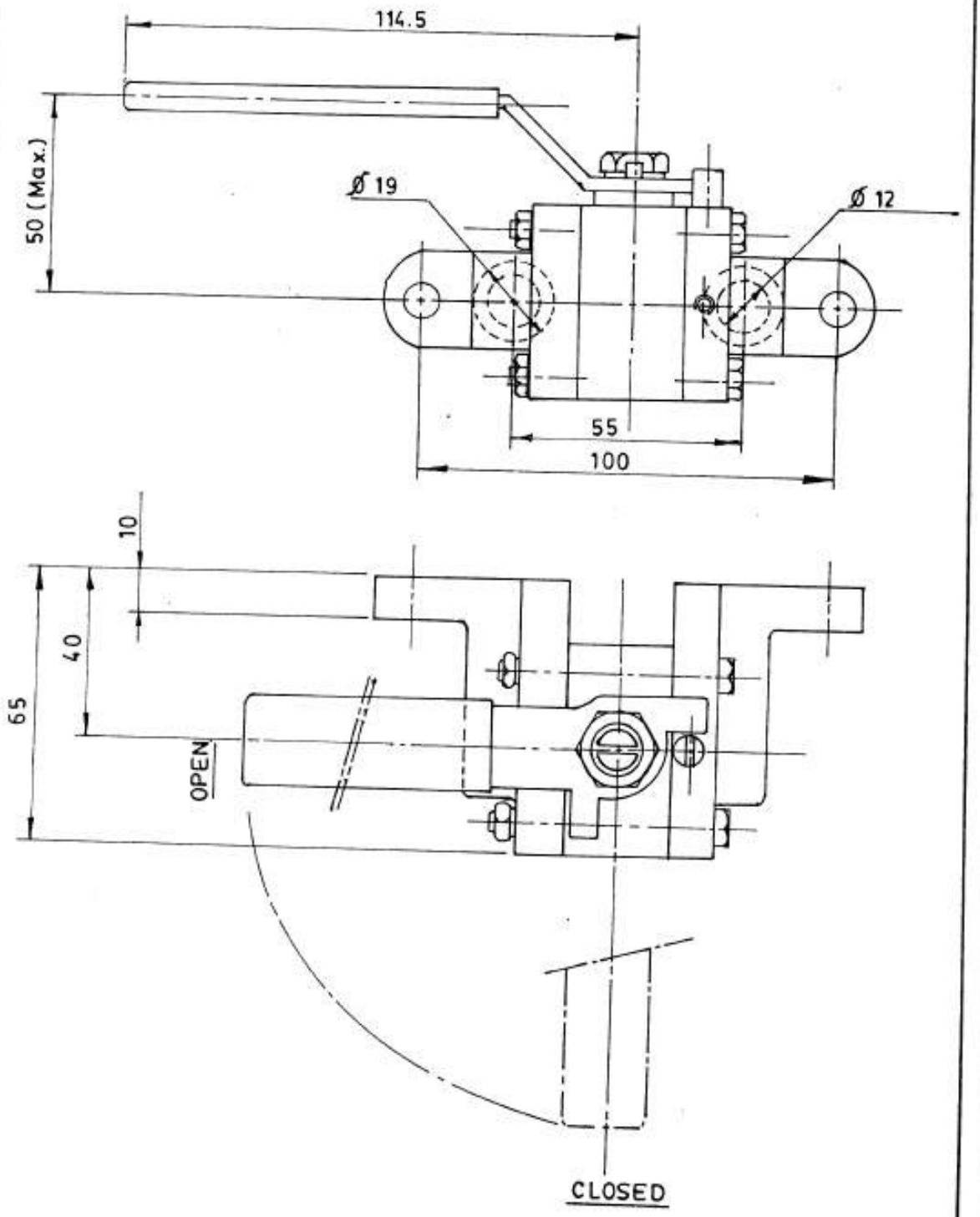
AIR FLOW MEASURING VALVE WITH BRACKET



5.	HEX.BOLT M6X 50mm.Lg.	70030650	4	
4.	SPRING WASHER M 6 B	71510601	4	
3.	'O' RING	30070228	1	
2.	BRACKET	29172301	1	
1.	AIR FLOW MEASURING VALVE	29193401	1	

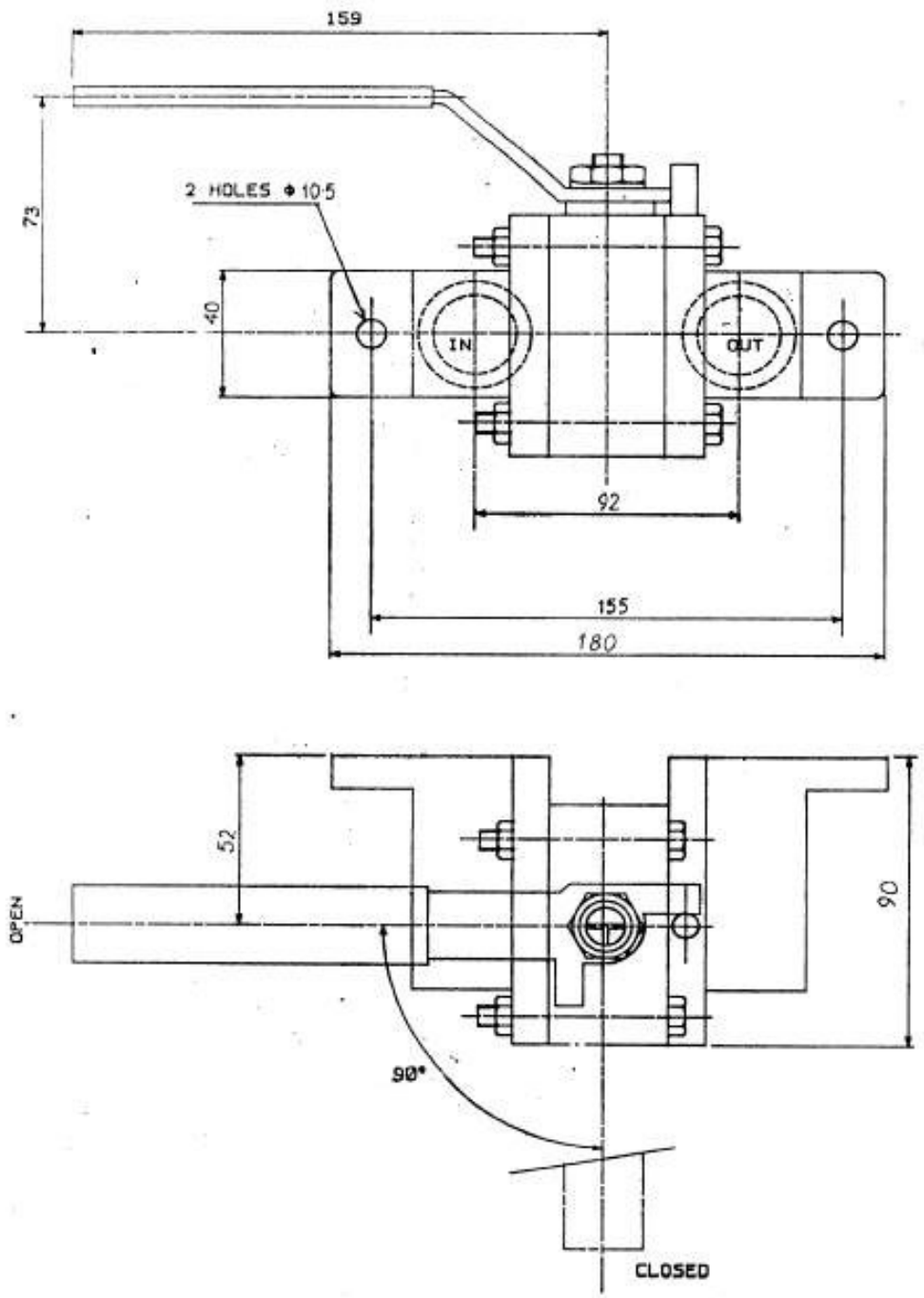


ITEM NO.	DESCRIPTION	DRGNO./CODE NO.	QTY.	REMARKS
13	PLATE, STRAINER	30 87 34 01	1	
12	STRAINER	30 87 33 02	1	
11	RETAINER	30 87 33 01	1	
10	BOLT MECH. Sq.Hd. 3/8" X 1-3/8"	70 52 56 22	4	
9	GASKET	30 89 15 21	1	
8	COVER	30 89 14 01	1	
7	NUT	30 87 32 01	1	
6	SEAL	3008 62 01	1	
5	SPRING	30 87 31 01	1	
4	RING	30 78 27 04	1	
3	PISTON	30 87 30 01	1	
2	BODY	29 18 54 01	1	



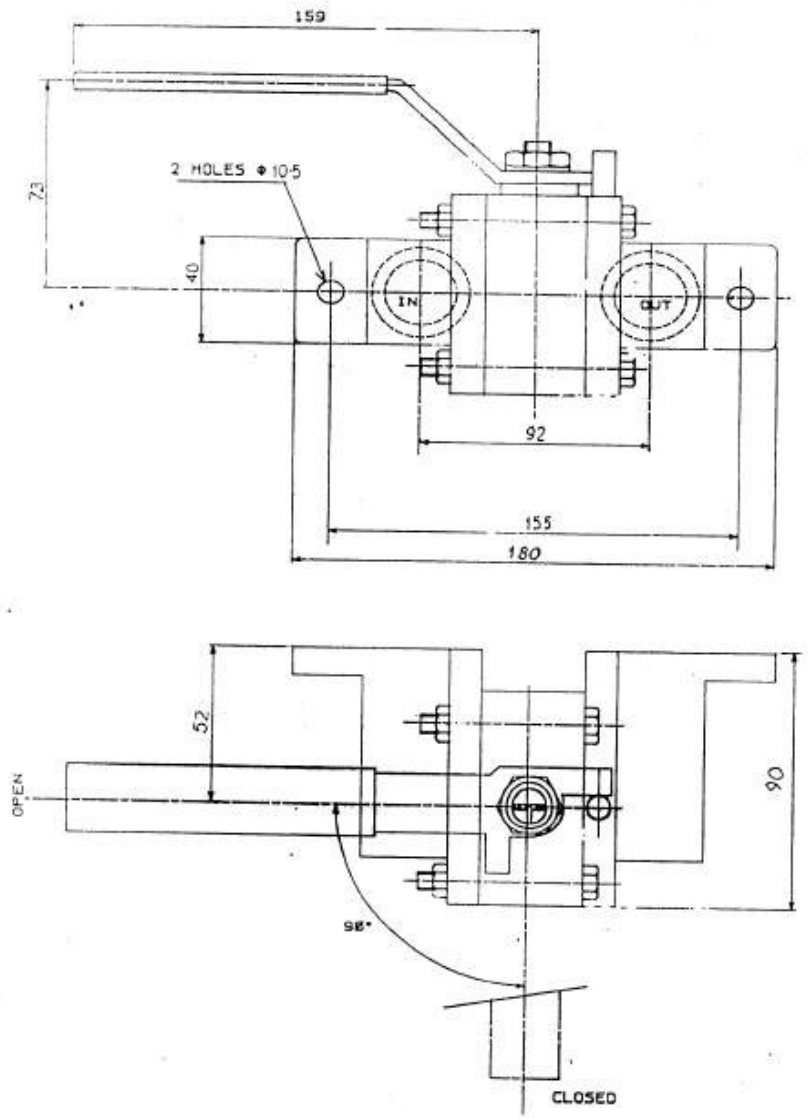
1/2"/3/8" CUT-OUT COCK
(WITHOUT VENT)

FIG.9



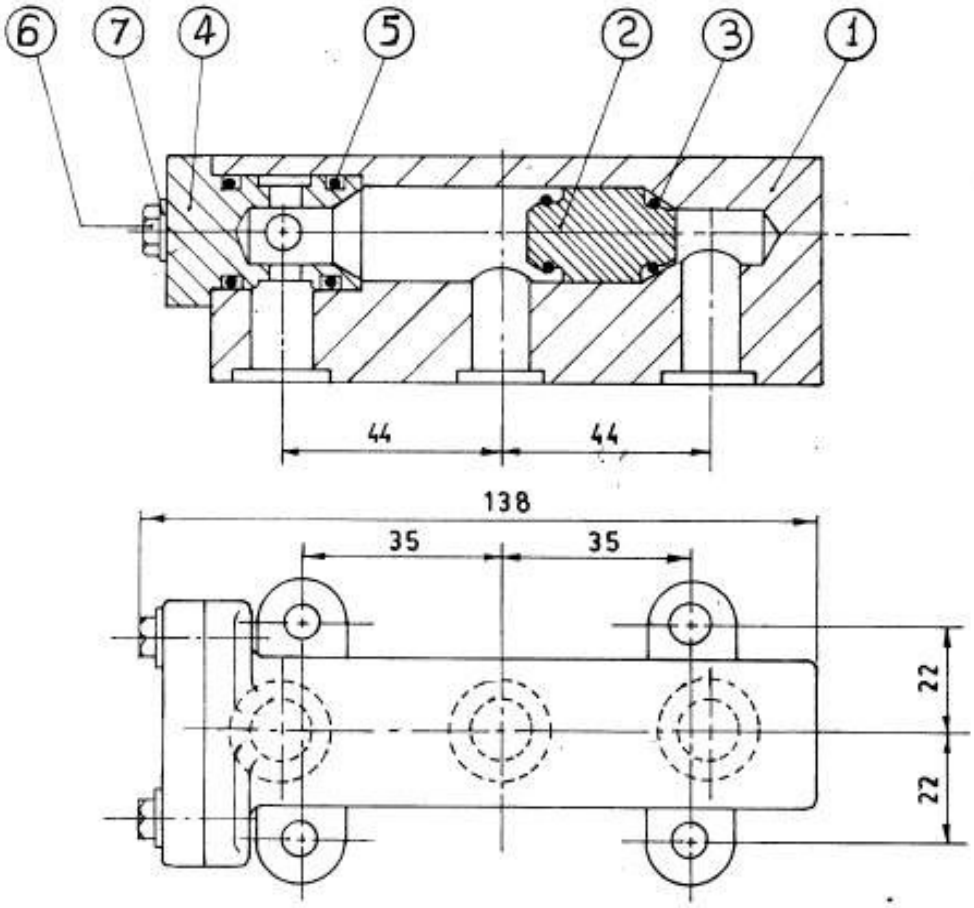
3/4" CUT-OUT COCK

FIG 10



1" CUT-OUT COCK

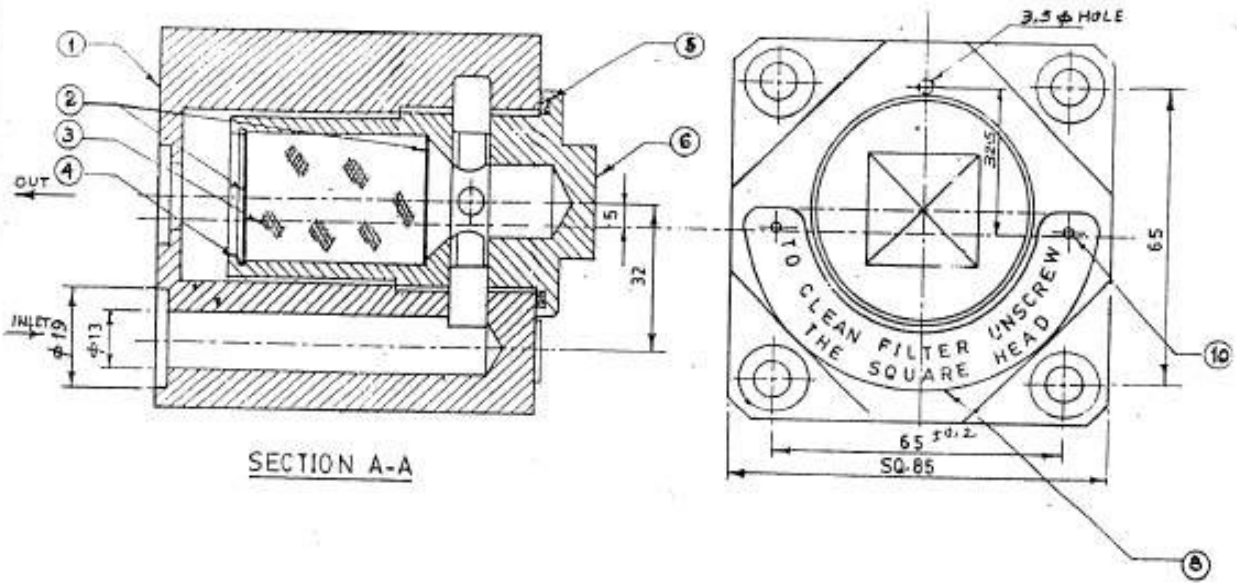
FIG.11



SL. NO.	DESCRIPTION.	DRG. NO	QTY.
7	SHAKE PROOF WASHER (EXTERNAL TYPE)	71 53 17 10	2
6	SCREW HEX HEAD	70 03 06 17	2
5	'O' RING	30 07 02 28	2
4	FLANGE & SEAT	29 17 17 01	1
3	'O' RING	30 07 02 33	2
2	VALVE	30 48 77 01	1
1	BODY	29 17 16 21	1

24 A- DOUBLE CHECK VALVE

FIG. 12



IT. NO.	DESCRIPTION	QTY.	DRG. NO.
10	RIVET 2.5 ϕ × 6 LG.	2	SNAP HEAD TO IS: 2155
9	NOT APPLICABLE		
8	NAME PLATE	1	29 18 43 01
7	NOT APPLICABLE		
6	STRAINER HOUSING	1	29 18 45 01
5	GASKET	1	29 18 44 01
4	CIRCLIP B 28 TYPE B	1	
3	STRAINER	12gms	
2	PERFORATED PLATE	2	29 18 42 01
1	BODY	1	29 18 41 01

AIR STRAINER

FIG 12

Brake System of three phase Locomotives: Following types of brakes are provided in three phase locomotives.

Engine Brake through SA-9: Only brakes in engine are applied in this case. There are two modes of operation.

1. Release
2. Operation

When SA-9 is in release mode brakes are not applied in engine. When brake handle is moved brakes are applied. Maximum brake cylinder pressure is 5.5 kg/cm^2.

Auto Train Brake through A9: In this mode of operation, the brakes are applied in engine as well as in Train.

Emergency Brake: Emergency brakes are provided on Panel A. When emergency brakes are applied it leads to braking in engine as well as in Train in following conditions.

1. When A-9 handle is kept in emergency condition.
2. Asstt. Loco Pilot opens emergency brake cock.
3. Loco Pilot presses emergency brake push button.
4. Emergency brakes through VCD.
5. Emergency brake through memotel.
6. Fault in Electronic brake system

Parking Brake: In order to avoid undesired engine rolling while engine is standing on down gradients, parking brakes are provided. Parking brakes can only be applied when engine speed is less than 5 kmph.

Regenerative Braking: The locomotives are provided with regenerative braking. The electrical energy generated is fed back to OHE through transformer primary winding. If OHE supply fails when regenerative braking is applied engine brakes are automatically applied.

Anti Spin Brakes: Anti spin brakes are provided in three phase locomotive to avoid wheel slipping. The Anti Spin brakes are applied when speed of locomotive is above 60 kmph in WAG-9 loco and 80 kmph in WAP-5 locomotive.

E-70 BRAKE SYSTEM FOR 3-PHASE ELECTRIC LOCOMOTIVES

1.1 INTRODUCTION

The brake frame groups together in one single assembly, all valves, pressure switches, control relays etc., which are not allocated special places on the locomotive. All equipment is easily accessible for maintenance.

1.2 CONSTRUCTION

The brake frame comprises a tri-plate manifold to which components and subassemblies are attached. The components are positioned in convenient and compact groups and pneumatic interconnections are formed by passages within the tri-plate manifolds.

The tri-plate manifolds are constructed from high grade aluminium alloy which is anodized after machining. The connecting passages formed in the front and rear tri-plates are of compact design. The tri-plate manifold comprises three parts, a front and rear plate in which connecting passages are formed, and a track separation plate. The track separation plate allows interconnection between the front and rear plates where required. A separate groove, formed around the outer edge of each

passage, allows O-rings to be fitted to form air tight seals when the three plates are bolted together. All pneumatic assemblies are constructed from corrosion resistant aluminium alloy and with internal components, e.g. valve stems, springs, circlips etc., of stainless steel. Valve faces are of hard synthetic rubber with ground faces. The valves are operated by means of patent self-sealing moulded synthetic rubber diaphragms, which are fully supported over their working surfaces.

Components are mounted to the outer face of a tri-plate manifold using O-ring joints to seal the interface connections. A conventional type manifold block, mounted at the base of the brake frame, forms an interface connection with the locomotive pneumatic system, e.g. main reservoir air supply, brake pipe, etc.

Electrical services to the brake frame are brought to multi-pin connection plugs.

The brake frame includes all necessary air filters, isolating cocks, pressure gauges and where required, test points.

All brake frame mounted components have identifying labels and all isolating /change over cocks have open / closed labels indicating handle positions. Pressure regulating components are provided with sealing facilities where appropriate.

1.3 INSTALLATION

The complete brake frame comprising the pre-assembled pneumatic system, pre-wired and tested is conveniently installed and located in the locomotive body via a roof hatch. It is bolted to a floor mounted manifold to which the locomotive pneumatic services are connected. The manifold is a permanent part of the locomotive and air connections to the counter manifold, which forms part of the brake frame, are made using O-ring joints.

2. DESCRIPTION OF AIR SUPPLY, DISTRIBUTION AND BRAKE CONTROL EQUIPMENT

This document covers the equipment fitted to the Indian Railways WAG9 Co-Co Freight Locomotive.

2.1 AIR SUPPLY

There are two electrically driven air compressor, which feed out through flexible hoses and through two compressor check valves into the main reservoir system. There is a 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 mounted on the brake frame. Once through the compressor check valves the compressors feed through a single water separator, which is fitted with an auto drain valve. This auto drain valve is operated from the same signal line that operates the unloader valves. Having passed through the water separator the air passes into the main reservoir, fitted with a manual drain cock and an auto drain valve. The auto drain valve is also operated from the signal that operates the unloader.

Having passed through the main reservoir which allow further condensate to be extracted from the air, the air flow is via a vented isolating cock into the twin tower air dryer which gives a significant dew point depression to the air passing into the locomotive, through the final filter which removes any of the dust which can be created from the air dryer desiccant and then the air passes through an isolating cock. There is another isolating cock which is intended to be wired closed and only used to bypass the air dryer if there is any significant problem with that unit. This portion of the main reservoir circuit has the main reservoir system safety valve and the two compressor governors being for operation of a single compressor in alternating mode between 10 bar and 8 bar and being for operation of both compressors between 7.5 bar and 10 bar.

The low main reservoir governor 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.

The main reservoir supply splits at this point one leg passing through check valve into another 450 litre main reservoir fitted with a manual drain cock only. This leg continues through an isolating cock and into the brake frame via port U where it passes through an in line filter before splitting and feeding the pilot supply for the direct brake isolating valves, the pilot supply for the brake cylinder cut out valve, the main reservoir supply for the direct brake relay valve and the main reservoir supply for the blending valve. There is a test point 40 in the section of the main reservoir supply where the two legs split. The other leg is the main reservoir feed to the brake frame through port W. This feed passes through an in line filter before splitting to various locations within the brake frame. One of these splits passes through the duplex check valve into the main reservoir equalizing pipe portion of the circuit. The main reservoir equalizing pipe is the through pipe which connects the main reservoir from one locomotive to another via hose and coupling and end cock. The connection between the main reservoir equalizing through pipe and the brake frame is via port X and this then passes through an in-line sieve into the passage work fed by the duplex check valve. The duplex check valve allows the main reservoir equalizing pipe to feed via simple check valve into the locomotive main reservoir supply within the brake frame and to the second main reservoir through check valve. This direction of flow through the duplex check valve has virtually no restriction and allows one locomotive to feed the main reservoir system with another in the event of a failure of the compressor system on that locomotive. It also enables air to be fed from the slave locomotives in a multiple consist to the lead locomotive if there is a heavy demand for air rather than the lead locomotive having to cope solely with that air demand. From the main reservoir to the main reservoir equalizing pipe however, the duplex check valve is set up at 5 kg/cm² such that the main reservoir pressure has to be at or above the set pressure before the valve will feed any air. This is to ensure that the locomotive retains air in the main reservoir system in the event of a burst main reservoir equalizing pipe hose or other problem in that portion of the system. The main reservoir equalizing pipe within the brake frame feeds three independent parts of the circuit. The first is a 'break-in-two' protection valve which is open connecting the direct brake valve on the lead locomotive to the direct brake pipe or connecting the direct brake pipe on the slave loco to the direct brake relay valve when main reservoir equalizing pipe pressure is present but shuts off this connection in the event of a 'break in- two' to ensure that it is possible to make a direct brake application on the locomotive once the 'break-in-two' has occurred. The second is the brake feed pipe regulator and relay valve. The regulator is used to set the pressure to the control port of the relay valve at 6 kg/cm² and the relay valve feeds out the large volume of air required at 6 kg/cm² level via isolating cock, port B of the brake frame to the brake feed pipe which is a through locomotive pipe and feeds the brake feed pipe on any two pipe trailing stock. The connection to other locomotives or trailing stock is made via hose and coupling and end cock. Within the brake frame downstream of the brake feed pipe isolating cock there is a test point and a pressure switch. The third area that the main reservoir equalizing pipe feeds within the brake frame is the sanding equipment. There is a direct feed taken to the pilot supply of the four sanding EP valves and the choke supply via choke through to reservoir and then via two legs each with an isolating cock to two of the four sanding valves per leg.

The sanding EP valves feed out via ports C and D to the number 1 end leading no. 1 bogie and the number 1 end leading the no. 2 bogie respectively. The other leg sanding EP valves feed out via ports E and F to the number 2 end leading no. 1 bogie and the number 2 end leading to no. 2 bogie respectively. The arrangement of choke and reservoir is there to ensure that when the sanding valves are operated there is a rush of air to start the sand moving in the sand ejectors, the rush of air coming from the air stored in the reservoir and subsequent sanding is carried out by the steady flow of air passing through choke. In this way the equipment ensures that the sand sitting in the nozzle of the ejector is moved so that flow can commence and a steady sand application made in a controllable fashion.

External to the brake frame the main reservoir equalizing pipe is used to provide the feed to the anti slip valves. The anti slip valves are utilized when an axle set(s) slips and the slip is not able to be corrected by the traction control equipment. The anti slip valve is energized and rapidly puts air into the brake cylinders feeding into the brake cylinder circuit via a double check valve. The anti-slip valve is designed to give a rapid build up of brakes cylinder pressure, typically in the order of one second and have a long release time typically 20 to 30 seconds in order that the power can be reapplied with some degree of brake application still present. The main reservoir equalizing pipe is also taken into each cab via an in-line strainer to provide the air supply to the wind screen wipers via vented isolating cock and the air supply to the horns. The horn supply is taken a two way horn valve, one on the driver's and one on the assistant driver's desk, each valve feeding the two horns 1 and 2, one operated in the forward direction and the other in the rearward direction of handle movement.

2.2 AUTOMATIC BRAKE SYSTEM

The main reservoir supply from port W is utilized by the flow meter to supply air to the direct brake valves in each cab via port H on the brake frame and to the E70 brake unit. Whenever there is a demand of air from either the direct brake or more importantly the E70 unit there is a pressure differential set up across the flow meter, which results in a reduction in pressure in the signal line from the flow meter to the flow meter valve.

The flow meter valve is in effect a pneumatic amplifier having a high gain so that with a small pressure change from the Venturi there is a large pressure change in the output pipe from valve to port M on the brake frame and hence to the flow meter gauges. Also on the output line from valve is a pressure switch which senses when there is a high flow demand. The flow meter valve also utilizes main reservoir air from port W.

The brake pipe output from the E70 unit is taken via isolating cock which has auxiliary switch contacts. These switch contacts are made when the isolating cock is closed to indicate if the cock is closed inadvertently during operation or as an indication that the brake pipe will not charge when taking control of a locomotive. The brake pipe passes out of the brake frame via port AA to connect to the through automatic air brake pipe.

This is taken to other locomotives and to trailing coaches (or wagons) via hose coupling and end cock. There are test points in the automatic air brake pipe. There is a connection taken from the automatic air brake through pipe into each cab which connects to the assistant driver's emergency cock and to a large bore exhaust valve which is pilot fed from the automatic brake controller. This gives two direct means of applying emergency brake from the cab either by the automatic brake controller or from the assistant driver's cock.

Within the brake frame the air brake pipe is taken to a port on the distributor and also to the brake pipe governor (pressure switch) and via emergency (vigilance) cock to the emergency (vigilance) exhaust valve. The brake pipe governor is used to signal to the traction equipment that an emergency brake application has been made. The emergency (vigilance) exhaust valve is controlled by the EP valve in turn being controlled by the vigilance device, emergency push buttons in the cab or over-speed switch. If the EP valve de- energises, an emergency brake application is made via the exhaust valve exhausting the air brake pipe through exhaust port Z. The EP valve takes its air supply from the main reservoir port W within the brake frame. The emergency (vigilance) cock also has auxiliary switch contacts so that an alarm is raised if this isolating cock is closed. The distributor responds to the variations in pressure in the brake pipe by comparing them with the control reservoir within the unit. A distributor supplies a signal proportional to the fall in the brake pipe, via the dynamic brake cut out EP valve to a volume reservoir, via double check valve to the relay valve. The relay valve is an amplifier taking the signal from the distributor and increasing it in the ratio of approximately 1.44 to 1 and passing this signal out

via port A on brake frame to the brake cylinders. There is a pressure switch which is used for vigilance suppression together with the output from the relay valve. The dynamic brake cut out EP valve is utilized when there is a dynamic brake present of greater than 10 Kilo Newtons, being energised to prevent the output of the distributor passing to the relay valve. This prevents any duplication of braking effort of both dynamic and automatic air brakes on the locomotive. Additionally, on the distributor there is an EP valve and limiter which allows the driver to operate a push button in the cab and remove the automatic air brake application on the locomotive. This allows the driver to make a train brake application via the automatic air brake pipe but remove the locomotive's proportion of this, allowing the train to brake the locomotive. This is inoperative when an emergency brake application is made, thus ensuring that a locomotive brake application will occur if an emergency brake application is made following a full service application where this feature has been used to remove the locomotive brake application.

The air supply for the distributor and the automatic brake relay valve is taken from the auxiliary reservoir, fitted with a manual drain valve, which is external to the brake frame and connected via port J. The auxiliary reservoir is charged from the main reservoir connection at port W via check valve. When the locomotive is being hauled dead, as part of the train, and not connected to another locomotive via the main reservoir equalizing pipe the auxiliary reservoir can be charged from the brake pipe which enters the brake frame at port K. The dead engine cock has to be turned from its normal closed position to be open and allow the brake pipe pressure to feed via check valve into the auxiliary reservoir.

2.3 PARKING BRAKE

The release air for the spring applied parking brake is taken from the auxiliary reservoir via reducing valve, latched solenoid valve and via choke through port N via the bogie hoses, to the spring brake port on the disc brake actuators. The reducing valve limits the maximum pressure that the spring brake release cylinder will have supplied to it. The latched solenoid valve enables the driver to apply and release the parking brake on both the lead and the slave locos in a multiple consists from the drivers cab. There are also manual push buttons on the latched solenoid valve so that in addition to being able to be controlled electrically from the cab, it can be manually operated to apply and release the parking brake provided there is air pressure on the locomotive. The choke ensures that in the event of a burst hose in the parking brake feed, that the loss of air from the auxiliary reservoir is restricted. The parking brake is supplied with its release air from the auxiliary reservoir so that when the locomotive is being hauled as a dead loco the brake pipe feed into the auxiliary reservoir can thus be used to ensure that the parking brake is also released. There is a pressure switch which indicates whether the parking brake is applied or released.

2.4 BRAKE BLENDING

The locomotive has the facility to blend the dynamic and air brakes. This facility will be used, in practice to apply the air brakes to the same level as the dynamic brakes in the event of a dynamic brake failure. The EBC/5 blending valve responds to the signal from the dynamic brake equipment which indicates the level of air brake required and feeds out via check valve to the relay valve, which supplies the air for the brake cylinders. There is a test point which can be used to check the output of the blending valve.

2.5 DIRECT BRAKE

The direct brake valves take their air supply from port H on the brake frame. The direct brake isolate valves on the brake frame are energised to close. On the lead loco the direct brake isolate valve is de-energised for the particular cab which is switched on and the direct brake valve input via either port

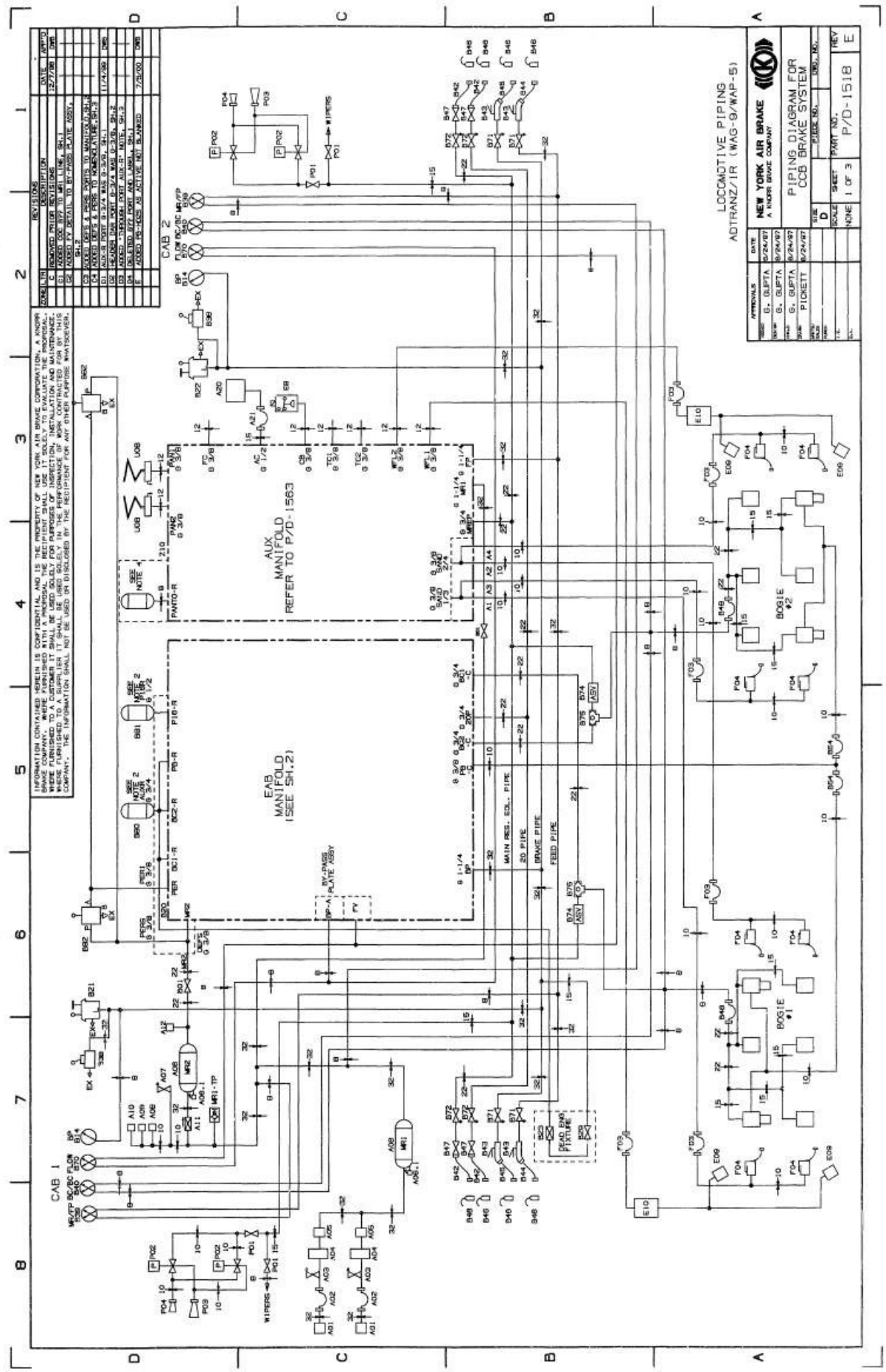
Y or port O is taken into the frame, passed by the de-energised isolate valve to the direct brake relay valve. There is a test point provided in the feed to the brake frame in order to test the output pressure from the brake valve. In addition to feeding the relay valve

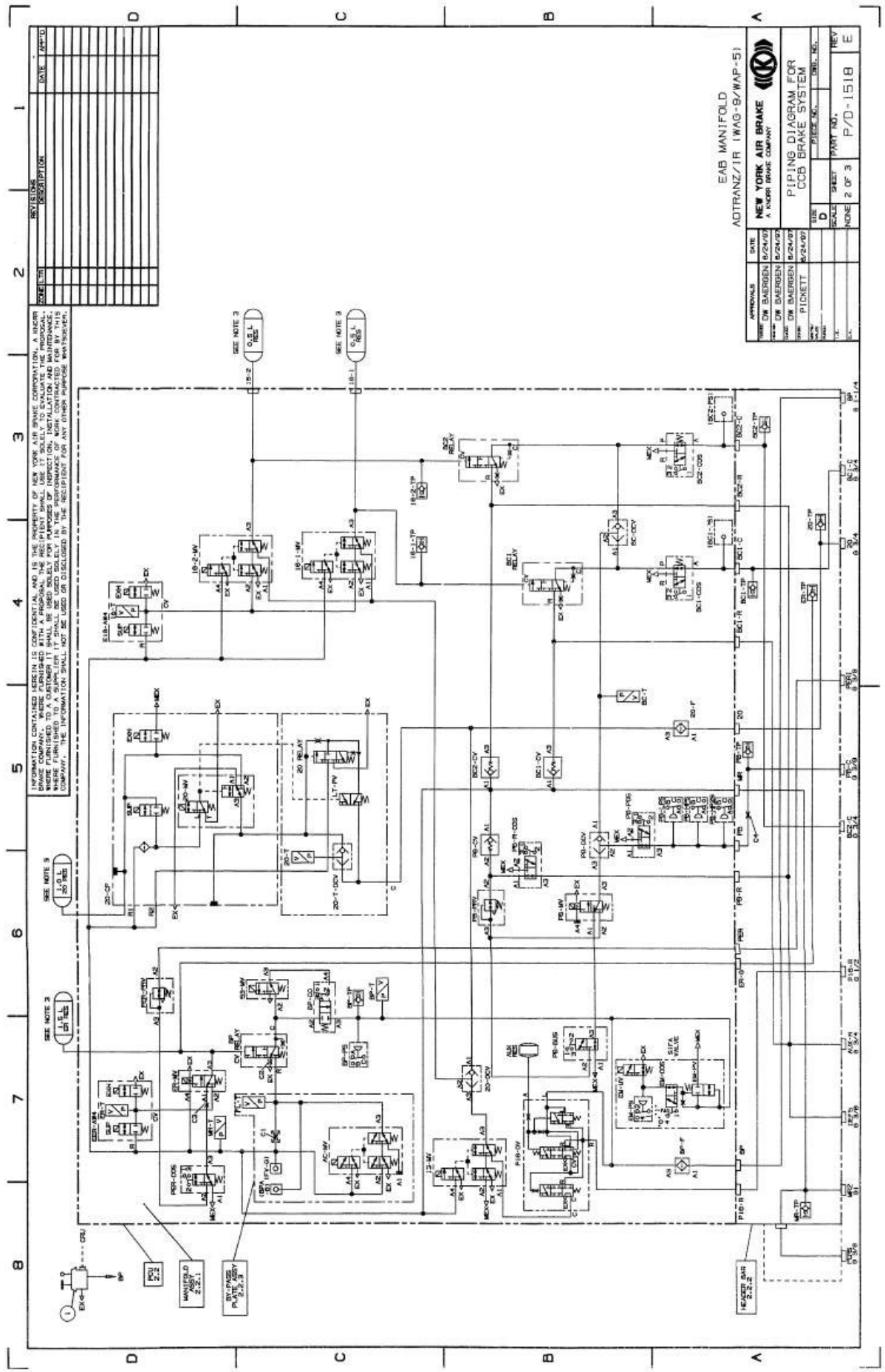
the direct brake valves also feed out via a 'break-in-two' protection valve through port L on the brake frame to the direct pipe which is a through pipe on the locomotive passing out to adjacent locomotives working in multiple via hose and coupling and end cock. On the trailing locomotive, feed in from the direct air brake pipe is taken in through port L on the brake frame passed via the 'break-in-two' protection valve to the direct brake relay valve. The direct brake isolate valves are both energised on the trailing loco and prevent any air being passed out to the direct brake valves in the cabs and hence allow the direct brake on the trailing locomotive to be applied.

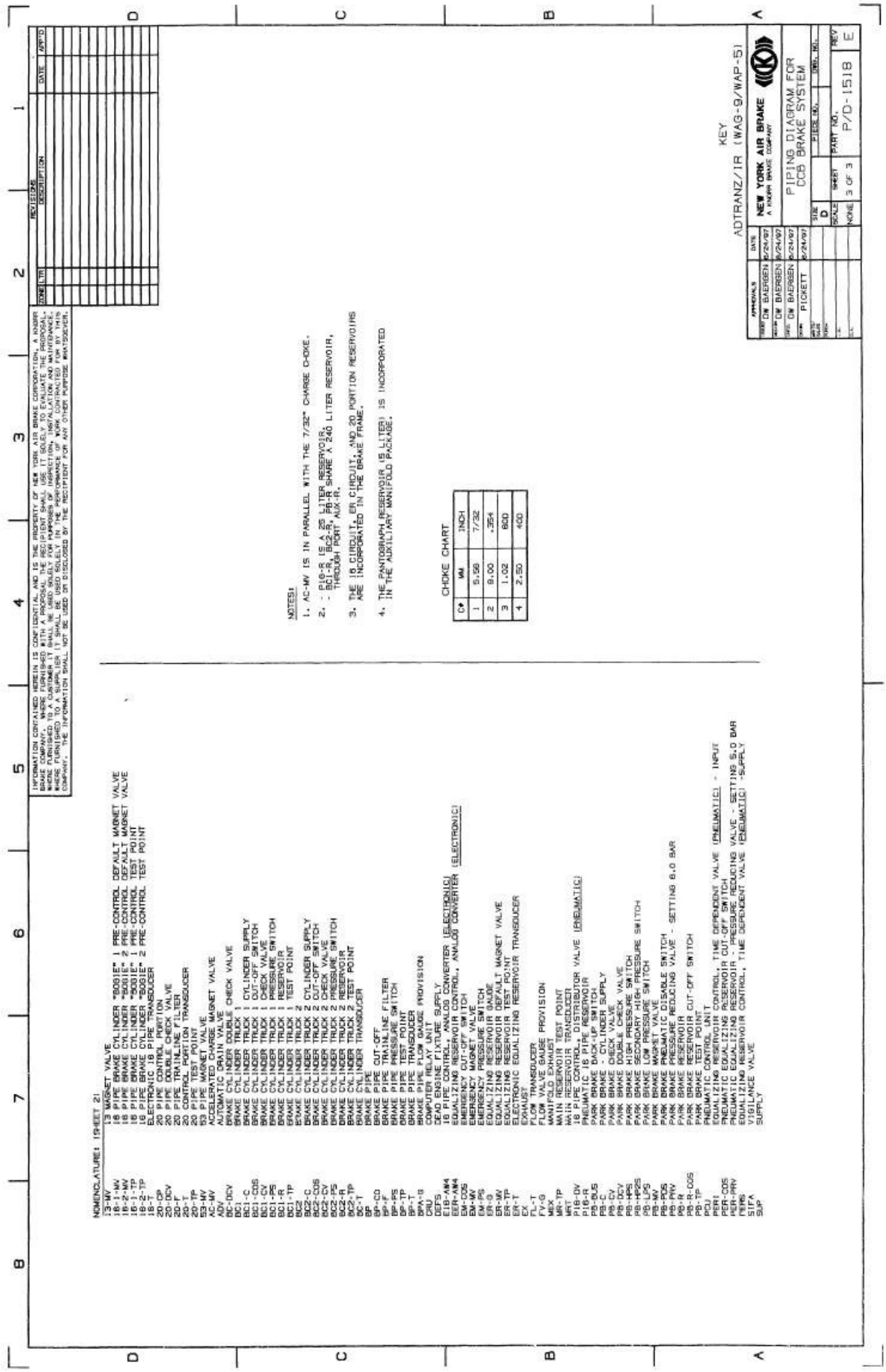
2.6 BRAKE CYLINDER FEEDS

The direct brake cylinder pressure is taken from the brake frame at port V having come from the direct brake relay valve, with test point in that portion of the circuit, and feeds down to each bogie via a bogie hose protection choke through a double check valve, which interfaces with the anti-slip valve and another double check valve, which interfaces with the automatic air brake application. The air then passes via vented bogie isolating cock through the bogie hose and then to the service brake portion of the 2 service/parking brake actuators 1 and to the 2 service actuators.

The automatic air brake application is supplied from port A on the brake frame and comes from the automatic air brake relay valve and out to each bogie via bogie hose protection choke and then through the double check valve 66 to go into the main bogie air supply pipe that is common with the direct brake and anti-slip brake feeds. Down stream of bogie isolating cock there is a connection taken off for the brake cylinder pressure switch and the connection to the cab gauge.


LOCOMOTIVE PIPING
ADTRANZ/IR (WAG-9/WAP-5)
NEW YORK AIR BRAKE
A KNORR BRAKE COMPANY
PIPING DIAGRAM FOR
CCB BRAKE SYSTEM
P/D-1518
E
SHEET 1 OF 3
SCALE NONE
SIZE D
CAB 2
CAB 1
AUX MANIFOLD
REFER TO P/D-1563
EAB MANIFOLD
(SEE SH.2)
BOGIE #2
BOGIE #1
MAIN RES. EQ. PIPE
2D PIPE
BRAKE PIPE
FEED PIPE
BY-PASS PLATE ASSY
DEAD END FIXTURE


EAB MANIFOLD
ADTRANZ/IR (WAG-9/WAP-5)
NEW YORK AIR BRAKE
A KNORR BRAKE COMPANY
PIPING DIAGRAM FOR
CCB BRAKE SYSTEM
P/D-1518
REVISIONS
DESCRIPTION
APPROVALS
DW BAERGEN 5/24/97
PICKETT 5/24/97
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NOMENCLATURE! (SHEET 2)
13-MV 13 MAGNET VALVE
16-1-MV 16 PIPE BRAKE CYLINDER "B091E" 1 PRE-CONTROL DEFAULT MAGNET VALVE
16-2-MV 16 PIPE BRAKE CYLINDER "B091E" 2 PRE-CONTROL DEFAULT MAGNET VALVE
16-1-TP 16 PIPE BRAKE CYLINDER "B091E" 1 PRE-CONTROL TEST POINT
16-2-TP 16 PIPE BRAKE CYLINDER "B091E" 2 PRE-CONTROL TEST POINT
16-T ELECTRONIC 16 PIPE TRANSDUCER
20-CP 20 PIPE CONTROL PORTION
20-DCV 20 PIPE DOUBLE CHECK VALVE
20-F 20 PIPE TRAINLINE FILTER
20-T 20 CONTROL PORTION TRANSDUCER
53-TP 53 PIPE TEST POINT
53-MV 53 PIPE MAGNET VALVE
AC-MV ACCELERATED CHARGE MAGNET VALVE
ADV AUTOMATIC DRAIN VALVE
BC-DCV BRAKE CYLINDER DOUBLE CHECK VALVE
BC1 BRAKE CYLINDER TRUCK 1
BC1-C BRAKE CYLINDER TRUCK 1 CYLINDER SUPPLY
BC1-COS BRAKE CYLINDER TRUCK 1 CUT-OFF SWITCH
BC1-CV BRAKE CYLINDER TRUCK 1 CHECK VALVE
BC1-PS BRAKE CYLINDER TRUCK 1 PRESSURE SWITCH
BC1-R BRAKE CYLINDER TRUCK 1 RESERVOIR
BC1-TP BRAKE CYLINDER TRUCK 1 TEST POINT
BC2 BRAKE CYLINDER TRUCK 2
BC2-C BRAKE CYLINDER TRUCK 2 CYLINDER SUPPLY
BC2-COS BRAKE CYLINDER TRUCK 2 CUT-OFF SWITCH
BC2-CV BRAKE CYLINDER TRUCK 2 CHECK VALVE
BC2-PS BRAKE CYLINDER TRUCK 2 PRESSURE SWITCH
BC2-R BRAKE CYLINDER TRUCK 2 RESERVOIR
BC2-TP BRAKE CYLINDER TRUCK 2 TEST POINT
BC-T BRAKE CYLINDER TRANSDUCER
BP BRAKE PIPE
BP-CO BRAKE PIPE CUT-OFF
BP-F BRAKE PIPE TRAINLINE FILTER
BP-PS BRAKE PIPE PRESSURE SWITCH
BP-TP BRAKE PIPE TEST POINT
BP-T BRAKE PIPE TRANSDUCER
BPA-10 BRAKE PIPE FLOW GAUGE PROVISION
CRU COMPUTER RELAY UNIT
DEFS DEAD ENGINE FIXTURE SUPPLY
EER-AM1 EQUALIZING RESERVOIR PRESSURE CONVERTER (ELECTRONIC)
EER-AM4 EQUALIZING RESERVOIR CONTROL, ANALOG CONVERTER (ELECTRONIC)
EM-COS EMERGENCY CUT-OFF SWITCH
EM-MV EMERGENCY MAGNET VALVE
EM-PS EMERGENCY PRESSURE SWITCH
ER-G EQUALIZING RESERVOIR GAUGE
ER-MV EQUALIZING RESERVOIR DEFAULT MAGNET VALVE
ER-TP EQUALIZING RESERVOIR TEST POINT
ER-T ELECTRONIC EQUALIZING RESERVOIR TRANSDUCER
EX EXHAUST
FL-T FLOW TRANSDUCER
FV-G FLOW VALVE GAUGE PROVISION
MR-G MAIN RESERVOIR GAUGE
MR-TP MAIN RESERVOIR TEST POINT
MRT MAIN RESERVOIR TRANSDUCER
P16-DV 16 PIPE CONTROL, DISTRIBUTOR VALVE (PNEUMATIC)
P16-R PNEUMATIC 16 PIPE RESERVOIR
PB-BCS PARK BRAKE BY CYLINDER SUPPLY
PB-C PARK BRAKE CYLINDER SUPPLY
PB-CV PARK BRAKE CHECK VALVE
PB-DCV PARK BRAKE DOUBLE CHECK VALVE
PB-HPS PARK BRAKE HIGH PRESSURE SWITCH
PB-LPS PARK BRAKE SECONDARY HIGH PRESSURE SWITCH
PB-MV PARK BRAKE MAGNET VALVE
PB-PDS PARK BRAKE PNEUMATIC DISABLE SWITCH
PB-PRV PARK BRAKE PRESSURE REDUCING VALVE - SETTING 6.0 BAR
PB-R PARK BRAKE RESERVOIR
PB-R-COS PARK BRAKE RESERVOIR CUT-OFF SWITCH
PB-TP PARK BRAKE TEST POINT
PCU PNEUMATIC CONTROL UNIT
PERI EQUALIZING RESERVOIR CONTROL, TIME DEPENDENT VALVE (PNEUMATIC) - INPUT
PER-COS PNEUMATIC EQUALIZING RESERVOIR CUT-OFF SWITCH
PER-PRV PNEUMATIC EQUALIZING RESERVOIR - PRESSURE REDUCING VALVE - SETTING 5.0 BAR
PERS EQUALIZING RESERVOIR CONTROL, TIME DEPENDENT VALVE (PNEUMATIC) -SUPPLY
SIPA VOLTAGE VALVE
SUP SUPPLY
NOTES:
1. AC-MV IS IN PARALLEL WITH THE 7/32" CHOKE CHOKE.
2. - P16-R IS A 25 LITER RESERVOIR.
BC1-R, BC2-R, ER-R SHARE A 240 LITER RESERVOIR, THROUGH PORT AUX-R.
3. THE 16 CIRCUIT, EB CIRCUIT, AND 20 PORTION RESERVOIRS ARE INCORPORATED IN THE BRAKE FRAME.
4. THE PANTOGRAPH RESERVOIR (5 LITER) IS INCORPORATED IN THE AUXILIARY MANIFOLD PACKAGE.
CHOKE CHART
D# MM INCH
1 5.56 7/32
2 8.00 .354
3 1.02 800
4 2.50 400
KEY
ADTRANZ/IR (WAG-9/WAP-5)
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APPROVALS DATE
DRN DW BAERSEN 6/24/97
DES DW BAERSEN 6/24/97
ENG DW PICKETT 6/24/97
NEW YORK AIR BRAKE A KNORR BRAKE COMPANY
PIPING DIAGRAM FOR CCB BRAKE SYSTEM
SIZE D
SCALE NONE
SHEET 3 OF 3
PART NO. P/D-1518
REV E

1.12 PANTOGRAPH AM-12 & SIMILAR DESIGN

INTRODUCTION

In electric locomotives, pantograph acts as mobile current carrying equipment which is mounted on the roof. It collects power from the overhead equipment under both static and dynamic conditions and transfers it to locomotive.

On electric locomotives WAM-4, WCAM-1/AC, WCAM-2/AC, WCAM-3/AC, WAG-5, WAG-7, WAG-9 Faiveley type AM-12 (make of M/s Stone India Ltd.) and similar design pantographs (IR 01 of M/s Contransys & PAN 01 of M/s General stores and engineering) are being used. The whole assembly of pantograph is mounted on the four foot insulators on locomotive roof. It is operated for its raising/ lowering positions with compressed air through servomotor.

Pantograph is an essential fitting of electric locomotives. There are two pantographs mounted on the roof of an electric locomotive. At a time one pantograph is raised and connects the locomotive with the OHE contact wire. Normally the pantograph rear to cab used for driving is raised i.e. rear to the direction of movement of the locomotive (if rear is defective or damaged, front can be used to work).

DESCRIPTION OF AM12/IR01/PAN01 TYPE OF PANTOGRAPH USED ON FREIGHT ELECTRIC LOCOMOTIVES AND EMU & MEMU.

This type of pantograph is made of the assembly comprising base frame, lower & upper arms, pan head/bow assembly and raising & lowering mechanism, mounted on porcelain base insulator.

Functional Description:

Air pressure is admitted through the Throttle Valve up to the cylinder of servo motor allowing the piston to compress the holding down spring causing displacement of the slotted link thus permitting rotation of the horizontal spindle under the action of working springs. The pantograph rises until the bow assembly fitted with collector strips touches the catenary system at the end of the piston strokes.

The piston of the servo motor becomes static and remains static during normal operation while the motor doesn't play any further part while the pin of the horizontal spindle is permitted to move freely in the slot of the control link, thus permitting the pantograph to operate purely on the up springs.

While the servo motor trapped air is released through the throttle valve to the atmosphere the piston returns under the force of the holding down spring causing at the slotted link to press on the pin on the horizontal spindle thereby lowering the articulated system. The spindle is adjusted in such a manner to allow the pantograph to lower without hovering even at the highest speed. The pantograph at the end is held against the rubber moulded buffers.

In general the compressor air acts as agent for raising the pantograph and the main springs lower the pantograph. The lowering effort of the pantograph is cancelled by the compressed air fed into the cylinder of the servo motor. During working of the pantograph in contact with OHE a constant air pressure is maintained in control cylinder, thereby keeping the piston in static condition when the entire articulation system is free and kept raised by the up springs arrangement which already demonstrate that the pantograph follows freely all the oscillations of the contact wire.

In case of the air pressure drops the piston of the servo motor retracts thereby activating the extension springs lowering pantograph.

The whole pantograph including the servo motor and the throttle valve, acts as a live conductor making the current collecting on the base separated from the roof top by four number of frame insulators.

PANTO ENTAGLEMENTS: ITEMS TO BE CHECKED ON PANTOGRAPH

1. Check that the pantograph wearing strips are properly fastened with the panto pan and there are no loose fasteners or bent strips or deep grooves on the strips. Pantograph strip joints must be smooth so as not to hinder smooth riding of the contact wire on the pan.
2. Check the bow plunger for free sliding while pressing. Check that the split pins are intact.
3. Check the horizontality of the pan and its free vertical movement. Check the transverse flexibility of the pan by pulling transversely at the middle cross member with a force of 30kg at maximum operating height. The displacement of the pan at the middle cross member should be 30 mm. Check that the positioning link is not bent/ cracked or dislocated from the fixing pivots. Check the intactness of split pins.
4. Check the pantograph frame for signs of bending or cracks. Check the springs for any cracks.
5. If possible, take the measurement of the pan as per drawing.
6. Check the broken or cracked fitting of the pantograph and see whether the cracks are old or fresh.

TECHNICAL DETAILS OF AM12/IR01/PAN01 TYPE OF PANTOGRAPH:

S.N.	Description	As per RDSO Specification	SIL AM12	Contransys IR-01	GS&EC PAN-01
1.	Mounting	4 point	4 point	4 point	4 point
2.	Distance between mounting	807 mm x 1160 mm	807 mm x 1160 mm	807 mm x 1160 mm	807 mm x 1160 mm
3.	Rated current	400 Amps.	400 Amps.	400 Amps.	400 Amps.
4.	Operating Voltage	Nominal 25 kV, 50Hz. Max(con) 27.5kv	25 kV AC	25 kV AC	25 kV AC
5.	Static up thrust	7 + 0.4 kgf	7 kg + 0.4 kg	7kgf,	7kgf
6.	Max. Weight (without Insulator)	235 kg. Approx.	215 kg	215 kg	215kg
7.	Maximum Extension	2.460 Mtrs. from locked down Height	2460mm	2460mm	2460+0/-20mm
8.	Working Range	0.25 Mtrs. to 2.0 Mtrs.	250mm-2246mm	250mm-2246mm	250mm to 2360mm
9.	Aerodynamic effort at maximum speed	3 to 5 kgs.	3 to 5 kgs.	3 to 5 kgs.	3 to 5 kgs.
10.	Maximum folded height with metallised carbon strips	295+5 mm	295mm	295mm	293+ 5mm
11.	Collector strips	Met.Carbon Grade MY7D, P5696 & BH424 C1	Metallised Carbon	Metallised Carbon	Metallised Carbon
12.	Maximum Speed	140 kmph	140 kmph	140 kmph Max (100 kmph) Optimum	140 kmph Max (100 kmph) Optimum

13.	Compressed air supply	Vary between 5.5 kg/cm2 to 11kg/cm2	Between 5.5 kg/cm2 to 11kg/cm2	Between 5.5 kg/cm2 to 11kg/cm2	Between 5.5 kg/cm2 to 11kg/cm2
14.	Minimum pressure to raise	4.5kg/cm2	4.5kg/cm2	4.5kg/cm2	4.5kg/cm2
15.	Raising time upto 2m height.	6 to 10 sec.	6 to 10 sec.	6 to 10 sec.	< 10 sec.
16.	Lowering time from 2m height.	< or = 10 sec.	Less than 10sec	Less than 10sec	< 10 sec.
17.	Resistance between collector and power take off.	2 mΩ	2 mΩ	2 mΩ	2 mΩ
18.	Pan width	1800+ 5 mm	1800 + 5	1800 mm (nominal)	1800 + 5mm
19.	Total length including Servo motor	3082+ 5mm	3082+ 5mm	3082+ 5mm	3085+ 2mm
20.	Transverse rigidity Max. deflection at 300N force	30mm	30mm	30mm	30mm

SINGLE ARM PANTOGRAPH MODEL: WBL-85

Introduction

The Single Arm Pantograph WBL 85 serves the Current Collection of electrically operated locomotive. Design of the Pantograph is light weight, easy to maintain Pantograph and optimum in catenary contact behaviour.

Technical Data

1.	Standard	IEC 60494-1
2.	Minimum height with insulators	630 ± 10 mm
3.	Insulating distance	275.5 mm
4.	Minimum working height over resting position	100 mm
5.	Maximum working height over resting position	1950 mm
6.	Maimum Extension	2000± 50 mm
7.	Width of pan head	1800 ± 10 mm
8.	Total length in resting position	2530 ± 10 mm
9.	Total weight without Insulators	approx. 130 kg
10.	Current collector strips - Length	1048 mm
11.	Current collector strips - spacing	390 ± 10 mm
12.	Current collector strip – material	Metalised Carbon.
13.	Frame Insulators (4)	25 kV
14.	Height	363 mm
15.	Weight	4 x 7 kg
16.	Nominal voltage	25 kV
17.	Nominal current	600A / max 800A
18.	Lateral deflection at max. working height & lateral force of 300 N	Max.30mm

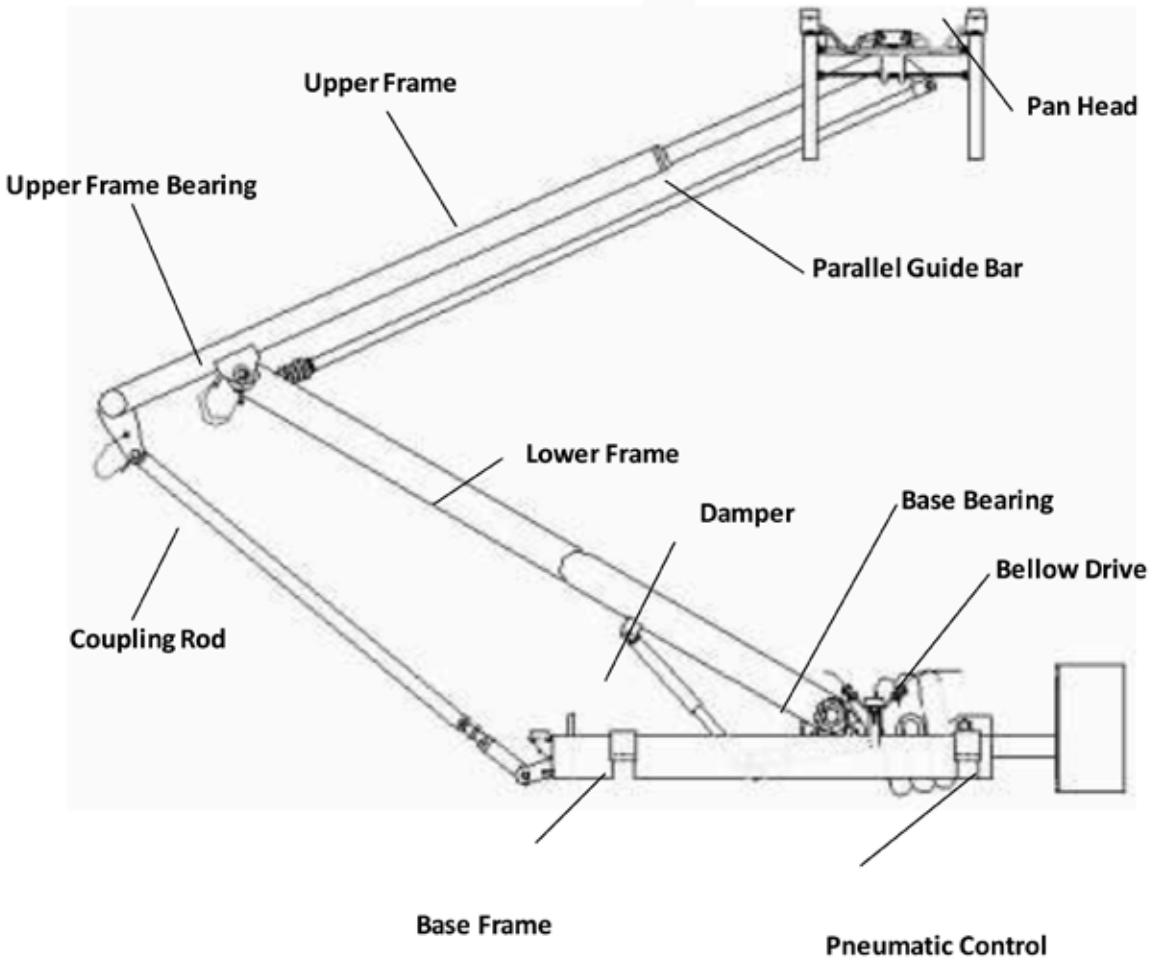
19.	Static reduced mass at apex tube in medium working height	approx.39.5 kg
20.	Static upward force of pantograph	70 N ± 5 N
21.	Pan head	Individual suspension of carbon/steel strip, parallel mounted
22.	Spring rate	7480N/m (± 10%)
23.	Maximum speed under good overhead wire conditions	max.250 km/h
24.	Ambient temperature	-10 to +50°C
25.	Air pressure for continious operation	min 4 bar
26.	Raising time to maximum working height	max. 10 s
27.	Lowering time from maximum working height	max. 10 s

Description of Pantograph Components

Main features of the Single Arm Pantograph WBL85 are:

1. Low weight
2. Simple construction
3. Minimum maintenance
4. Excellent contact behaviour, even under basic catenary conditions
5. Maximum operating safety

Structural Components



Base Frame

The base is a welded structure of closed rectangular hollow steel profiles. The following component parts are located on the base frame:

1. Basic bearings for the lower frame
2. Resting buffer for upper and lower frame

Mounting fixtures for:

1. Air bellow
2. Coupling rod
3. Hydraulic damper
4. Insulators
5. High voltage hook-up
6. Pneumatic hook-up
7. Support spring
8. Shunts

Lower Frame

The lower frame is a welded structure. Its seating is located on the base frame. The following component parts are mounted to the lower frame:

1. Cam disks with suspension fixture for the bellow-drive cables
2. Parallel guide bar
3. Hydraulic oscillation damper
4. Shunts

Upper Frame

The upper frame is a welded structure made of seamless tubes. Necessary lateral stability is achieved through a cross wire-rope construction.

Attached to the upper frame are the following component parts:

1. Pan head
2. Coupling rod
3. Lower frame
4. Bearing blocks for the knuckle joint bearings
5. Shunts

Coupling Rod

The coupling rod consists of two individually welded round-tubes. Both tubes are then connected through a control element. Through this control element the geometry of the pantograph will be adjusted and fine tuned.

Pan Head

The pan head is located at the crest of the upper frame and uses leaf springs for the suspension of the carbon / steel strips. They are affixed in the rocker box, and carry at each end bearing supported mounts to which the carbon strips are then attached. Parallel guiding links assure that the copper strips operate parallel to the catenary

Parallel Guide Bar

The parallel guide bar prevents the pan head from distorting, while the pantograph is raised or lowered.

Air Bellow

The pneumatic bellow drive allows the pantograph to rise. It is mounted between the base frame and the lower frame. A pneumatic line connects the bellow drive with the pneumatic control, and then continues via the solenoid valve on to the compressor. The contact pressure is adjusted through the pneumatic control system.

Pantograph Damping

The pantograph damping is attained through the oscillating damper between base frame and lower frame. This guarantees a good contact between the copper strips and the overhead wire. The dampers are suitable for temperatures ranging from -40 to +80 degrees Celsius (approx. -40 to +176 degrees Fahrenheit).

Electrical Equipment

All bearing locations are by-passed by shunt connectors. These prevent the current from flowing through the bearings. The shunts are consisting of flexible copper cables with clamped end pieces. The current connectors are greased with copper grease to achieve good conducting properties between the shunts and the frame parts.

Base- and Upper frame bearing

The bearings of the pantograph are maintenance free and greased for life. At each bearing two, in a certain distance on an axle arranged, ball bearings are used. To avoid condensation the gap between the ball bearings is filled with grease. The outside of the bearings is protected with cover plates against mechanical damage.

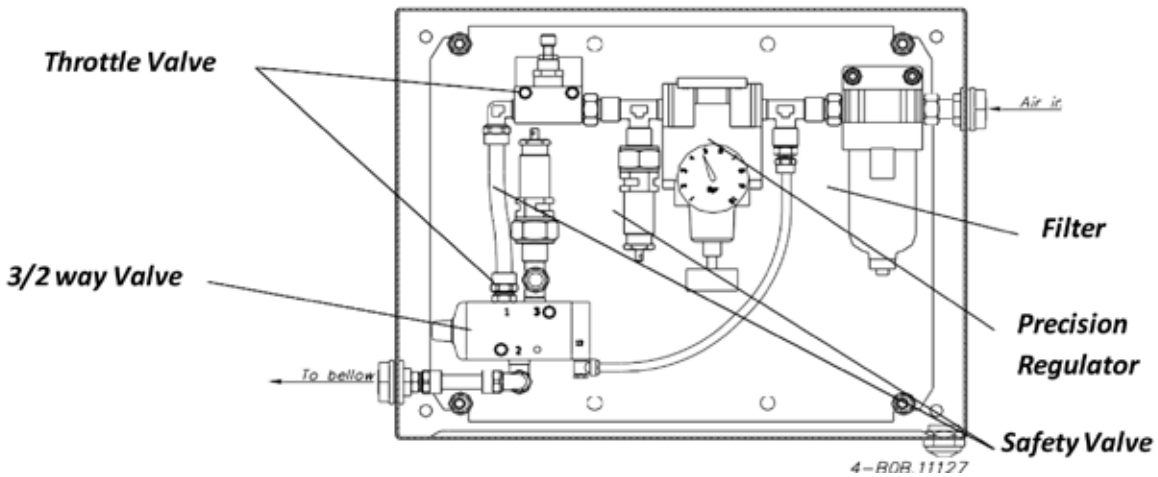
Pneumatic Control

The pneumatic control consists mainly of one part:

1. Pneumatic control panel For the connection to the pneumatic system are one connections available:
2. one for the pressure supply of the air bellow

Pneumatic control

The pneumatic control is fixed at the base frame and consists mainly of a filter, throttle valve, one safety valve and a pressure regulator. The main part of the valve unit is the pressure regulator; it is responsible for a constant pressure for the air bellow during all service conditions. The pressure regulator has a high sensitivity and is adjustable in a range of 1 to 8 bar.



TECHNICAL DETAILS OF HIGH SPEED PANTOGRAPH

S.N.	Description	As per RDSO,s Specification	AM 92 M/s SIL	IR-03H M/s Contransys	WBL-85 M/s Schunk
1.	Mounting	4 point	4 point	4 point	4 point
2.	Distance between mounting	807 mm x 1160 mm	807 mm x 1160 mm	807 mm x 1160 mm	807 mm x 1160 mm
3.	Rated current	400 Amps.	400Amps.	400 Amps	600 Amps.
4.	Operating Voltage	25 kV, 50Hz.	25 kV AC	25 kV AC	25 kV AC
5.	Static up thrust	7 + 0.4 kgf	7 kg + 0.4 kg	7.0 kg+ 0.4 kg	70 N +5N
6.	Max. Weight (without Insulator)	235 kg. Approx.	227 kg	226kg	130kg.
7.	Maximum Extension	2.460 Mtrs. from locked down Height	2600mm - 40mm	2000 mm Max.	2000 mm Max.
8.	Working Range	0.1 Mtrs. to 2.0 Mtrs.	100mm to 2400mm	250mm– (2000 +20/-0)mm	100mm-2000+10mm
9.	Aerodynamic effort at maximum speed	3 to 5 kgs.	3 to 5 kgs.	3 to 5 kgs.	3 to 5 kgs.
10.	Maximum folded height with out Metallised Carbon Strip	635mm with insulator	623mm with insulator	635mm with insulator	630mm(min) with insulator
11.	Collector strips	Metallised Carbon Strips MY7D, P5696 BH424 C1	Metallised Carbon	Metallised Carbon	Metallised Carbon
12.	Maximum Speed	160 kmph	160 kmph	160 kmph	250 kmph
13.	Compressed air supply	Vary between 5.5 kg/cm2 to 11kg/cm2	4.5 kg/cm2 to 11kg/cm2	4.5 kg/cm2 to 11kg/cm2	4.5 kg/cm2 to 11kg/cm2
14.	Minimum pressure to raise	4.5kg/cm2	4.5kg/cm2	4.5kg/cm2	4bar
15.	Raising time for 2m	6 to 10 sec.	6-10sec.	6-10sec.	6-10sec.
16.	Lowering time from 2m	</=10 sec.	<10sec.	<10sec.	<10sec.
17.	Resistance between collector and power take off.	2 mΩ	</=2 mΩ	</=2 mΩ	</=2 mΩ
18.	Pan width	1800 mm	1800+5mm	1800+0/-7 mm	1800+ 10mm
19.	Total length	2530+ 10mm	2530mm	2430mm	2530+ 10mm
20.	Transverse rigidity Max. deflection at 300N force.	30mm	30mm	30mm	30mm

The design of pantograph and its electromechanical interaction with OHE contact wire is very significant. To improve the reliability of the pantograph, life of the OHE contact wire and to reduce the cases of panto entanglements with OHE, RDSO has carried out continuous study and issued various modification sheets, special maintenance instructions and technical circulars etc. time to time, some of them are as under :

a. RDSO Modification Sheet no. 0265, Rev. 1 dtd. May, 2000 & Technical Circular No. 071 dtd. July

2001 for adoption of metalized carbon strips.

b. RDSO Modification Sheet no. 0333, dtd. Dec., 2004 for Standardisation of Panto Pan assembly of AM 12 or similar design.

c. RDSO Technical Circular no. 0094 dtd. June 2007 for Components to be changed during AOH/ IOH and POH.

d. RDSO Investigation report No. 0147 Rev.0 dtd. July 2011 for Pantograph for Electric Locomotives.

Inspection schedule of Maintenance of Pantograph AM-12 & Similar design								
S.N	**Description**	**IT**	**IA**	**IB**	**IC**	**TOH**	**IOH**	**POH**
1	**Bow assembly**							
	Check that there is no foreign material on pantograph.	√	x	x	x	x		
	Check upper articulation assembly for any cracks.	x	√	√	√	√		
	Check tightness of fixing screw of bow assembly.	x	√	√	√	√		
	Check for any groove, chipping on the surface or breakage. Check the tightness of fixing nut & bolts.	x	√	√	√	√		
	Check Panto pan horns for any cracks.	x	√	√	√	√		
	Clean and check for wear, grooves or any other abnormality. Measure thickness of metalized carbon strip. Replace the strip, if required - Condemn limit is 3.5 mm above sheath.	√	√	√	√	√		
	Check visually the horizontally of bow assembly.	√	x	x	x	x		
	Check free swiveling on both sides and proper functioning of the pantograph - Swivel angle 7°±1°	√	√	√	√	√		
2	**Plungers**							
	Check the free movement of plunger/support rod cylinder in both plunger boxes.	√	x	x	x	x		
	Check the bow plunger for free sliding while pressing on both sides. In case of jamming, loosen the sleeves fixing the spring boxes, turn them round to their vertical axis until jamming is removed, if required oil the plunger boxes.	x	√	√	√	√		
	Check the deflection of R.H.S. and L.H.S. plunger with 10 kg weight - Shall be less than 25 mm.	x	√	√	√	√		
	Check the side play of plunger piston.	x	√	√	√	√		
3	**Copper shunts**							
	Check for damage or loose connection. Replace if necessary.	√	√	√	√	√		
	Check availability of all shunts and their tightness (total 10 no. shunts per Panto).	x	√	√	√	√		

	While replacing a shunt, care should be taken that in the bimetallic plate, aluminium touches the aluminium alloy part and copper side touches the shunt. Contact surface of alluminium alloy must be rubbed with metallic brush and then covered with conducting grease.	x	√	√	√	√		
4	**Main springs**							
	Check visually for cracks or breakage etc.	√	√	√	√	√		
	Check the L1, L2 gap of main springs - Shall be more than 18mm	x	√	√	√	√		
	Check main spring catchers and additional spring catchers for intactness	x	√	√	√	√		
5	**Insulators**							
	Check all insulators for cracks and flash marks and clean.	√	√	√	√	√		
	Clean the foot insulators and operating rod insulator with spirit and wipe by dry cloth.	x	√	√	√	√		
6	**Roof bars**							
	Check for breakage, flash marks, loose connection etc. Special care must be taken with aluminium bars.	x	√	√	√	√		
	Clean the roof bar clamps and provide graphite grease.	x	√	√	√	√		
7	**Lubrication**							
	Check the different moving parts such as YOKE assembly, plunger, I-let rod etc. and if found dry clean it and apply lubricant as per lubrication chart (SMI 198).	x	√	√	√	√		
8	**Split pins**							
	Check all split pins are available and intact. (Total 19 nos. per pantograph)	√	√	√	√	√		
9	**Rubber Stopper**							
	Check rubberized thrust block for condition and intactness.	x	√	√	√	√		
10	**Raising and lowering times**							
	Check the raising and lowering of the pantograph.	√	√	√	√	√		
	It should gradually rise and slow down before touching the contact wire and should not rebound - Raising time 6 to 10 seconds for rise of 1.5 m.	√	√	√	√	√		
	While lowering, it should be fast in the beginning and slow down as it reaches the rest position - Lowering time less than 10 seconds.	√	√	√	√	√		
11	**Nut and Bolts**							
	Check the tightness of all nuts and bolts of the pantograph.	x	√	√	√	√		
12	**Load on rubberized stops**							

	Check the load on the rubberized stops by lifting off the stops. If the required load is not available, adjustment of control rod shall be done and if still not achieved, remove the air motor and check for air leakage as described earlier - The force required shall be 15 kg min.	x	√	√	√	√		
13	**Mechanical parts**							
	Verify the operation; check visually the frame for distortion or any other damage.	√	√	√	√	√		
14	**Transverse Rigidity**							
	Experience by pulling panto upper articulation assembly by hand in both transverse directions.	√	√	√	√	√		
	Throttle valve							
	Check the working, clean and lubricate as per SMI 198.	x	x	x	√	√		
	Overhaul the throttle valve and replace items as mentioned in AOH/IOH/POH kit and lubricate as per SMI 198	x	x	x	x	√	√	√
	Servomotor							
	Check for air leakage from cylinder.	x	x	x	√	√		
	If servomotor is giving abnormal sound during operation, drain the cylinder by unscrewing the cap of drain plug and replace the same.	x	x	x	√	√		
	Overhaul the servo motor and replace the items as mentioned in AOH/IOH/POH kit (TC 0094)	x	x	x	x	√	√	√
	Measure the internal diameter of the cylinder. The maximum diameter allowed is 202.290 mm.	x	x	x	x	√		
	Lubrication							
	Lubricate all articulations pin bearings and plungers with recommended oil as per SMI 198.	x	x	x	√	√		
	Static Balancing of Panto Pan							
	To check the thrust exerted upwards by pantograph on the contact wire, balancing of panto pan must be checked, by hanging a weight of 7 kg. on the head at extensions of 0.5,1 .0, 1.5 and 2.0 m. (SMI 192) The thrust must be uniform. If the pressure exerted is above or below the limit, it can be adjusted as given in SMI 64.	x	x	x	√	√		
	Horizontally of bow assembly.							
	Check and correct the horizontally of panto pan at an extension of 1.5 m by using spirit level. (SMI 192-1997, Spec.066-2008)	x	x	x	√	√		
	Transverse rigidity							

	Experience by pulling panto upper articulation assembly by hand in both transverse directions - The displacement of the bow should not be more than 36 mm on each side.	x	x	x	√	√		
	Isolating cocks							
	Operate all isolating cocks by hand and put back to the previous position.	x	x	x	x	√		
	Frame and other components							
	Carry out the checks for bent, distortion, and cracks on frame and other components.	x	x	x	x	√		
	Items mentioned in IOH and POH kit to be replaced accordingly (TC 0094)	x	x	x	x	√	√	√

Pantograph AM92/IR03H
(Ref- RDSO SMI NO: RDSO/2016/EL/SMI/0292(Rev'0'))

S.N	Description of work	IA	IB	IC	AOH	IOH	POH
A.	**Pantograph Insulators**						
i.	Thorough cleaning and checking of flash marks/ chipping/crack etc.	√	√	√	√	√	√
ii.	Check Foundation bolt tightness	√	√	√	√	√	√
iii.	Record Make/Year of insulator	√	√	√	√	√	√
B.	**Servomotor**						
i.	Condition of pneumatic pipe (crack etc.)	√	√	√	√	√	√
ii.	Foundation bolt tightness	√	√	√	√	√	√
iii.	Air leakage test	√	√	√	√	√	√
C.	**Throttle valve**						
i.	Throttle valve - thorough inspection of body for dent or crack.	x	x	√	√	√	√
ii.	Over haul throttle valve	x	x	√	√	√	√
iii.	Cleaning of moving parts with kerosene oil and lubricate with Vaseline	x	x	√	√	√	√
iv.	Change all rubber component (Joint for valve, piston ring, joint ring & Gasket)	x	x	x	√	√	√
D.	**Panto pan**						
i.	Check condition of Plunger, its lubrication and free movement.	√	√	√	√	√	√
ii.	Inspection of cylinder support rod spring by pressing panto pan for proper working of support rod.	√	√	√	√	√	√
iii.	Strip size should not be less than 3.5mm above metal surface	√	√	√	√	√	√
iv.	Clean carbon strip properly and record its make	√	√	√	√	√	√
v.	Check for groove mark on carbon strip, note and change if required	√	√	√	√	√	√
vi.	Panto Horn paint condition and paint if necessary	√	√	√	√	√	√
E.	**RDPT test of the followings for crack detection**						
i.	Top mounting	x	x	√	√	√	√
ii.	Cylinder support bracket	x	x	√	√	√	√

iii.	Steady link	x	x	√	√	√	√
iv.	Centre pivot block of horn	x	x	√	√	√	√
v.	Push rod	x	x	√	√	√	√
vi.	Middle articulation assembly	x	x	√	√	√	√
vii.	Yoke assembly	x	x	√	√	√	√
viii.	Upper arm	x	x	√	√	√	√
ix.	Base frame	x	x	√	√	√	√
x.	Pedestal assembly	x	x	√	√	√	√
F.	**Check Pantograph parts/Assemblies for (Crack, Tightness of bolts and Bending of following)**						
i.	Frame	√	√	√	√	√	√
ii.	Main spring	√	√	√	√	√	√
iii.	Lower articulation arm	√	√	√	√	√	√
iv.	Eyelet/inlet rod insulator arm	√	√	√	√	√	√
v.	Spring catcher, Rubber stopper	√	√	√	√	√	√
vi.	Yoke assembly	√	√	√	√	√	√
vii.	Check the Condition of Spring Catcher	√	√	√	√	√	√
viii.	Steady link assembly	√	√	√	√	√	√
ix.	Plunger Box assembly	√	√	√	√	√	√
x.	Upper arm assembly	√	√	√	√	√	√
G.	**Check shunt for the following (Wear, Flashing Tightness etc.)**						
i.	Panto pan Assembly to Top Mounting	√	√	√	√	√	√
ii.	Middle Articulation Assembly to Lower Articulation Assembly	√	√	√	√	√	√
iii.	Lower Articulation Assembly To Base Frame	√	√	√	√	√	√
H.	**Contact force of pantograph with 7kg weight**						
i.	Check contact force with 7.0 kg weight	√	√	√	√	√	√
ii.	0.5m, 1.0m, 1.5m, 1.75m and 2.0m height (Adjust screw clockwise if Panto raises and vice versa in IR-03H pantograph only)	x	x	x	√	√	√
I.	**Raising and lowering time of pantograph**						
i.	Panto raising time should be 6 to 10 sec.	√	√	√	√	√	√
ii.	Panto lowering time should be up to 10 sec.	√	√	√	√	√	√
iii.	Deflection of plunger support rod.	√	√	√	√	√	√
iv.	Transverse Flexibility.	√ *	√ *	√	√	√	√
v.	Panto Pan swivel angle.	√	√	√	√	√	√

* By feel test method

1.14 Heatless Regenerative Twin Tower type compressed AIR DRYER for Elcetric Locomotives (As per RDSO SMI No. RDSo/2017/EL/SMI/0305 Rev '0' Dated. 17.04.2017)

Maintenance Schedule of Air Dryer of M/s FTRTIL

Sl No	Type	Activities	Maintenance schedule					
			IA	IB	IC	Schedule 'A' after 18/24 months TOH)	Schedule 'B' after 36/48 months (IOH)	POH
1	Humidity Indicator	1))Visually Inspect Humidity Indicators (ref. trouble shooting guide)	√	√	√	X	X	X
		2) Overhaul the equipment as recommended by OEM and Replace Humidity Indicator Kit	X	X	X	√	√	√
2	Purge Valve	1) Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check part performance i.e. proper purging.	√	√	√	X	X	X
		2) Cleaning of Purge Valve and Replace parts if any damage	X	X	√	X	X	X
		3) Overhaul the equipment as recommended by OEM and Replace Purge Valve Kit	X	X	X	√	√	√
3	Drain Valve	1) Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check part performance i.e. Check for Automatic Draining through double seated valve.	√	√	√	X	X	X
		2)0verhaul the equipment as recommended by OEM and Replace Drain Valve Kit	X	X	X	√	√	√
4	Pressure switch	1) Visually examine for loose fastenings or damages/ Operate and/ or Check part performance i.e. Functioning of pressure switch. Replace if found damage / non functioning	√	√	√	√	√	√

5	Renew Regenerating Orifice kit	1) Visually examine forloose fastenings, leaks or other damages.	√	√	√	X	X	X
		2) Overhaul the equipment as recommended by OEM and Replace Regenerating Orifice Kit.	X	X	X	√	√	√
6	Renew Pre-coalescing Element	1) Visually examine for loose fastenings, leaks or other damages. Check part performance.	√	√	√	X	X	X
		2) Overhaul the equipment as recommended by OEM and Replace Pre-coalescing Kit FTRTIL Part no. 790029165	X	X	X	√	√	√
7	Renew Final Filter Element	1) Visually examine for loose fastenings, leaks or other damages. Operate and check performance.	√	√	√	X	X	X
		2)Replace Final Filter kit Part no. 790029125	X	X	√	X	X	X
		3) Overhaul the equipment as recommended by OEM and replace kit for final fllter. FTIL Kit Part no. 790029125	X	X	X	√	√	√
8	Mufflers	l. Visually examine for loose fastenings and damages and check performance	√	√	√	√	√	X
		2. Overhaul the equipment as recommended by OEM and replace Muffler if found damage.	X	X	X	√	√	√
9	Timer Circuit Board	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check part performance (Cycling time of each Tower). Replace if found damage / non performance	√	√	√	√	√	√

10	Desiccant Canister	1. Visually examine for loose fastenings, leaks or other damages/ Operate and I or Check part performance.	√	√	√	√	√	X
		2. Check the condition of Desiccant (replace if contaminated)	X	X	√	X	X	X
		3. Overhaul the equipment as recommended by OEM. Replace Desiccant Canister Kit	X	X	X	√	√	√
11	Inlet Check valve	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check part performance.	√	√	√	X	X	X
		2. Overhaul the equipment as recommended by OEM. Replace Inlet check valve Kit	X	X	X	X	√	√
12	Outlet Check valve	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check part performance.	√	√	√	X	X	X
		2. Overhaul the equipment as recommended by OEM. Replace outlet check valve Kit and Solenoid Valve assembly kit	X	X	X	X	√	√
13	Compactor Assembly	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check part performance.	√	√	√	X	X	X
		2. Overhaul the equipment as recommended by OEM. Replace Compactor Assembly Kit.	X	X	X	X	√	√

14	Completely overhaul the Air Dryer (ref. Maintenance Manual and the major parts change details as follows)	1. Complete Dismantling and Overhaul the Air Dryer as recommended by OEM	X	X	X	X	√	√
		2. Replace all Rubberparts as recommended as per OEM	X	X	X	X	√	√

Maintenance Schedule of Air Dryer Model LTZ015.2 of M/s KBIL

Sl No	Type	Activities	Maintenance schedule					
			I A	I B	I C	Schedule 'A' after 18/24 months (AOH/TOH)	Schedule 'B' after 36/48 months (IOH)	POH
1	Check Functioning of Dryer	When compressor is ON, Dryer should work. Verify Dryer's purge & tower changeover	√	√	√	√	√	√
2	Check Humidity status	Check the color of humidity indicator installed at the outlet port of air dryer. Blue is OK	√	√	√	√	√	√
3	Check Tower changeover	Check lifting of indicator pin of respective tower. During the operation, alternatively INDICATOR PIN of respective tower should be up	√	√	√	√	√	√
4	Measure Cycle Time	By using Stop watch, record the time interval between two consecutive air releases from the drainage port of piston valve. # Time interval should be within 120+ I- 5 seconds.	√	√	√	√	√	√
5	Verify Pressure setting	Start from Zero pressure and note the pressure when changeover of towers occurs. Though air flows through dryer from starting but dryer does not change cycle unless pressure has reached - 4. 7 kg/ cm^2	√	√	√	√	√	√
6	Drain moisture from Final/ After filter	Drain moisture collected (if any) at the bottom of Final/ After Filter	√	√	√	√	√	√

7	Replace Final/ After Filter Element	Dismantle Filter housing and replace the Element with new part.	X	X	X	√	√	√
8	Overhaul Air Dryer Unit	Dismantle Air Dryer alongwith Piston Valve andreplace all Consumablesparts, Rubber parts and Desiccant according to recommended IOH/POH kit. Follow OverhaulInstructions catalogue UMA20.26- EN	X	X	X	X	√	√

Maintenance Schedule of Air Dryer of M/s SIL make.

Sl No	Type	Activities		Maintenance schedule					
				I A	I B	I C	Schedule 'A' after 18/24 months (TOH)	Schedule 'B' after 36/48 months (IOH)	POH
1	Check the color of humidity indicator	i. Blue color Dryer is performed	OK.	√	√	√	X	X	X
		ii. Lavender- Dryer is suspect	Verify dryer is cycling.	√	√	√			
		iii. White - Possible dryer is not regenera ting.	a. verify dryer is cycling.b) Desiccant Bag to be checked.	√	√	√			
2	Check electrical connection of Air dryer and their tightness	Red wire for positive. Black wire for negative. White wire for intermittent positive	Electrical power available when compressor is loaded condition	√	√	√	X	X	X
3	Check cyclic operation of Air Dryer	Cycling time for purging from regenerating tower	1 (one) minute drying 1 (one) minute regenerating	√	√	√	X	X	X

4	Check memory feature	When compressor gets unloaded purging of air should stop and when compressor again gets loaded purging should continue		√	√	√	X	X	X
5	Check the drain valve on coalescing filter	With the Dryer operating, the Drain Valve must expel a short burst of Air once a minute	Each cycle	√	√	√	X	X	X
6	Replace the filter Coalescing	Parts to be renewed	List of item as per overhaulin g Kit 'A'	X	X	X	√	√	√
7	Overhaul the complete air Dryer and Change desiccant	Parts to be renewed	List of item as per overhaulin g Kit 'B'	X	X	X	√	√	√

Maintenance Schedule of Air Dryer of M/s Prag polymers.

Sl No	Type	Activities	Maintenance schedule					
			I A	I B	I C	Schedule 'A' after 18/24 months (TOH)	Schedule 'B' after 36/48 months (IOH)	POH
1	Check electrical connections and their tightness		√	√	√	√	√	√
2	Operational check of the dryer with compressor loaded and unloaded a. Purge va lves must expel air every minute. b. Drain valve must expel collected impurities every min. c. Cyclic operation of the unit must be OK	Attend/replace the component (s) behaving erratic	√	√	√	√	√	√
3	Check Auto d rain of MR-1 & MR-2	It should function properly	√	√	√	√	√	√
4	Shut off cock of After/Fina l filler	Open to drain moisture collected in the bowl	√	√	√	√	√	√

5	Check color of humidity indicator, which in dicates: Blue- Dryer performing satisfactorily Pink/ Lavender- Dryer is suspect White- Dryer not performing	If found 'Pink', run the unit to see whether after some time the colour should change to blue. Verify if dryer is cycling. If cycling operation is ok, check condition of Coalescer filter element. If contaminated with oil, replace element and also replace Humidity Indicator	√	√	√	√	√	√
6	Charge the system from '0' pressure and check the pressure setting	Cut In- 7 Kgjsq.cm Cut out- 6 Kg/sq.cm	X	X	√	√	√	√
7	Air dryer assembly	Clean dirt and dust	√	√	√	√	√	√
8	Mufflers of Purge valves and Drain valve	Remove and clean Mufflers	X	X	X	√	√	√
9	Pipe connections	Check pipe connections for their tightness	X	X	X	√	√	√
10	Drain and purge valves	Dismantle, Clean and re-assemble	X	X	X	√	√	√
11	Coalescer filter and After I Final Elements	Replace element with gasket.	X	X	X	√	√	√
12	Overhaul the complete Dryer unit.	Replace all parts as mentioned in kit A & 8	X	X	X	X	√	√

Maintenance Schedule of Air Dryer of M/s Trident

Sl No	Maintenance Activity	Maintenance schedule					
		I A	I B	I C	Schedule 'A' after 18/24 months (TOH)	Schedule 'B' after 36/48 months (IOH)	POH
1	Open drain cock of final filter to drain off any accumulated water content	√	√	√	√	√	X
2	Check the colour of humidity indicator	√	√	√	√	√	X
3	Check auto drain of main reservoir No.1 & main reservoir No.2	√	√	√	√	√	X
4	Check electrical connection of air dryer and their tightness.	√	√	√	√	√	X
5	Check cyclic operation of air dryer.	√	√	√	√	√	√
6	Check Memory Feature	√	√	√	√	√	√
7	Examine the drain valve on the sump of pre coalescer	√	√	√	√	√	√
8	Charge the system from zero pressure and check the dryer does not cycle immediately. Note the pressure when the dryer starts cycling.	X	X	√	√	√	√
9	Replace consumables as per respective manufacturer's recommended replacement kit-A	X	X	X	√	√	√
10	Clean external muffler connected with purge valves.	X	X	X	√	√	√
11	Check condition of each pipe assembly and their tightness.	X	X	X	√	√	√
12	Overhaul the complete air dryer and change desiccant.	X	X	X	X	√	√
13	Test each air dryer before putting it back in to service. Schematic diagram of test bench is given in Annexure-I List of tests to be conducted and record to be maintained is given in Annexure-II	X	X	X	X	√	√
14	Replace consumables as per respective manufacturer's recommended replacement kit-B	X	X	X	X	√	√

Schedule of works for CCB of M/s KBIL
(Ref- RDSO SMI NO: RDSO/2016/EL/SMI/0298(Rev'0'))

S. No	Equipment	Activities	Maintenance schedule					
			IA	IB	IC	MOH	IOH	POH
Electrical items								
1	Electrical junction box with cables	Check tightness of connectors to ensure proper locking. Function test with complete	√	√	√	√	√	√
2	Relay Control Portion (RCP)	system and repair/replace if any problem found in any individual unit.						
3	Multi-Purpose Input/ output Node (MPIO)							
4	Power Supply Junction Box (PSJB)							
5	Electronic Vigilance Computer (EVC)							
Auxiliary manifold assembly								
6	Isolating Cocks (TC1, TC2, FC, UL, CB, PAN1,PAN2,SAND1, SAND2,Feed Pipe cock, SIFA cock, Kaba Key)	1. Check for correct orientation of Isolating Cocks handles	√	√	√	√	√	√
		2 Overhaul of Isolating cocks & Functional / leakage test as per OEM guidelines	x	x	x	x	√	√
7	Pressure Reducing Valve	1 Ensure that PRV seals are not tempered	√	√	√	√	√	√
		2 Overhaul of valve & functional test as per OEM guidelines	x	x	x	x	√	√
8	Magnet Valves (UL, 21, PAN1, PAN2, SAND1 & SAND2)	1 Ensure that connectors of Magnet valve are fixed properly.	√	√	√	√	√	√
		2 Overhaul of Magnet valves & functional test as per OEM guidelines	x	x	x	x	√	√
9	Feed Valve	1. Check the working and condition of valve. Repair/Replace, if any problem found.	√	√	√	√	√	√
		2. Overhaul of valve & functional test as per OEM guidelines	x	x	x	x	√	√
10	Over flow Valve	1. Check the working and condition of valve. Repair/Replace, if any problem found.	√	√	√	√	√	√
		2. Overhaul of valve & functional test as per OEM guidelines	x	x	x	x	√	√
11	Check Valve	1. Check the working and condition of valve. Repair/Replace, if any problem found.	√	√	√	√	√	√
		2. Overhaul of valve & functional test as per OEM guidelines	x	x	x	x	√	√

12	Impulse magnet valve Parking Brake	1. Check connector for proper tightness And functional test	√	√	√	√	√	√
		2. Overhaul of valve	x	x	x	x	√	√
		3. functional test as per OEM guidelines						
13	Pressure Governors	1. Check the working and condition of Governors. Calibrate/Replace, if any problem found.	√	√	√	√	√	√
		2. Functional test and calibration	x	x	x	x	√	√
14	Pressure Governors	1. Check the working and condition of Governors. Calibrate/Replace, if any problem found.	√	√	√	√	√	√
		2. functional test as per OEM guidelines	x	x	x	x	√	√
15	Safety Valves (AR-SV and AC- SV)	1. Check the working and condition of gauge. Calibrate/Replace, if any problem found	√	√	√	√	√	√
		2. Functional test as per OEM guidelines	x	x	x	x	√	√
16	Filter (AC-F and MREP-F)	1. Check the condition of filters	√	√	√	√	√	√
		2. Replacement of filter elements and rubber parts	x	x	x	√	√	√
17	Unloader Valve & Auto Drain Valve	1. Check the working and condition of valve. Repair/Replace, if any problem found.	√	√	√	√	√	√
		2. Overhaul of valve & functional test as per OEM guidelines	x	x	x	√	√	√
EPCU functions Items								
18	Control Portion (16-CP, 20-CP, ER-CP, BP-CP,BC-CP)	1. Ensure that connectors of LRU's are fixed properly.	√	√	√	√	√	√
		2. Overhaul of Valves & functional / leakage test	x	x	x	x	√	√
19	Distributive Valve	1. Ensure DV/C3W Isolation handle in working position.	√	√	√	√	√	√
		2. Functional / leakage test as per OEM guidelines	x	x	x	x	√	√
		3. Overhaul of Valves						
20	Pneumatic Equalizing Reservoir Actuator (PER COS)	1. Check the functioning of valve	√	√	√	√	√	√
		2. Overhaul of valve & Functional / leakage test	x	x	x	x	√	√
		3. Ensure that connector of Magnet valve are fixed properly.	√	√	√	√	√	√
21	MR Filter Assembly	1. Drain the CCB main Reservoir Filter assembly by opening manual drain valve located at the bottom of MR filter housing.	√	√	√	√	√	√
		2. Replacement of all Filter Elements & rubber parts of filters.	x	x	x	√	√	√
		3. Check leakage after replacement						

22	Filter Element Aux R, DBP, BP)	1. Replacement of all Filter Elements & rubber of filters.	x	x	x	√	√	√
		2. Check leakage after replacement						
Accessories Items								
23	Brake Controller Cab1 and Cab2	1. Check connector to ensure proper tightness at both ends (cab side & panel side)	√	√	√	√	√	√
		2. Overhaul of controllers & Functional test.	x	x	x	x	√	√
24	Emergency Valve NB11, PTDC, PRV, check valves, unloader valve, oil separator, Auto drain valves, Microphone horns, horn operating valves, sanding valve	1. Check the working and condition of valve. Repair/ Replace, if any problem found.	√	√	√	√	√	√
		2. Overhaul of Valves & functional test	x	x	x	x	√	√
25	Safety Valves (MR-SV and CP- SV)	Check the working and condition of valve. Replace, if any problem found	√	√	√	√	√	√
26	Check Valve (CP-NRV)	1. Check the working and condition of valve. Repair/Replace, if any problem found.	√	√	√	√	√	√
		2. Overhaul of valve & functional test as per OEM guidelines	x	x	x	x	√	√
27	Pressure Governors	1. Check the working and condition of governors. Calibrate/Replace, if any problem found.	√	√	√	√	√	√
		2. Functional test and calibration	x	x	x	x	√	√
28	Isolating cock 1 1/4" vented (Air dryers, MR,BP,FP)	Check for correct orientation of Cocks handle, leakage, functioning. Replace if found damaged during inspection/shed visit.	√	√	√	√	√	√
29	Isolating cock w/ vent 3/4" (for MREP & DBP and BC)	Check for correct orientation of Cocks handle, leakage, functioning. Replace if found damaged during inspection/shed visit.	√	√	√	√	√	√
30	Drain Cocks Reservoirs 1/2"	Check for functioning, leakage. Replace if found damaged during inspection/shed visit.	√	√	√	√	√	√
31	Isolating cock 3/8" horns & wipers	Check for correct orientation of Cocks handle, leakage, functioning Replace if found damaged during inspection/shed visit.	√	√	√	√	√	√

32	Angle cocks	Check for correct orientation of Cocks handle, leakage, functioning. Replace if found damaged during inspection/shed visit.	√	√	√	√	√	√
33	Hose coupling 1"(MREP, DBP) , BP, FP1 1/4"),	Check the working and condition of coupling. Replace if found damaged during inspection/shed visit.	√	√	√	√	√	√
34	Flexible hose sanding, parking, Brake cylinders	Check the working and condition of hose. Replace if found damaged during inspection/shed visit.	√	√	√	√	√	√
35	Pressure gauges	Functional test Replace, if any problem found.	√	√	√	√	√	√
Reservoir								
36	Reservoir	Visually examine fastenings, leaks or other damages/ Replace if required.	√	√	√	√	√	√

Schedule of works for Brake System of E-70 of M/s FTRTIL
(Ref- RDSO SMI NO: RDSO/2016/EL/SMI/0298(Rev'0'))

S. No	Equipment	Activities	Maintenance schedule					
			IA	IB	IC	MOH	IOH	POH
BRAKE MANIFOLD								
1	Tri-Plate & Equipment Manifold	1. Visually examine for loose fastenings, leaks or other damages	√	√	√	√	√	√
		2. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check part performance with the brake equipment module	x	x	x	x	√	x
		3. Overhaul the equipment as recommended by OEM	x	x	x	x	x	√
2	Unloader Exhaust Valve	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2. Cleaning of exhaust valve	x	x	x	√	x	x
		3. Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
3	Drip cup With Auto Drain Valve	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2. Cleaning of drain valve	x	x	x	√	x	x
		3. Overhaul the equipment as recommended by OEM	x	x	x	x	√	√

4	Driver Brake Controller	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2. Clean/ Operate and / or Check performance	x	x	√	√	x	x
		3. Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
5	Driver Brake Driver's Direct Air Brake Valve	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2. Cleaning of brake valve	x	x	x	√	x	x
		3. Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
6	E70 Brake Piping Interface Main	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2. Cleaning of piping interface main	x	x	x	√	x	x
		3. Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
7	Auto Drain Valve	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2. Cleaning of drain valve	x	x	x	√	x	x
		3. Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
8	Pressure Switch Assembly	1.Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2. Cleaning of pressure switch assembly	x	x	x	√	x	x
		3. Overhaul the equipment as recommended by OEM	x	x	x	x	√	x
		4. Overhaul/ Renew material/ Replace as recommended by OEM	x	x	x	x	x	√
AIR HORN								

9	Pneuphonic Horn - Low Tone	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2. Overhaul the equipment as recommended by OEM	x	x	x	√	√	√
10	Pneuphonic Horn - High Tone	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	x	x	x	√
		2. Overhaul the equipment as recommended by OEM	x	x	√	√	√	x
11	Two Way Horn Valve Assembly Type 15	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	x	x	x	x
		2. Clean	x	x	x	√	x	x
		3. Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
ALL ISOLATING COCKS & DRAIN COCKS								
12	Isolating Cock Assembly	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2. Cleaning of cock	x	x	x	√	x	x
		3. Overhaul the equipment as recommended by OEM.	x	x	x	x	√	x
		4. Replace as recommended by OEM.	x	x	x	x	x	√
		5. Replace if found damaged during inspection/shed visit	√	√	√	√	√	√
13	Isolating Cock & Regulator Assembly	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2. Cleaning of cock and assembly	x	x	x	√	x	x
		3. Overhaul the equipment as recommended by OEM	x	x	x	x	√	x
		4. Renew material/Replace as recommended by OEM	x	x	x	x	x	√
		5. Replace if found damaged during inspection/shed visit	√	√	√	√	√	√

14	Isolating Cock Olp 1-1/4"	1. Visually examine for loose fastenings, leaks or other damages.	√	√	√	√	√	√
		2. Cleaning of cock	x	x	x	√	x	x
		3. Overhaul the equipment as recommended by OEM and replace if required	x	x	x	x	√	√
		4. Replace if found damaged during inspection/shed visit	√	√	√	√	√	√
15	Isolating Cock Clp1-1/4"	1. Visually examine for loose fastenings, leaks or other damages.	√	√	√	√	√	√
		2. Clean	x	x	x	√	x	x
		3. Overhaul the equipment as recommended by OEM and replace if required	x	x	x	√	√	x
		4. Replace if found damaged during inspection/shed visit	√	√	√	√	√	√
16	Isolating Cock 3/8" Vented	1. Visually examine for loose fastenings, leaks or other damages.	√	√	√	√	√	√
		2. Clean	x	x	x	√	x	x
		3. Overhaul the equipment as recommended by OEM and replace if required	x	x	x	x	√	√
17	Isolating Cock 1-1/4" Vented	1. Visually examine for loose fastenings, leaks or other damages.	√	√	√	√	√	√
		2. Clean	x	x	x	√	x	x
		3. Overhaul the equipment as recommended by OEM and replace if required	x	x	x	x	√	√
18	1/2" Isolating Cock W/O Vent (Olp)	1. Visually examine for loose fastenings, leaks or other damages.	√	√	√	√	√	√
		2. Cleaning of cock	x	x	x	√	x	x
		3. Overhaul the equipment as recommended by OEM and replace if required	x	x	x	x	√	√
19	Latched Isolating Cock 1-1/4" W/O V	1. Visually examine for loose fastenings, leaks or other damages.	√	√	√	√	√	√
		2. Cleaning of cock	x	x	x	√	x	x
		3. Overhaul the equipment as recommended by OEM and replace if required	x	x	x	x	√	√
20	Latched Isolating Cock With Vented	1. Visually examine for loose fastenings, leaks or other damages.	√	√	√	√	√	√
		2. Cleaning of cock	x	x	x	√	x	x
		3. Overhaul the equipment as recommended by OEM and replace if required	x	x	x	x	√	√

21	Latched Isolating Cock With Vented	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	√	x	x
		2. Overhaul the equipment as recommended by OEM/ Renew material/Replace as recommended by OEM	x	x	x	x	√	√
22	End Cock Lh	1.Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	√	x	x
		2. Overhaul the equipment as recommended by OEM/ Renew material/Replace as recommended by OEM	x	x	x	x	√	√
23	Cut-Out Cock-3/4"With Drain	1. Visually examine for loose fastenings, leaks or other damages.	√	√	√	√	x	x
		2. Cleaning of cock	x	x	x	√	x	x
		3. Overhaul the equipment as recommended by OEM and replace if required	x	x	x	x	√	√
24	1.25 “Latched Isolating Cock	1. Visually examine for loose fastenings, leaks or other damages.	√	√	√	√	√	√
		2. Cleaning of cock	x	x	x	√	x	x
		3. Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
25	1-1/4"Cutoff Angle cock Bp W/V101	1. Visually examine for loose fastenings, leaks or other damages	√	√	√	√	√	√
		2. Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
26	1-1/4"Cutoff Angle cock Fp W/V	1. Visually examine for loose fastenings, leaks or other damages	√	√	√	√	√	√
		2. Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
HOSE & COUPLING								

27	1"Uic Hose M R E P	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	√	x	x
		2. Check performance with the brake equipment module/ Renew material/Replace as recommended by OEM	x	x	x	x	√	x
		3. Replace as recommended by OEM	x	x	x	x	x	√
		4. Replace if found damaged during inspection/shed visit	√	√	√	√	√	√
28	1"Uic Hose 905mm Long	1. Visually examine for loose fastenings, leaks or other damages/ Operate and Check performance with the brake equipment module	√	√	√	√	x	x
		2. Check performance with the brake equipment module/Replace as recommended by OEM	x	x	x	x	√	x
		3. Replace as recommended by OEM	x	x	x	x	x	√
		4. Replace if found damaged during inspection/shed visit	√	√	√	√	√	√
29	Air Brake Hose Coupling-BP	Visually examine for loose fastenings, leaks or other damages. Replace if any problem found. Replace if found damaged during inspection/shed visit.	√	√	√	√	√	√
30	Air Brake Hose Coupling-FP	Visually examine for loose fastenings, leaks or other damages. Replace if found damaged during inspection/shed visit	√	√	√	√	√	√
31	Flexible Hose 3/4"	Visually examine for loose fastenings, leaks or other damages. Replace if found damaged during inspection/shed visit	√	√	√	√	√	√
32	Flexible Hose 1/2"	Visually examine for loose fastenings, leaks or other damages. Replace if found damaged during inspection/shed visit	√	√	√	√	√	√
33	Flexible Hose 3/8"	Visually examine for loose fastenings, leaks or other damages. Replace if found damaged during inspection/shed visit	√	√	√	√	√	√
PRESSURE GAUGES								

34	Panto Gauge	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	√	x	x
		2. Check performance/ Replace Part as recommended by OEM	x	x	x	√	√	x
		3. Replace Part as recommended by OEM	x	x	x	x	x	√
35	Pressure Gauge(FP-MR)	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check part performance with the brake equipment module.	√	√	√	√	x	x
		2. Check part performance/ Replace Part as recommended by OEM	x	x	x	x	√	x
		3. Replace Part as recommended by OEM	x	x	x	x	x	√
36	Duplex Pressure Gauge	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	√	x	x
		2. Check performance/ Replace as recommended by OEM	x	x	x	x	√	x
		3 Replace as recommended by OEM	x	x	x	x	x	√
37	Pressure Gauge BP	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	√	x	x
		2. Check performance/ Replace as recommended by OEM	x	x	x	x	√	x
		3. Replace as recommended by OEM	x	x	x	x	x	√
38	Spring Parking Brake Pressure	1. Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	√	x	x
		2. Check performance/ Replace as recommended by OEM	x	x	x	x	√	x
		3. Replace as recommended by OEM	x	x	x	x	x	√

39	Air Flow Measuring Gauge W/Led	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	√	x	x
		2 Check performance/ Replace as recommended by OEM	x	x	x	x	√	x
40	Duplex Check Valve 1 1/4"	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	√	√	√
		2 Cleaning of valve	x	x	x	√	√	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	x	√
41	Venturi Check Valve Assembly	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of check valve	x	x	x	√	x	√
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
42	1" Spring Loaded Check Valve	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of valve	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
43	Emergency Exhaust Valve	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	x	x	x	x	x
		2 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance	x	√	√	x	x	x
		3 Clean	x	x	x	√	x	x
		4 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√

44	1/2" Double Check Valve	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of valve	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
45	1/2" Strainer- Check Valve	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of valve	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
46	Safety Valve 1/4"Bsp	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of valve	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	x
		4 Replace as recommended by OEM	x	x	x	x	x	√
47	Check Valve Assembly	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of Check Valve Assembly	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	x
		4 Replace as recommended by OEM	x	x	x	x	x	√
48	Compressor Check Valve/Pu Type Check Valve	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of valve	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
49	Safety Valve 3/4" Bsp - Type 9	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of safety Valve	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	x

		4 Overhaul the equipment as recommended by OEM/ Replace as recommended by OEM	x	x	x	x	x	√
50	Safety Valve 1/4" Bsp - Type 9	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of safety Valve	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	x
		4 Overhaul the equipment as recommended by OEM/ Replace as recommended by OEM	x	x	x	x	x	√
51	Safety Valve 1/4" Bsp - Type 9	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of safety Valve	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	x
		4 Overhaul the equipment as recommended by OEM/ Replace as recommended by OEM	x	x	x	x	x	√
52	Sander Nozzle Imported	1 Visually examine for loose fastenings, leaks or other damages.	√	√	√	√	√	√
		2 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
53	Air Line Sieve 3/8”	1 Visually examine for loose fastenings, leaks or other damages.	√	√	√	√	√	√
		2 Visually examine for loose fastenings, leaks or other damages./ Replace as recommended by OEM	x	x	x	x	√	x
		3 Replace as recommended by OEM	x	x	x	x	x	√
54	C3 W DV	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of valve	x	x	√	x	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√

55	Double Check Valve Assembly	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of valve	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
56	Emergency Exhaust Valve	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of valve	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
57	Double Check Valve-3/8"	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of valve	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
ELECTRO-PNEUMATIC VALVES								
58	Solenoid Valve 110v Dc Nc	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of valve	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
59	Solenoid Valve 110v Pressure Switch Manifold Assembly	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of assembly	x	x	x	√	√	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√

60	Solenoid Valve Assembly	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of assembly	x	x	x	√	√	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
61	Latched Solenoid Valve Assembly	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of valve assembly	x	x	x	√	√	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
62	Transducer Assembly	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of assembly	x	x	x	√	x	x
		3 Operate and / or Check performance	x	x	x	x	√	x
		4 Replace as recommended by OEM	x	x	x	x	x	√
63	D2 Relay Valve	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of valve	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
64	EP Relay Valve 110v Dc	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of valve	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
65	Limiting Valve Assembly (6kg/8kg)	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of valve	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√

66	Limiting Valve Assembly (Auto Brake)	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of valve assembly	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
67	Limiting Valve Assembly (EBC/5 Blending)	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of limiting valve assembly	x	x	x	√	√	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
68	Solenoid Valve	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of valve	x	x	x	√	√	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
69	Pilot Valve 110 V Dc	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of valve	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
70	Venturi Valve Assembly	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of valve assembly	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√

71	Brake In Two Protection Valve	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of valve	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
		4 Replace as recommended by OEM	x	x	x	x	x	√
72	Pressure Control Valve	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of control valve	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
		4 Renew material/Replace as recommended by OEM	x	x	x	x	x	√
73	Transmission Valve Assembly	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Clean	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
		4 Renew material/Replace as recommended by OEM	x	x	x	x	x	√
74	D2 Relay Valve Assembly	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of valve assembly	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
75	Pressure Regulating Valve Assembly	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of valve assembly	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
		4 Replace as recommended by OEM	x	x	x	x	x	√
ELECTRONICS RACK/ MOTHER BOARD								

76	Electronic Rack/ Mother Board	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Clean/ Operate and / or Check performance	x	x	x	√	√	x
		3 Refurbish the equipment as recommended by OEM/ Replace, if required.	x	x	x	x	x	√
77	PSU CARD	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Clean/ Operate and / or Check performance	x	x	x	√	√	x
		3 Refurbish the equipment as recommended by OEM/ Replace, if required.	x	x	x	x	x	√
78	LPO CARD	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Clean/ Operate and / or Check performance	x	x	x	√	√	x
		3 Refurbish the equipment as recommended by OEM/ Replace, if required.	x	x	x	x	x	√
79	Control Card	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Clean/ Operate and / or Check performance	x	x	x	√	√	x
		3 Refurbish the equipment as recommended by OEM/ Replace, if required.	x	x	x	x	x	√

80	Blender Card	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Clean/ Operate and / or Check performance	x	x	x	√	√	x
		3 Refurbish the equipment as recommended by OEM/ Replace, if required.	x	x	x	x	x	√
81	Vigilance Control Unit	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Clean/ Operate and / or Check performance	x	x	x	√	√	x
		3 Refurbish the equipment as recommended by OEM/ Replace, if required.	x	x	x	x	x	√
82	Conduit Assembly	1 Visually examine for loose fastenings, leaks or other damages.	√	√	√	√	√	√
		2 Clean/ Replace as recommended by OEM	x	x	x	x	√	x
		3 Replace as recommended by OEM	x	x	x	x	x	√
83	EBC/5 Blending Unit (3.5 Bar)	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of unit	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
84	SUPPRESSION BOX UNIT	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Clean/ Operate and / or Check performance	x	x	x	√	√	x
		3 Overhaul the equipment as recommended by OEM/ l/Replace as recommended by OEM	x	x	x	x	x	√

MANIFOLD ASSEMBLY

85	Pantograph Pipe Bracket Manifold	1 Visually examine for loose fastenings, leaks or other damages	√	√	√	√	√	√
		2 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
86	Pantograph Interface Manifold	1 Visually examine for loose fastenings, leaks or other damages	√	√	√	√	√	√
		2 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
87	DV Equipment Manifold(Freight	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of manifold	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
88	Isolator Assembly	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of Isolator Assembly	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
89	Pantograph Equip Manifold Assembly	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of manifold	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
90	Manifold Mounting Regulator/High Flow Limiting Valve	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of unit	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
		4 Overhaul the equipment as recommended by OEM/Replace as recommended by OEM	x	x	x	x	x	√

91	Direct Brake Equ Manifold Assy	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of assembly	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
92	Sanding Equip Manifold Assembly	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of assembly	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
93	Venturi / EP Manifold Assembly	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of assembly	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
94	SPB Equip Manifold Assemblyy	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of assembly	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
95	¾” Manifold Assembly	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of unit	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
96	TRACTION CONTROL Assembly	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of unit	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√

97	E-70 Brake Control Unit Assembly	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Clean	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
98	Centrifugal Air Strainer Assembly	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of unit	x	x	x	√	x	x
		3 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
99	Coil Assembly	1 Visually examine for loose fastenings, leaks or other damages/ Operate and / or Check performance with the brake equipment module	√	√	√	x	x	x
		2 Cleaning of assembly	x	x	x	√	x	x
		3 Operate and / or Check performance	x	x	x	x	√	x
		4 Replace as recommended by OEM	x	x	x	x	x	√
RESERVOIR								
100	Main/Aux Reservoirs	1 Visually examine for loose fastenings, leaks or other damages.	√	√	√	√	√	√
		2 Hydrostatic test	x	x	x	x	√	√
101	RESERVIOR 5 L	1 Visually examine for loose fastenings, leaks or other damages.	√	√	√	√	√	√
		2 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√
102	E70 Control Reservoir 1lt	1 Visually examine for loose fastenings, leaks or other damages.	√	√	√	√	√	√
		2 Overhaul the equipment as recommended by OEM	x	x	x	x	√	√

Pneumatic Testing of Three phase Electric Locomotives fitted with E-70 brake system

(As per RDSO TC No. RDSO/2012/EL/TC/0113 rev'0', Dated. 29.03.2012)

S.N	Parameters	Value	Reference
1	**Auxiliary Air supply system (Pantograph & VCB)**		
1.1	Ensure, air is completely vented from Pantograph Reservoir (Ensure Panto Pressure Gauge reading is Zero)		
1.2	Turn ON BL key. Now MCPA starte. Record Pressure build up time (8.5 Kg/cm²)	60sec. (max)	
1.3	Auxiliary compressor safety valve 23F setting	8.5±0.25Kg/cm²	Faiveley Doc. No.DMTS- 014-1 & CLW's check sheet no. F60.821 Version 2.
1.4	Check VCB Pressure switch setting	Opens 4.5±0.15Kg/cm² Closes 5.5±0.15Kg/cm²	CLW's check sheet no. F60.812 Version 2.
1.5	Set Pantograph selector switch is in Auto, open Pan - 1&2 Isolating cocks & KABA cock by key (KABA Key)		
1.6	Set Cab-1 Pan UP in Panel A	Observed Pan-2 rises	
1.7	Close Pan-2 Isolating cock, Open Pan-2 Isolating cock	Panto-2 Fall down Panto-2 rises	
1.8	Record Pantograph rise time	06 to 10 seconds	
1.9	Record Pantograph Lowering time	06 to 10 seconds	
1.1	Panto line air leakage	0.70 kg/cm² in 5 minutes	
2	**Main Air supply system**		
2.1	Ensure air is completely vented from locomotive. Drain out all reservoirs by opening the drain cocks and then close drain		Theoretical calculation and test performed by Railways.
	cocks. MR air pressure build up time by each compressor from 0 to 10 kg/cm² **1. With 1750 LPM Compressor** **2. With 1450 LPM compressor**	**7 Mts.Max** **8.5 Mts.Max**	
2.2	Drain air below MR 8 Kg/cm² to start both the compressors	Check starting of both compressors	
2.3	Drain air from main Reservoir up to 7 Kg/cm². Start compressors, check presure build time of individual compressor from 8 Kg/cm² to 9 Kg/cm²	30 Sec (Max)	
2.4	Check low MR pressure switch setting (37)	Closes at 6.40±0.15kg/cm²Op ens at 5.60±0.15kg/cm²	D&M test Spec. MM3882 & MM3946
2.5	Check compressor pressure switch RGCP setting (35)	Opens at 10±0.20kg/cm² Close at 8.0±0.20kg/cm²	D&M test spec. MM3882 & MM3946
2.6	Run both the compressors record pressure build up time	3.5 Minutes Max	Trial results
2.7	Check unloadervalve operation time	Approx 12sec	
2.8	Check Auto Driain valve functioning (124 & 87)	Operates when compressor starts	

2.9	Check CP-1 delivery safety valve setting (10/1). Run CP direct by BLCP	11.50±0.35kg/cm²	D & M test spec. MM3882 & MM3946
2.1	Check CP-2 deliveries safety valve setting. (10/2) run CP. Direct by BLCP.	11.50±0.35kg/cm²	D & M test spec. MM3882 & MM3946
2.11	Switch 'OFF' the compressors and ensure that the safety valve to reset at pressure 1.2 kg/cm² less than opening pressure		D & M test spec. MM3882 & MM3946
2.12	BP pressure: Switch 'OFF' compressor, Drain MR pressure by drain cock of 1st Main Reservoir. Start compressor, check setting pressure of Duplex check valve 92F	5.0±0.10kg/cm²	CLW's check sheet no. F60.812 Version 2.
2.13	FP pressure: Fit test gauge in test point 107F FPTP. Open Isolate cock 136F. Check pressure in Gauge	6.0±0.20kg/cm²	CLW's check sheet no. F60.812 Version 2.
3	**Air Dryer Operation**		
3.1	Open drain cock 90 of 2nd MR to start compressor, leave open for test. Check Air dryer towers to change	Tower to change i) Every minute (FTIL & SIL) ii) Every two minute (KBIL)	
3.2	Check purge air stops from Air dryer at compressor stops		
3.3	Check condition of humidity indicator	Blue	
4	**Main Reservoir Leakage test**		
4.1	Put Auto brake (A-9) in full service. Check MR pressure air leakage from both cabs	Should be less than 1 kg/ cm² in 15 minutes	D & M test spec. MM3882 & MM3946
4.2	Check BP Air leakage (Isolate BP charging cock-70)	0.15kg/cm² in 5 minutes	D & M test spec. MM3882 & MM3946
5	**Brake Test (Automatic Brake Operation)**		
5.1	Record Brake pipe & Brake cylinder pressure at each step		
	Check Proportionality of Auto Brake system Auto Controller position / BP Pressure kg/cm2 / BC (WAG9 & WAP7) kg/cm2 / BC (WAP5) kg/cm2 Run / 5.0 ± 0.1 / 0.00 / 0.00 Initial / 4.60 ± 0.1 / 0.40 ± 0.1 / 0.75 ± 0.15 Full Service / 3.35 ± 0.2 / 2.50 ± 0.1 / 5.15 ± 0.30 Emergency / Less than 0.3 / 2.50 ± 0.1 / 5.15 ± 0.30		CLW's check sheet no F60.812 Version 2.
5.2	Record time to BP pressure drop to 3.5 kg/cm². Ensure automatic brake controller handle is full service from run.	8±2 sec	D & M test spec. MM3882 & MM3946
5.3	Operate Asst. Driver Emergency cock	BP pressure falls rapidly to below 2.5 kg/cm²	D & M test spec. MM3882 & MM3946
5.4	Check Brake pipe pressure switch 69F operates	Closes at BP 4.05-4.35 kg/cm² Opens at BP 2.85-3.15 kg/cm²	CLW's check sheet no. F60.812 Version 2.

5.5	Move Auto brake controller handle from "Running to Emergency" BC filling time from 0.4kg/cm² i.e 95% of Max. BC developed. WAP_5 BC 5.15±0.3kg/cm²apply time. WAP_7 BC 2.50±0.1kg/cm². WAG_9 BC 2.50±0.1kg/cm²	4±1 sec 7.5±1.5 sec 21±3 sec	D & M test spec. MM3882 & MM3946
5.6	Move Auto brake controller handle to Full service and allow BP pressure 3.5 kg/cm². Move Brake controller to Running position BC release time to fall BC pressure up to 0.4 kg/cm² i.e 95% of Max, BC developed. BC release time WAP_5 & WAP_7 WAG_9	17.5±2.5 sec 52.5±7.5 sec	D & M test spec MM3882 & MM3946
5.7	Move Auto brake controller handle to release, check BP pressure steady at 5.50 ±0.2 kg/cm² time.	60 to 80 sec	CLW's check sheet no. F60.812 Version 2.
5.8	Auto brake capacity test: The capacity of the A9 valve in released condition must conform to certain limit in order to ensure compensation for air leakage in the train without interfering with the automatic functioning of brake. . Allow the MR pressure to build up to maximum stipulated limit. . Close brake pipe angle cock and charge brake pipe to 5 kg/cm² by A9 (Automatic brake controlling) at run position. . Couple 7.5 dia leak hole to the brake hose pipe of locomotive. Open the angle cock for brake pipe. The test shall be carried out with all the compressors in working condition.	BP pressure should not fall below 4.0 kg/cm² within 60sec	RDSO Motive Power Directorate report No. 11 July 1999 Rev.1
5.9	Keep Auto brake controller (A-9) in full service. Press Driver End Paddle switch (PVEF)	BC comes '0'	
6	**Direct Brake (SA-9)**		
6.1	Apply direct brake in full check BC pressure WAP_7, WAG_9 WAP_5	3.50±0.20kg/cm² 5.15±0.3kg/cm²	CLW's check sheet no. F60.812 Version 2.
6.2	Apply direct brake, Record brake cylinder charging time.	8 sec Max	D & M test spec. MM3882 & MM3946
6.3	Check direct brake pressure switch setting 59 (F)	0.2±0.1kg/cm²	D & M test spec. MM3882 & MM3946
6.4	Release direct brake & BC release time to fall BC pressure up to 0.4 kg/cm²	10-15 sec	

7	**Dynamic Brake (Brake blending)**		
7.1	This test is to be done by forcing signal by laptop 06H Actual BE E1=100%	WAP_7 &WAP_9 2.5 kg/cm² WAP_5 5.15 kg/cm²	D & M test spec. MM3882 & MM3946
7.2	This test is to be done by forcing signal by laptop 06H Actual BE E1= 50%	WAP_7 &WAP_9 1.25 kg/cm² WAP_5 2.55 kg/cm²	D & M test spec. MM3882 & MM3946
8	**Parking Brake**		
8.1	Press BPPB to release parking brake	PB released Lamp Off in panel pressure in parking brake gauge 6.0kg/cm²	D & M test spec. MM3882 & MM3946
8.2	Pressure BPPB to apply parking brake	PB applied, Lamp ON in panel pressure in parking brake gauge 0.0kg/cm²	
8.3	Manually release and apply parking brake by pressing soleod valve 30F	Verify release and application of parking brake.	
8.4	Check pressure in PB gauge	6.0±15kg/cm²	
8.5	Check Brake block clearance	10mm in TBU 3 mm in Disc brake (WAP_5)	D & M test spec. MM3882 7 MM3946
9	**Sanding Equipment**		
9.1	Check Isolating cock-134f is in open position. Press sander paddle switch (To confirm EP valves operated.	Sand on roll	
10	Test vigilance equipment: As per D & M test specification.		

Pneumatic Testing of Three phase Electric Locomotives fitted with Computer Controlled Brake (CCB) system are appended below. (As per OEM Maintenance manual of M/s. Knorr-Bremse)

S. No	Tests to be conducted	Standard	Result	
			Cab 1	Cab 2
1	**Auxiliary Compressor (PANTOGRAPH & VCB)**			
1.1	Ensure Air is completely vented from locomotive Pantograph Reservoir (Panto Pressure Gauge reading must be zero before commencing the test). Turn ON BL key. Now MCPA starts. Record Pressure Build up time Check Panto Pressure switch Un-earth VCB HOM switch. Open Blue Key (KABA Key) and Fit in Panto isolating Cock (KABA cock) in Pneumatic panel.	Open 8±0.15 kg/ cm2 closes 6±0.15 kg/cm2		
1.2	Check Panto Safety Valve operate between 8.3-8.7 Kg/cm2 Pressure should not exceed 9.5±0.2 Kg/cm2 Above opening pressure	8.5±0.20 kg/cm2 9.5±0.20 kg/cm2		
1.3	Set Pantograph selection switch is in Auto open Pan -1&2 isolating cocks & KABA Cock by Blue Key (KABA key)			

1.4	Set Cab-1 Pan UP in Panel A see Pan-2 Rises. Close VCB then open. Check signal config file05A MPrSWPan-2 P/S- 09/2 (Repeat this test from Cab-2 & Also check Signal)	Open/ Close 4.5±0.15 kg/cm2 5.5±0.15 kg/cm2		
1.5	Close Pan-2 isolating cock, Panto 2 fall down/Open Pan-2 isolating cock, Panto 2 rises & close KABA cock, Panto-2 down			
1.6	Set Panto selection switch on Pan-1, Cab Pan ON in Panel A. See Panto-1 Rises/close VCB/Open VCB. Check Signal config file:05A MPrSWPan-1 P/S- 09/1 Close Pan-1 isolating cock, Panto 1 fall down/open Pan-1 isolating cock, Panto 1 Rises, close KABA cock Panto 1 Down	Open/close 4.5±0.15 kg/cm2 5.5±0.15 kg/cm2		
1.7	Set Panto Selection Switch in Pan-2, Cab Pan ON in Panel A. See Panto-2 Rises/Close VCB/Open VCB			
1.8	Record Pantograph Rise time	6 to 10 seconds		
1.9	Record Pantograph lowering time	6 to 10 seconds		
1.10	Pantograph drops if TP-Panto is less than 0.7 kg/cm2 in one (01) Mts	0.70/01 Mts		
2.0	**AIR SUPPLY**			
2.1	Compressor system			
2.2	Fit test gauge at test point 40 in the machine room			
2.3	Isolate compressor No.2 Run comp No.1 record Pr. Build up time Check Low MR pressure switch 37 Close at 6.40±0.15 kg/cm2 Check signal Config File:06E-MPr Sw Low MR Check compressor pressure switch 35 Close at 10±0.2 kg/cm2 Check signal Config file :06E-MPr Sw8 bar	12 minute Max. 6.25-6.55 kg/cm2 9.80-10.20 kg/cm2		
2.4	Check compressor pressure switch 35 Close at 8±0.2 kg/cm2 Check signal config file:06E-MPr Sw8 bar Check low MR pressure switch 37. Open at 5.60±0.15 kg/cm2 Check Signal Config File:06E-MPr Sw Low MR	7.8-8.2 kg/cm2 5.45-5.75 kg/cm2		
2.5	Isolate compressor No.1 Run comp No.2 record Pr. Build up time Check Compressor pressure switch 36 Close at 10±0.2 kg/cm2 Check signal Config File:06E-MPr Sw7.5 bar	12 minute Max. 6.25-6.55 kg/cm2 9.80-10.20 kg/cm2		
2.6	Check compressor pressure switch 36 Close at 8±0.2 kg/cm2 Check signal config file:06E-MPr Sw7.5bar	7.8-8.2 kg/cm2		
2.7	Run both compressors record Pr. Build up time	06 Min Max		

2.8	At the time Comp Start up for CP-1. Unloader 1 operates for 3 sec. min. Check signal config file :06D-BEPCPUnlode	03 Sec Min		
2.9	At the time Comp Start up for CP-2. Unloader 2 operates for 3 sec. min. Check signal config file :06D-BEPCPUnlode	03 Sec Min		
2.10	Check both auto drain valve operates when compressor starts	Little drain		
2.11	Drain MR air below 8 kg/cm2 to start both compressors Check signal config. File:06E-BcontComp-1&2	Check start up of both comp.		
2.12	Check operation of compressor-1 safety valve 10, Range 11 15-11.85 Kg/cm2	11.50±0.35 kg/cm2		
2.13	Pr. Does not exceed 1.2kg/cm2 above safety valve opening pressure	Approx. 12.30±0.35 kg/cm2		
2.14	Safety valve 10 resets by 1.2 Kg/Cm2 below safety valve opening pressure	Approx. 10.3±0.35 kg/cm2		
2.15	Check operation of compressor-2 safety valve 10, Range 11 15-11.85 Kg/cm2	11.50±0.35 kg/cm2		
2.16	Pr. Does not exceed 1.2kg/cm2 above above safety valve opening pressure	Approx. 12.30±0.35 kg/cm2		
2.17	Safety valve 10 resets by 1.2 Kg/Cm2 below safety valve opening pressure	Approx. 10.3±0.35 kg/cm2		
2.18	Run compressor direct through BLCP switch in Panel A	Comp starts		
2.19	Check operation of safety valve 39, 10.35 to 11.05 kg/cm2	10.7±0.35 kg/cm2		
2.20	Safety valve 39 resets by 1.1 Kg/Cm2 below safety valve opening pressure	Approx. 9.6±0.35 kg/cm2		
3	**MAIN RESERVOIR EQUALIZING PIPE EQUIPMENT**			
3.1	Isolate Compressor, Drain MR Pr. Below 3 Kg/cm², by MREQ End cock			
3.2	Start Compressor, Check setting of overflow valve 4.80 to 5.20 Kg/cm²	5.0±0.20 Kg/cm²		
3.3	Fit test Gauge in FP-TP			
3.4	Open Isolating Cock FP, FP Pr. 5.90 to 6.10 Kg/cm²	6.0±0.10Kg/cm²		
3.5	Fit end hose in dummy holder			
3.6	Open end Cock FP, Ensure both compresssor starts in 29 sec	Max. 29sec		
3.7	Open Pr, Switch FP, Open/ Close at 5.00/5.60Kg/cm² Check Signal Config File: 06E- MPr Sw BkFP	Open/Close 5.0±0.10Kg/cm² 5.6±0.15Kg/cm²		
4	**AIR DRYER OPERATION (Record make & Sr.No. of Air Dryer)**	**Make: Sr.No**		

4.1	Open Drain Cock of MR2 to start Compressor			
4.2	Air Dryer towers to change in every 2 Min±10Sec. Min 4 changes of CP-1. Check Signal Config File: 06D B Air Dryer	110 sec to 130 sec		
4.3	Air Dryer towers to change in every 2 Min±10Sec. Min 4 changes of CP-2. Check Signal Config File: 06D B Air Dryer	110 sec to 130 sec		
4.4	Check Purge Air stops from Air Dryer at just Compressor stops CCP-2. Check signal config File: 06D Bair Dryer			
4.5	Close Isolating Cock of Air Dryer & Open Bypass cock to position NO. Pr. Builds up when MCP starts. Close & Seal Air Dryer Isolating Cock (at position NC)			
5	**MAIN RESERVOIR SYSTEM**			
5.1	Set up Loco in normal from any Cab for Activation in Driving mode, Charge BP at 5.0Kg/cm² and			
5.2	Pr. Drop at MR-TP is 0.35Kg/cm² in 5 Mts. 2 Min settling time to be given	0.35/5 Mts		
5.3	Put Auto Brake in FS Direct in ON in 5 Mts, 2 min settling time. Given Cab1	0.35/5 Mts		
5.4	Put Auto Brake in FS Direct in ON in 5 Mts, 2 min settling time. Given Cab2	0.35/5 Mts		
5.5	BP Drop in 5 Mts. At BP-TP, 2 Min settling time to be given	0.30/5 Mts		
5.6	Close MR Isolating cock, Open drain cock MR2, Fit gauge at Aux. MR Drain cock & Check Pr. Drop	01.15/5 Mts		
6	**BRAKE TEST- Automatic Brake Operation**			
6.1	Take Auto brake controller handle to release, BP Pr steady at 5.50±0.1Kg/cm² in 60 sec to 60 sec	BP 5.4 to 5.6Kg/cm²		
6.2	When BP comes to 5.10 Kg/cm² make initial application. Check BP Pr. Falls to 4.7±0.05Kg/cm² , Return controller to RUN, BP Pr. Goes to 5.10±0.05Kg/cm² . Before bleed down starts.			
6.3	Record BP reduction time is 180±20 sec from 5.50±0.1Kg/cm² to normal brake pipe pressure of 5.0±0.1Kg/cm²			
6.4		5Kg/cm²=%		
6.5	Record time to BP Pr fall to 3.50Kg/cm² in 06 to 10 sec and BC Pr 2.50±0.15Kg/cm² (WAP5- 5.15±0.30Kg/cm²) (Ensure Automatic brake controller handle moved directly to FS from run)	8±2 sec		
6.6	Operate Asst.Driver cock, BP Pr drops below 2.50Kg/cm² Check BP-RS operates, close Asstt.Driver cock, BP-RS resets (Close/open 4.2±0.15Kg/cm² / 3.0±0.15 Kg/cm²). Check signal config file: 06A MPr Sw EmgBk	Close BP 4.05-4.35Kg/cm² Open BP 2.85-3.15Kg/cm²		

6.7	BC apply time: Passenger- 4±1 sec, BC 2.50/5.15±0.1Kg/cm². Freight- 21±3 sec, BC: 2.50/5.15±0.1Kg/cm²	03-05 sec 18-24 sec		
6.8	BC release time: Passenger- 17.5±2.5sec, BC: 0.4Kg/cm² Freight- 52.5±7.5sec, BC: 0.4Kg/cm²	15-20 sec 45-60 sec		
6.9	Close BP isolating cock (keep brake controller mode switch in test position) Check signal config: 06A L cock Bk Con & also in DDS.			
6.10	Close SIFA cock Check signal config file: 06A LemgBkut & also in DDS.			
6.11	Press driver end 'Foot Switch PVEF', Drop BP, BC should not develop.			
6.12	Lift bail off ring at Brake controller, drop BP, BC should not develop.			
6.13	Fit 7 mm leak hole dummy coupling at non- operative end in BP end hose. The open end cock BP	BP Pr 4.0Kg/cm²		
6.14	Move Auto handle to relese, BP Pr 4.25Kg/cm²	BP Pr 4.25Kg/cm²		
6.15	Isolate BC isolating cock CoC-BC1, Gauge for BC2 show. Pressure in both Cab BC gauge Check Pr.Sw, 64/1 (0.20±0.15/0.65±0.15Kg/cm²) Check signal config file: 06A Mpr Sw BkCyl-1	Close 0.50-0.80Kg/cm² Open 0.05- 0.35Kg/cm²		
6.16	Isolate BC isolating cock CoC-BC2. Gauge for BC1 show pressure in both Cab BC gauge Check Pr.Sw 64/1 (0.20±0.15/0.65±0.15Kg/cm²) Check signal config file: 06A Mpr Sw BkCyl-2	Close 0.50-0.08 Kg/cm² Open 0.05-0.35 kg/cm²		
7	**DYNAMIC BRAKE- (Blending Brake)**			
7.1	This test to be done by forcing signal by Laptop 06H actual BE E1	100%=2.5/5.15± 0.15Kg/cm²		
7.2	This test to be done by forcing signal by Laptop 06H actual BE E1	50%=1.25/2.62± 0.15Kg/cm²		
8	**DIRECT BRAKE**			
8.1	From Cab-1 direct (Independent) brake handle Apply direct brake in full BC Pr is 3.50±0.05Kg/cm² (WAG9/WAP7) BC Pr. is 3.50±0.05Kg/cm² (WAP5) Check DBP (Yellow End Hose) is 3.50±0.2Kg/cm² Check P/S 59F, close at 0.65±0.1Kg/cm², Open at 0.2±0.1Kg/cm² Check signal config file: 06A MPrSwLocoBk.	3.45-3.55Kg/cm² 5.00-5.30kg/cm² 3.3-3.7Kg/cm² Close 0.55- 0.75kg/ cm²		
8.2	Release DB, BCP 0Kg/cm². P/S 59F operates at 0.2±0.1Kg/cm². Check signal config file: 06A MPrSwLocoBk	1.10-0.30Kg/cm²		
8.3	Apply DB full. Record BC filling time	Max 8 sec		
8.4	Repeat test- 8.1, 8.2 & 8.3 from Cab-2, Ignore DBP check			

8.5	Close CP & isolate cocks 13, 14 & 70F, drain MREP by AC Below 1 Kg/cm², Apply full DB & check Full BC comes in Cab gauges In DBP (Yellow End hose) No pressure	BC 3.5/5.15Kg/cm ² DBP 0.0Kg/cm²		
8.6	Close 13, 14, 70F. Check in 601 mode, apply 3.5 Kg/cm² External pressure in DBP, BCP comes 3.5/5.15Kg/cm²	BC 3.5/5.15Kg/cm ²		
9	**PARKING BRAKE**			
9.1	PB applied, auto & DB release, drain MR below 4.5Kg/ cm², Charge Aux Reservoir thorough Main compressor	Open isolating cock 47F		
9.2	Press BP-PB,PB release in each axle,Lamp Off in Panel A, Check signal config file: 06B BEPRelPBk	PB pressure in PB gauge 6Kg/cm²		
9.3	Press BP-PB, PB applied in each axle, Lamp glow in Panel A, Check signal config file: 06B BEPApply PBk	PB pressure in PB gauge 0 Kg/cm²		
9.4	Manually press parking brake impulse magnet valve release plunger, PB released in each axle, Lamp Off in Panel A, Check pressure switch on PB module, close 5.00±0.1Kg/cm²	PB pressure in PB gauge 6 Kg/cm²		
9.5	Manually press parking brake impulse magnet valve apply plunger, PB applied in each axle, Lamp clow in Panel A, Check pressure switch on PB module, Open 4.00±0.1Kg/cm²	PB pressure in PB gauge 0 Kg/cm²		
9.6	Pull manual release lever of eaach parking brake cylinder provided on wheels 2,6,7 & 11, PB releases	PB releases		
9.7	Reset manually parking brake impulse magnet valve in release condition, wait for 30 sec, again apply PB by parking brake impulse magnet valve apply plunger, PB applied in each axle, Lamp glw in Panel A Check signal config file: 06B BEPApplyPBk			
9.8	Fit test gauge in Aux reservoir, close 47F, remove Hose 104 from Body side	Gauges in D/C 90		
9.9	Release PB, Pr in Aux reservoir test gauge is more than 6.00 Kg/cm² (maintained by MR prevention choke) Ensure parking brake is indicated as applied (Lamp in Panel A glow)	Pressure in Aux reservoir is □6.00Kg/cm²		
9.10	Apply PB, connect bogie hose 104, Open isolating cock 70F			
9.11	Check lock of impulse magnet valve	locking		
9.12	Check pressure in PB gauge with R 10Kg/cm², 6±0.15Kg/cm²	5.85-6.15Kg/cm²		
10	**ANTI SLIP BRAKE**			
10.1	Force signal by Laptop: 06B ASV Bogie-1	0.6Kg/cm² in Freight 0.8Kg/cm² in pass		

10.2	Force signal by Laptop: 06B ASV Bogie-2	0.6Kg/cm² in Freight 0.8Kg/cm² in pass		
11	**FRICTIONAL BRAKE COMPONENT**			
11.1	Check brake block clearance is 5+5=10mm in freight 1.0-1.5mm each side i.e 3mm in Passenger (WAP5)			
12	**Trailing Locomotive Operation (Set Brake Controller Mode Switch in Trail Mode)**			
12.1	Connect ext. supply in BP line, wait 2 min to fill MR, No leakage observed in Brake panel			
12.2	Drop BP tp 4 Kg/cm², BC comes 1.00 Kg/cm² (2.00Kg/cm² WAP5)	BC 1.00/2.00Kg/c m²		
12.3	Drop BP to 0Kg/cm², BC comes 2.5Kg/cm² (5- 5.15Kg/cm² WAP5)	BC 2.50/5.15Kg.c m²		
12.4	Increase BP to 4 Kg/cm², BC comes 2.00Kg/cm² (Less than 4.00Kg/cm² WAP5)	BC 1.00/2.00Kg/c m²		
12.5	Increase BP to 0Kg/cm², BC comes zero	00Kg/cm²		
13	**DEAD ENGINE WORKING**			
13.1	Drain MR & Aux res Air 2Kg/cm², close 74F, 136F, open 47F, switch OFF Pneumatic MCB in SB2 Panel.			
13.2	Connect ext supply in BP line, wait 2 min to fill Aux Res to 5Kg/cm²			
13.3	Drop BP to 4 Kg/cm², BC comes 1.00Kg/cm² (2.00Kg/cm² WAP5)	BC 1.00/2.00Kg/c m²		
13.4	Drop BP to 0Kg/cm², BC comes 2.5Kg/cm² (5- 5.15Kg/cm² WAP5)	BC 2.50/5.15Kg.c m²		
13.5	Increase BP to 4Kg/cm², BC comes to 2.00Kg/cm² (less than 4.00Kg/cm² WAP5)	BC 1.00/2.00Kg/c m²		
13.6	Increase BP to 0Kg/cm², BC comes zero	00 Kg/cm²		
13.7	Re-install loco in correst postion,close 47F			
14	**SANDING EQUIPMENT**			
14.1	Check sand-1 isolating cock in open position, press sander foot switch with reverser in forward direction. Check signal config file: BEPS and -1&3 (To confirm operation of EP valves)	Sand on Rail front		
14.2	Check sand-2 isolating cock in open position, press sander foot switch with reverser in reverse direction. Check signal config file: BEPS and -2&4 (To confirm operation of EP valves)	Sand on Rail rear		
15	**CAB EQUIPMENTS (Cab Gauge Check)**			
15.1	Check Cab gauge with test gauge against the volume shown			
15.2	MR gauge in both Cabs (Permitted error ±0.15Kg/cm²)			
15.3	FP gauge in both Cabs (Permitted error ±0.15Kg/cm²)			
15.4	BP gauge in both Cabs (Permitted error±0.15Kg/cm²)			

15.5	BC gauge in both Cabs (Permitted error ±0.15Kg/cm²), BC1 & BC2			
15.6	PB gauge in both Cabs (Permitted error ±0.15Kg/cm²)			
15.7	Panto gauge at Pn Panel (Permitted error ±0.15Kg/cm²)			
16	**AIR HORN (Warning) & FRONT LOOK OUT GLASS CLEANING**			
16.1	Open horn isolating cock 120/1&2, operate Dr. & Asst Dr. horn valve in front direction	HT Horn sounds		
16.2	Open horn isolating cock 120/1&2, operate Dr. & Asst Dr. horn valve in back direction	LT Horn sounds		
***	**Wiper/ Washer (Wiper make:**			
16.3	Adjust wiper blade vertical in all 4 glasses in both Cabs as per Drg.	Vertical 90°		
16.4	Turn on wiper operating valve, check wiper's stroke/min	35 to 55 min		
16.5	Check Manual operating handle is as per requirement (tightened)	Check tightness		
16.6	Carry on washer test	Water spray		
17	**VIGILANCE SYSTEM TESTING**			
17.1	Check Vigilance control unit by test & monitor unit EU-148 of D&M	VCU-ok/Not ok		
	IN Vigilance unit green LED is On. Active Loco in simulation position in "Driving Mode" from any cab. Check No air leakage from Exhaust valve - 71F	Set up for check loco normal		
17.2	Turn Off Vig Elect supply BP Pr fall through valve 71, turn switch 237.1 to (0-pos) Vigilance isolate. BP now re-charge (Vig by passed)	No supply in 14 Nos Vig in service		
17.3	Turn Off Vig Iso switch 237.1 Chk indication in Cab in Pixy/ Memotel ABB give false speed exceeding 10Kmph Chk indication after 60.6sec in Pixy normal Vig Iso Sw 237.1 to normal see indication in DDS (ABB Memotel) vigilance is in service	See DDS NO message normal		
17.4	Close Iso cock 74F chk indication in Pixy	74 isolated		
17.5	Speed above 10Kmph after 60± sec alarm sound after 6 to 10 sec penalty Bk applied BP falls to 2.5/WAP5-5.15Kg/cm reset possible after 115sec.			
17.6	Speed above 10Kmph after 30sec hold depressed paddle Sw Vig after 60 sec alarm sound after 6 to 10 sec penalty BK applied BP falls 2.5Kg/cm reset possible after 160sec. Return power control OFF, Press BPVR, operate foot Sw Vig ensure Vig reset.			
17.7	Speed above 10Kmph after 20" press/Rel sander Vig reset for 60" further 50" move throttle cont one notch vig reset for 60"			

17.8	Speed above 10Kmph after 20"/Rel sander Vig reset for 60" further 50" move throttle cont one notch but in OFF vig reset for 60/ press BPVG ASSL or ON Panel-1			
17.9	Speed above 10Kmph after wait alarm come press Dr.Vig paddle Vig reset next on alarm press/ Rel BPVG Asst Dr Vig reset next On alarm press/ Rel sander Vig does not reset than penalty Bk applied reset possible after 125 sec.			
17.10	Throttle count is in off speed above 10Kmph after wait alarm come press Dr. Vig Paddle apply Auto Bk above 2.2Kg. After 90 sec Vig no alarm come when BC Pr come less than 1.3Kg speed to 1 Kmph No vig warning.			
17.11	Throttle count is in of speed above 10Kmph after wait alarm come press Dr. Vig Paddle apply Auto Bk above .2Kg. After 90 sec Vig no alarm come when BC Pr come less than 1.3Kg speed to 1 Kmph No vig warning.			
18	**ALARM CHAIN PULLING SYSTEM in Passenger Locomotives**			
18.1	Check Alarm chan pull system works properly in passenger locomotives			
19	**TRACK TEST**			
19.1	(Do not carry out the following tests unless you are sure that the mechanical brakes are fully operational) Set up the loco in cooling mode and try to drive. It should not be possible.			
19.2	Test emergency stop push button and functionally of mechanical brake. This test must be carried out on both cabs. Set up loco in driving mode raise pantograph and close VCB.			
19.3	Brake loco by means of the auto air brake in initial. BCP must increase (Check gauge in panel B).			
19.4	Set reverser 140 in forward position, set throttle 150 and move loco with a low speed (5km/hr). Push emergency stop in operating Cab VCB must open. Pantograph must lower emergency brake should apply & loco must stop.			
19.5	Set up loco in driving mode, raise pantograph and close VCB move loco with low speed (5km/hr). Brake loco by using the direct brake and loco must stop.			
19.6	Move the loco with low speed (max 5km/hr). Brake loco by using the Auto Brake in full service. Loco must brake and stop.			

19.7	Test emergency brake. In this test the following cab controls, which activate the emergency brake must be tested fo their functionality on both cabs. Cock Assistant Driver's Emergency brake. Driver's brake controller emergency position.			
19.8	Test equivalent pneumatic loco brake. Set up loco in driving mode. Move loco with a speed around 20kmph, start a slightly regenerative braking by setting a braking effort demand through throttle 150 more than 10KN. Apply brake by drivers auto brake controller to full service. Brake pipe pressure drops to 3.35 but brake cylinder pressure does not develop (Auto BC Bail Off Function)			
20	**Test Vigilance Equipment**			
20.1	Loco is in stand still- No vigileance warning			
20.1	Loco moves less than 1.5km/hr- No vigilance warning			
20.3	Loco moves more than 2km/hr-After 60 sec vigilance warning another 8 sec vigilance penalty reset possible after 120 sec			
20.4	Loco drives more than 2 km/hr- Movement of TE/BE throttle			
20.5	No vigilance warning if press of sanding paddle switch vigilance drivers foot paddle switch			
20.6	Press of assistant Drivers push button in Panel D			
20.7	BY pass Vigilance system by Rotary switch 237.1 pos-0			
20.8	Loco moves than 10km/hr after 60sec No vigilance warning move vigilance switch in pos-I, loco moves more than 10km/hr- After 60 sec vigilance warning come.			
21	**Vigilance System OK**			
22	**RE-INSTALLING OF LOCOMOTIVE AFTER TEST**			
	Remove all test gauge's plug which fitted for test. Ensure Electrical items of Pn Panel & Terminal are tight and cover's secured. Wire/ seal electronic enclosure of pneumatic panel is closed position. Ensure all isolating cocks and other items of equipment are in normal & safe working position.			

Annexure. 3.06

MUST CHANGE ITEMS

Conventional Electric Locomotives:

(Ref: For AOH as per TC No. 31, for IOH as per TC No. 29 & POH as per TC No. 123)

S.N.	Item and its sub- assemblies	Replacement during first AOH	Replacement during first IOH	Replacement during first POH
1	**Traction Motor**			
i	Gear case- passenger loco - goods loco	All felt rubber items of Gearcase	To be replaced for passenger locos	√
ii	Suspension bearing (plain sleeve) along with lubricating pad assly.	x	Remetalling only	Remetalling/ Replacement
iii	Pinion of Oil pump for suspension bearing	x	√	√
iv	Lubricating pad assembly-TAO 659	√	√	√
v	Traction Motor bellow	x	√	√
vi	Traction Motor pinion	x	x	√
vii	Sandwich mounting assembly for passenger fit locos	√	√	√
	Sandwich mounting assembly for goods locos	x	√	√
viii	Gear in two halves for suspension bearing oil pump	x	x	√
ix	Hitachi TM suspension tube bolt	x	x	√
x	PE end bearing	x	x	√
xi	CE end bearing	x	x	√
xii	Brush holder assembly of TM	x	x	√
xiii	All carbon brushes liners, gaskets, needle roller bearings of TM	x	x	√
xiv	Teflon ring of armature	x	x	√
xv	Insulating rod, 5565/675 & 5565/740	x	x	√
2	**Auxiliary Machines**			
i	Auxiliary motor bearing	x	√	√
ii	Auxiliary Compressor	x	x	
iii	MVMT Impeller with duct	x	x	√
iv	HP & LP valves, crank shaft of compressor	x	HP & LP vales only to be replaced	√
v	MPH	Only Set of gaskets for MPH to be replaced	Only Set of gaskets for MPH to be replaced	√
vi	MVMT & MVRH impeller	x	x	√
vii	Main compressor	x	x	
viii	Axial fan for SIV Motor	x	x	√

ix	DC & AC MVRF	x	x	√
x	MVSI, MVSL& MVRF	x	x	√
xi	All churning fans of SIV	x	x	√
xii	All door and panel rubber gaskets of SIV	x	x	√
xiii	Rubber kits & Oil seals of compressors	√	√	x
xiv	All end shields of auxiliary motors	x	x	To be replaced in 2nd POH
xv	All auxiliary motors	x	x	*Rewinding after 12 years *Replacement of Aux motors after 18 years
xvi	Piston ring for compressor	√	x	x
3	**Pantograph**			
i	Bow assembly with plunger	x	x	√
ii	Other items	To be replaced as per TC-94 for freight locos and as per OEMs manuals for passenger locos		
4	**All Damping panels**			
i	VCB Damping panel	x	x	√
ii	TFP damping panel	x	x	√
iii	Capacitors of RC network	x	x	√
iv	Other Damping panels	x	x	√
5	**Roof**			
i	Twin beam Headlight Reflector with holder, gaskets & bulbs	HL reflector & Cover gasket to be replaced	HL reflector & Cover gasket to be replaced	√
ii	25 KV condenser bushing	x	x	To be replaced with vertical take off CHT assembly
6	**VCB/DJ**			
i	Air dryer sieve	x	x	√
ii	Other items/components	To be replaced as per RDSO's latest version of SMI No. ELRS/SMI/0223 & 236 for kits of single and double bottle VCBs		
iii	DJ	x	x	To be replaced with single bottle VCB
7	**Transformer**			
i	Transformer oil	x	x	√
ii	Tap changer N-32 (including SMGR)	RDSO's TC No.0102 to be followed		
8	**Cab**			
i	BL Box complete with switches	x	x	√
ii	Rubber mat	x	x	√
iii	All relay covers	x	x	√
iv	Bakelite separators of TK panel	x	x	√
v	A9 valve	x	x	√
vi	BL box of driving desk	x	x	√

vii	Cab fans	x	x	√
viii	Cab heaters	x	x	√
ix	Cab window assembly complete	x	x	√
x	All gauges, meters, indication panel & light fittings	x	x	√
xi	Wiper servo motor assembly complete with arms/blades/control valves	x	x	√
xii	Master Controller (Cam switches) & rollers	x	x	√
xiii	DC-DC Converter	x	x	√
xiv	Flasher light unit & Lamp box.	x	x	√
xv	Marker Light	x	x	√
xvi	All Push buttons	x	x	√
xvii	All PC8 Relay Contacts & springs	x	x	√
xviii	RU of all voltmeters	x	x	√
xix	Analog NR	x	x	To be replaced with digital NR
xx	Indication panel	x	x	√
xxi	FDCS	x	x	All PCB Cards to be rehabilitated
xxii	VCD	x	x	Foot switch and push button to be replaced.
xxiii	Driver and Asstt. Driver seat	x	x	√
xxiv	Front look out glass and corridors glasses	x	x	√
9	**Corridor**			
i	Pressure switches and air flow relays-micro switch and diaphragm	x	x	√
ii	All NR valves, NC4, NC7 valves	x	x	√
iii	Body filters	x	√	√
iv	SMGR-PR valve	x	x	√
v	All gauges	x	x	√
vi	Electro-magnetic contactor	x	x	√
vii	Micro switch of relays	x	x	√
viii	Time delay relay timer	x	x	√
ix	Shunt for QF relay & traction ammeter	x	x	√
x	RC network	x	x	√
xi	TM cable cleats	x	x	√
xii	All programme switches including HOM switch, selector switch, SPDP toggle switch & D type fuses	x	x	√
xiii	All gauges and meters	x	x	√
xiv	Auxiliary contactors for EP contactors with power contact tips, all insulators and hardware's including square head bolt.	x	x	√
xv	Rehabilitation of Safety relays by OEM	x	x	

xvi	Tri-plate panel All valves rubber components, all valves base gasket, O ring between plates, NC-4&NC-7 valves and pressure switches	x	x	√
xvii	EPC, C-145,shunting contactors	x	x	√
xvii	Servomotor Piston Bucket, Gasket Piston Bucket & Felt Ring Fixed & Mobile Contacts Complete shunt Assembly Aux Switch with Cam.	Sl.No. a & b to be replaced	Sl.No. a & b to be replaced	√
xviii	**CTF/ Reverser** a. Fork & all Dowel Pins b. Servomotor Piston Bucket, Gasket Piston Bucket & Felt Ring c. Finger & Drum Contacts with brass ball. d. Aux Switches e. Notching Lever Complete	Sl.No. b to be replaced	Sl.No. b to be replaced	√
xix	HOM AIR Valve	x	x	√
xx	RSI Block PTFE Cable	x	x	√
xxi	Hinges of all doors	x	x	√
10	**Under frame**			
i	Battery lead acid with battery box	x	√	√
ii	Replacement of Vertical/horizontal dampers	x	x	√
iii	Side buffer assembly along with fixing bolts.	x	x	√
iv	Complete CBC assembly	x	x	√
v	EMU type inter and after cooler	x	x	√
vi	Set of cover for SL	x	x	√
vii	Cattle guard with rail guard	x	x	√
viii	Air Dryer	x	x	Overhauling Kit to be replaced in POH as per instructions of RDSO
11	**Bogie**			
i	Springs	x	x	√
ii	Spring seat & equalizer of trimount bogie	x	x	√
iii	Replacement of equalizer & compensating beam, pin, bushes, modified centre block, side bearer, D-shackle (high adhesion bogie), tie rod for equalizer, snubbers, split cotters	All Cotter pins and Split pins to be replaced.	All Cotter pins and Split pins to be replaced.	√
iv	Complete brake rigging along with pins, bushes & fasteners	x	x	√

v	All spring seats, wearing plate, all synthetic liners/pads, oil seal felts, pins, bushes, high tensile fasteners, safety clamps of bogie & axle box etc.	x	x	√
vi	Foot step assembly	x	x	√
vii	Maintenance kits of brake cylinder	x	x	√
viii	Sander pipe arrangement including rubber hose for sanders	x	x	√
ix	WAP-4 bogies items: outer & inner straps, Conical thrust pad, Hanger pin, bush, Brake head spring, brake hanger, happy pad	x	x	√
x	Wheel items: Axle box bearing, MSU & its bearings, (DE& NDE side)MSU bolts, Axle box complete	x	x	√
xi	Snubbers & Shock Absorber	x	√	√
xii	Horizontal and vertical polymide bush in center pivot of WAP1/WAP4 locos	√	√	√
xiii	O' ring and rubber pad/ bushes in axle box	x	√	√
xiv	All liners including Horn-check liners	x	√	√
xv	Brake cylinder bucket	√	√	√
xvi	Replacement os side bearers (High adhesion bogie)	x	√	√
xvii	All pins & bushes (Except Mn - pin/ bush) of Bogie / Brake rigging	x	√	√
xvii	Knuckle for HT Transition CB coupler	x	√	√
xviii	Clevis for HT Transition CB coupler	x	√	√
xix	Knuckle pivot pin with washer for HT Transition CB coupler	x	√	√
12	**General**			
i	All perishable items like rubber gaskets, rubber grommets, felts, rubber pipes, hoses rubberized cork sheets, oil seals etc.	x	x	√
ii	Brake block, carbon brushes, silica gel, grease nipple, metalized carbon strip for pantograph etc.	x	x	√
iii	All oil and greases	x	x	√
iv	Replacement of filters, pipelines, ceramic filters in DJ & SMGR	x	x	√
v	MU coupler jumper pins	x	x	√
vi	All type of washers, spring washers etc.	x	x	√
vii	Various ball type isolating cocks, check valve, pressure cut out switch etc.	x	x	√
viii	All O rings, bushes, gasket & Diaphragm	√	√	

ix	Diaphragm for horns with horn valve	x	x	√
x	All flexible shunts	x	x	√
xi	Auxiliary Switches (SMGR, MP, CTF, J, C-118	x	x	√
xii	A9 & SA9 pipe line	x	x	To be replaced with stainless steel pipe line
13	**Electrical items**			
i	DBR grids	x	x	√
ii	Shunts SHA/SHF	x	x	√
iii	C-118 with R-118	x	x	To be replaced on condition basis
iv	All capacitors other than in damping panels	x	x	To be replaced (including Oil type to be replaced with dry type)
14	**Loco Body**			
i	PU painting of locomotive	x	x	To be incorporated as per standard procedure already advised vide Report No. ELRS/ IR/0115 (Rev'0') of Sept'06.

3. PHASE ELECTRIC LOCOMOTIVES

(Ref RDSO Letter No. EL/3.1.35/16 dt: 07.02.2012)

MUST CHANGE ITEMS OF WAP5, WAP7, WAG9 AND WAG9H LOCOMOTIVES.				
SN	**DESCRIPTION**	**MOH/ TOH**	**IOH**	**POH**
A	**LOCO BODY**			
1	**PU painting of locomotive.**	X	√	√
2	**Roof Hatch Gaskets:**			
	The pantograph and converter roof hatch gaskets.	X	√	√
3	**Roof hatch rubber seals:**			
	The rubber seals around the pantograph and converter roof hatches and the roof beam.	X	√	√
4	**Body Structure**			
	Fibre body above buffer and CBC coupler (WAP5 only).	X	X	√
	Decals (stickers).	X	√	√
5	**Exterior**			
	Seals involved in fitment of side body and roof filters.	X	X	√
6	**Draft gear & couplers:**			
	Complete CBC assembly including Draft gear.	X	X	√
	Transition coupling.	X	X	√
	Knuckle, clevis, clevis pin and yoke pin.	X	√	√
	Striker block wear plate.	X	√	√
7	**Buffers:**			
	Buffers along with fasteners.	X	X	√
	All rubber rings.	X	√	√
8	**Cattle guard:**			
	Cattle guard along with its hardware.	X	X	√
9	**Doors and steps**			
	Door seals.	X	√	√
10	**Washer and Wipers:**			
	Wiper motor driver shaft seal, wiper arm, pneumatic end water hoses, wiper blade and idler shaft assembly.	X	√	√
11	**Wind screen and windows:**			
	Front lookout glass and side glass.	X	X	√
	Seals of cab windows, sliding window, splashed shield, windscreen shield and rubber flap on the cab side window drainage channel outlet.	X	X	√
B1	**Underframe:**			
1	**Sanding equipments:**			
	Sand in all sand boxes.	√	√	√
	Sander hosepipe and seal in the sand box lids.	√	√	√
2	**Battery Box:**			
	All fasteners of battery boxes.	X	X	√
	Battery box ventilation hose.	X	X	√
B2	**Bogie and Running Gear:**			

1	**Secondary Suspension**			
	All Secondary Suspension springs.	X	X	√
	Dampers.	X	X	√
	The lateral bump stops.	X	X	√
	Insulating bases of secondary suspension (WAP5 only).	X	X	√
2	**Primary Suspension**			
	All Primary Suspension springs.	X	X	√
	Dampers.	X	X	√
3	**Traction link**			
	Traction link assembly with housing.	X	X	√
	Safety sling, pins and R- clips.	X	√	√
	Aclathan / Vulkollan Rings and tab washers. Fitment Procedure as per SMI 316 dt. 09.10.17	Alternate MOH	√	√
	All fasteners of Aclathan / volkollan ring retaining plate.	X	√	√
	All Nylock Nuts opened for lifting of locos at: Secondary Dampers (Yaw, Vertical, horizontal) Primary Dampers top side. Traction link Gear Case Support arm.	√	√	√
4	**Bogie Frame and brake Gear:**			
	All pins, bushes and pads of brake rigging.	√	√	√
	All rubber components, hoses and fasteners on the bogie.	X	√	√
	The hoses between – a) the bogie frame connection and the brake cylinders and b) the locomotive under frame and bogie.	X	√	√
	Overhauling kit of brake caliper.	X	X	√
	Replacement of Brake hanger of WAP7/WAG9	X	√	√
	Replacement of safety sling of brake hanger of WAP7/WAG9	√	√	√
5	**Wheel set:**			
	Taper Roller bearing unit (CRU 150/SKF, BC2-0067A) for WAP7, WAG9 & WAG9H.	X	X	√
	Taper Roller bearing Unit (SKF 1639457A) for WAP5.	X	√	√
	Fasteners of brake discs.	X	X	√
6	**Axle box (except bearing):**			
	Axle box “O ring and cover bolts.	√	√	√
7	**Gear case/ Transmission**			
	Gear case oil.	√	√	√
	Gear case bearing along with associate components (for WAP5 only).	X	X	√
	Gearbox oil seal / “O rings.	X	√	√
	All gear case fasteners and TM fixing bolts.	X	X	√
	Drain plug washer and oil filling plug washer.	√	√	√
	Gauge glass oil seal.	√	√	√
	TM support arm, Gear case support arm (for WAP5 only) & Axle guide rod.	X	X	√
8	**Crown Gear Coupling (WAP5)**			

	The membrane and the oil of Crown Gear coupling.	√	√	√
9	**Spheriblock (RDSO Lr. No. EL/3.1.35/16 dt: 12.02.2020)**			
	The Spheriblocks of the axle guide rod, gear case support arm, TM & TM support arm (WAP5).	X	√	√
	The Spheriblocks of the axle guide rod and TM support arm (WAP7).	X	√	√
	The Spheriblocks of the axle guide rod and TM support arm (WAG9/WAG9H).	Alternate major overhaul (At the interval of 4 years)		√
	Spheriblocks of all types of dampers	X	√	√
C	**Power supply System**			
1	**Pantograph**			
1.1	**Pantograph type AM12, IR01 & PAN01 for freight locomotives**			
	As per TC No. RDSO/2007/EL/TC/0094 (Rev"0")	√	√	√
1.2	**Pantograph for M/E locomotives**			
	As per OEM's maintenance manual	√	√	√
2	**Primary voltage Transformer:**			
	The rubber cable conduit between transducer & terminal box and the roof cable duct.	X	√	√
3	**High voltage bushing insulator:**			
	The seal on the high voltage bushing.	X	√	√
4	**Main circuit breaker (VCB):**			
	All items specified in RDSO's Special maintenance instruction no. ELRS/SMI/0236	√	√	√
5	**Harmonic Filter Resistor:**			
	The cable glands & seal of the filter resistor junction box on the converter roof hatch.	X	√	√
	Replacement of the seal of the filter resistor.	X	√	√
6	**Main transformer:**			
	The silica gel in breather assembly.	√	√	√
	All sealing gaskets including tank cover gasket of TFP.	X	X	√
	All rubberised cork sheets.	X	√	√
	All TFP bushings rubber seals.	X	√	√
	All transformer foundation bolts & bushing lock nuts	X	X	√
	Transformer Oil.	X	X	√
D.	**Propulsion System**			
1	**Traction Converter:**			

	The rubber parts of servo motor of pre-charging & main contactor.	*	√	√
	The rubber parts of main cylinder of pre-charging & main contactor.	X	√	√
	The air cooling hoses, seals on the traction converter doors (WAG9/WAG9H).	2nd MOH	√	√
	The air cooling hoses, seals on the traction converter doors (WAP5/WAP7).	X	√	√
	Silica gel in breather assembly.	√	√	√
	Converter Oil.	X	X	√
	Contact tips of Electro-pneumatic and Electro- magnetic contactors.	X	X	√
2	**Traction Motor:**			
	Traction motor bearing (DE + NDE) along with Outer/inner labyrinth pins and accessories.	X	√	√
	Suspension tube bearing.	X	X	√
	Bull gear (WAG9/WAG9H/WAP7)	X	X	√
	TM pinion (WAG9/WAG9H)	2nd MOH	√	√
	TM pinion (WAP7).	X	√	√
	End plate “O”Rings & the gaskets on the terminal box of TM.	X	√	√
	TM bellows.	X	√	√
	Gasket of temperature sensor cover.	√	√	√
	The helical inserts of Junction box of TM.	X	X	√
3	**VCU bus station and Electronics of Power Converter & Auxiliary Converter:**			
	Back up batteries in VCU bus station diagnostic & communication computers, DIA, DDA1 & 2.	X	√	√
	The seals in the UIC socket.	X	X	√
	All Fibre-optic cable of Power Converter, including spares.	X	X	√
	Rehabilitation of cards as per RDSO guidelines No. EL/G/2008/01 Rev.1 with latest amendment.	X	IOH or six years which e ver is later	POH or 12 years which ev er is later
	Instrument cooling fans.	X	√	√
E.	**Auxiliary System Ensure replacement of all must change items during MOH, IOH POH as per guidelines.(Ref. EL/3.1.35/16 dated 30/03/2007).**			
1	**Auxiliary converter:**			
	Gasket of DC link capacitor bank.	X	√	√
	Gasket of WRE, GG and battery charger modules.	X	X	√
	Bearing of internal cooling fan.	X	√	√
	Seals on the Aux. Converter cabinets & equipment modules.	X	√	√
	Contact tips of EMC.	X	X	√
	Contact tips of contactors in the BUR 1, 2 & 3.	X	√	√
2	**Battery Set**	X	X	√

3	**Lights**			
	The head light gasket, head light seals (between headlight retaining ring & head light housing), Marker Light rubber gasket and its "O" rings and the flasher light gasket (between flasher & loco roof).	X	√	√
	Head light lamp.	√	√	√
4	**Oil Cooling Piping:**			
	The "O" rings in the main transformer & main converter oil cooling piping joints.	X	√	√
5	**Oil Cooling Pumps:**			
	The bearings & "O" rings.	2nd MOH	√	√
6	**Oil Cooler Blower / Motor:**			
	The bearings of oil cooler blower motor and associate component.	2nd MOH	√	√
	Impeller of oil cooler blower.	X	X	√
7	**Oil Cooler Blower Seals:**			
	The seals between the oil cooler blower & the filter duct, between the oil cooler blower filter & the pantograph roof hatch on the oil cooler blower unit, between the oil cooler blower & machine room floor, on the oil cooler blower filter & ducting and on the oil cooler blower inspection door (WAP5/WAP7).	X	√	√
	The seals between the oil cooler blower & the filter duct, between the oil cooler blower filter & the pantograph roof hatch on the oil cooler blower unit, between the oil cooler blower & machine room floor, on the oil cooler blower filter & ducting and on the oil blower inspection door (WAG9/ WAG9H).	2nd MOH	√	√
8	**Machine Room Blower Motor:**			
	The drive & non drive end bearings along with associated components.	2nd MOH	√	√
9	**Machine Room Blower Seals:**			
	The seals of machine room blower filter plenum & duct, inspection door, blower filter & ducting and between the machine room blower and machine room floor, between the machine room blower filter and filter duct and the machine room blower filter duct seal and wear plate (WAP5/WAP7)	X	√	√
	The seals of machine room blower filter plenum & duct, inspection door, blower filter & ducting and between the machine room blower and machine room floor, between the machine room blower filter and filter duct and the machine room blower filter duct seal and wear plate (WAG9/ WAG9H).	2nd MOH	√	√
10	**Traction Motor Blower Seals:**			

	The traction motor blower filter, plenum, wear plate and duct seals (WAP5/WAP7).	X	√	√
	The traction motor blower filter, plenum, wear plate and duct seals (WAG9/ WAG9H).	2nd MOH	√	√
	The seals on the TM blower filter & ducting (WAP5/WAP7)	X	√	√
	The seals on the TM blower filter & ducting (WAG9/ WAG9H).	2nd MOH	√	√
	The seals between the TM blower & machine room floor and between the plenum box and body side panel (WAP5/WAP7).	X	√	√
	The seals between the TM blower & machine room floor and between the plenum box and body side panel (WAG9/ WAG9H).	2nd MOH	√	√
	The seals on the TM blower inspection cover (WAP5/WAP7)	X	√	√
	The seals on the TM blower inspection cover (WAG9/ WAG9H).	2nd MOH	√	√
11	**Traction Motor Blower Motor:**			
	The drive & non drive end bearings along with associated components.	√	√	√
12	**TM & Oil cooler Blower Scavenger:**			
	The hoses at the oil cooler blower filter scavenger boxes (WAP5/WAP7).	X	√	√
	The hoses at the oil cooler blower filter scavenger boxes (WAG9/ WAG9H).	2nd MOH	√	√
	The equaliser hoses between the TM & oil cooler blower scavenger & the filter (WAP5/WAP7).	X	√	√
	The equaliser hoses between the TM & oil cooler blower scavenger & the filter (WAG9/ WAG9H).	2nd MOH	√	√
	The seal at the oil cooler blower scavenger duct slip joint (WAP5/WAP7).	X	√	√
	The seal at the oil cooler blower scavenger duct slip joint (WAG9/ WAG9H).	2nd MOH	√	√
	The seals and gaskets on the TM and oil cooler blower scavenger ducting (WAP5/WAP7).	X	√	√
	The seals and gaskets on the TM and oil cooler blower scavenger ducting (WAG9/ WAG9H).	2nd MOH	√	√
	Rubber hoses.	X	√	√
13	**TM & Oil cooler Blower Scavenger Motor:**			
	The driving & non-driving end bearings along with associated components.	√	√	√
14	**Machine Room Blower Scavenger Motor:**			
	The driving & non-driving end bearings along with associated components.	√	√	√
15	**Machine Room Blower Scavenger:**			

	The flexible duct between the machine room blower scavenger motor and filter.	2nd MOH	√	√
	Rubber hoses.	X	√	√
	The equaliser hoses between the machine room blower scavenger motor and the filter (WAP5/WAP7).	X	√	√
	The equaliser hoses between the machine room blower scavenger motor and the filter (WAG9/ WAG9H).	2nd MOH	√	√
	The seals and gaskets on the machine room blower scavenger ducting (WAP5/WAP7).	X	√	√
	The seals and gaskets on the machine room blower scavenger ducting (WAG9/ WAG9H).	2nd MOH	√	√
16	**Main Compressor Motor:**			
	The main compressor drive motor bearings along with associated components.	√	√	√
17	**Cab heater/Blower motor and crew fan motor:**			
	Bearing of cab heater Blower motor and crew fan motor.	X	√	√
18	**Cubicles:**			
	The rubber parts of servo motor of EP Contactors in cubicles.	*	√	√
	The rubber parts of main cylinder of EP Contactors in cubicles.	X	√	√
	Contact tips of EP contactors.	X	X	√
	Filter of fire detection unit.	√	√	√
F	**Air Supply and Pneumatic System:**			
1	**Main Compressor:**			
	The main element & the safety element of the air intake filter & other parts as prescribed in manual.	X	√	√
	Suction air filter element.	√	√	√
	Compressor oil.	√	√	√
	Secondary oil filter.	√	√	√
	Gaskets of concentric valves.	√	√	√
	The main compressor resilient mountings & mounting pads.	X	√	√
	CP delivery pipe.	√	√	√
	HP & LP cylinder, HP & LP concentric valves all make.	X	√	√
	Concentric valve kit.	X	√	X
	The delivery hose from the main compressor.	√	√	√
	Inter cooler after cooler assembly	X	X	√
	Copper Interconnecting pipes between intercooler and after cooler (WAP5/WAP7).	X	√	√
	Copper Interconnecting pipes between intercooler and after cooler (WAG9/WAG9H).	2nd MOH	√	√
	Overhaul kit of Inter cooler after cooler assembly.	X	X	√
	Overhaul kit of Main Compressor (Elgi / Knorr Bremse).	√	√	√
	Overhaul kit of Main Compressor (D&M / SWIL) (WAP5/ WAP7)	X	√	√
	Overhaul kit of Main Compressor (D&M / SWIL) (WAG9/ WAG9H).	2nd MOH	√	√
2	**Auxiliary Compressor:**			

	The delivery hose between the auxiliary compressor and brake frame.	√	√	√
	Compressor oil.	√	√	√
3	**Pneumatic Valves, Cocks and Filters:**			
	All rubber components (WAP5/WAP7).	X	√	√
	All rubber components (WAG9/ WAG9H).	3 rd MOH	X	√
4	**Horn:**			
	Horn gasket and other rubber parts of Horn.	√	√	√
5	**Brake Pneumatics:**			
	Overhauling kit of Complete E-70 / CCB brake system.	As per OEM's		
	Overhauling kit of driver brake controller and instructions automatic brake controller.			
	TBU and PBU kit (WAP7).	X	√	√
	TBU and PBU kit (WAG9/ WAG9H).	2nd MOH	√	√
	Brake activating mechanism (main cylinder & parking brake cylinder)	X	√	√
6	**Air dryer**			
	Overhauling kit of air dryer.	√	√	√
G	**Interior**			
1	**Cab Door and Machine Room Door:**			
	The door seals, door window seals.	X	√	√
2	**Drivers Seat:**			
	The seat cover and cushion of driver seat.	√	√	X
	Driver seat.	X	X	√
3	**Cab Interior**			
	Antiskid flooring in cab.	√	√	√
4	**Cab. Equipment:**			
	Vigilance, Sanders, PVEF pedal switches.	X	√	√
	BPFA, BLPR, ZPRD, BLDJ, ZPT, BPVR, BPVG.	X	√	√
	Cab activation switch.	X	√	√
	Cab heater flexible duct.	2nd MOH	√	√

Annexure. 3.03 A

FIRE PREVENTION ON ELECTRIC LOCOMOTIVES

RAILWAY BOARD LR.NO.2008/ELECT(TRS)/113/5 PT. DATED 08.12.2016

Sl. No.	Equipment & Item to be checked	Periodicity
	Extracts of RDSO's letter no. EL/022 dated 08.09.06 (Report no. ELRS/PR/0113 (Rev-'O')	
1.0	**Transformer:**	
	DGA of transformer oil should be carried out as per RDSO SMI No. 138.	IC schedule
	Break down value of the transformer oil should be checked as per IS:6792/1992.	IC schedule
	The centrifuging of transformer oil should be done during every AOH besides during changing of transformer.	AOH/IOH+ Chg of TFP
	The cold centrifuging for minimum 4 hours must be done before switching on the heaters of the centrifuging plant.	Before oil filling
	Oil fill up through filtration plant only.	During oil filling
	Thorough checking of transformer in case of loco tripping through QLM only.	During investigation
	Maintain the oil level in winter and summer season as stipulated.	All schedules & seasons
	Checking of transformer safety valve should be done whenever transformer is taken out for maintenance.	During O/H & repairs.
2.0	**PHGR:**	
	The working of PHGR should be ensured during every inspection, trip inspection or testing of locomotive.	All Schedules
	If the locomotive is to be attended after PHGR has stopped working for some time or PHGR is not found working, in this case the oil accumulated in the pipe line of PHGR should be flushed and cleaned with new oil.	Special Repairs
3.0	**GR:**	
	Materials are procured from RDSO approved sources only.	
	Replacement of material should strictly be in terms of AOH/IOH kits by sheds.	AOH/IOH Schedules
	GR should be opened for thorough checking, flushing with oil after every 6 months.	IC Schedule
	Oil discharge duct on tap changer should be removed and canopy arrangement should be adopted and ensured as per RDSO's odification sheet no.	
	WAM4/187.	
	Checking of GR safety valves should be done whenever GR cover is opened for maintenance.	IC Schedule
	The filling up and topping up of the oil in GR should invariable be done from directly centrifuging plant (not manually by carrying in container).	Every oil filling
	DGA of GR oil should be carried out as per RDSO SMI No. 138.	IC Schedule
	Break down value of the GR oil should be checked as per IS:6792/1992.	IC Schedule
	The centrifuging of GR oil should be done during every AOH besides during changing of GR.	AOH + Chg. of GR

	The cold centrifuging for minimum 4 hours must be done before switching on the heaters of the centrifuging plant.	Before oil filling
	Thorough checking of GR in case of loco tripping through QLM only.	During Investigation
	Oil fill up through filtration plant only.	During oil filling
	Maintain the oil level in winter and summer season as stipulated.	All schedules & seasons
4.0	**CGR/RGR:**	
	Gap between CGR contacts should be maintained as specified and CGR contact tips should always be replaced whenever, it is necessary. This is essential to minimize the arching in CGR.	Minor & Major Schedules
	The condition of CGR arc chutes should be thoroughly checked during AOH/IOH and should be replaced, if required.	AOH/IOH
5.0	**Cables:**	
	Use of neoprene base rubber insulated sheets should be extensively used for protection of cables against mechanical damage at bends or at the critical locations where there are chances of cables coming into contact with sharp edges of locomotive metallic part.	AOH/IOH & special repairs
	All the cable cleats should be of SRBGF (IS: 10192 UP1 grade) and procured from CLW approved sources only.	AOH/IOH
	All the cable lugs and ferrules must be of the sizes, which is suitable for a particular size of cable only.	AOH/IOH
	PVC cable bunching ties should be used as wrapping straps for securing the control and auxiliary cables.	AOH/IOH
	During the major schedules i.e. AOH/IOH/POH, all the holes through which the cables passes, should be checked for sharp edges, burrs and availability of proper size of grommets should be ensured in proper condition.	AOH/IOH
	The ferrule of traction motor connection cables should be checked during every disconnection of traction motor in locomotive i.e. during every lifting. The replacement of ferrules should be strictly as per the size of cables.	AOH/IOH & during lifting
	The traction motor cable ferrules size is also to match with the size of cable connectors (PG clamps) so as to avoid any looseness of the connection in junction box or flash over. Also, to avoid cables coming out of the clamp.	AOH/IOH & during lifting
	Always use proper crimping tools and ensure their calibration for proper crimping force annually.	Annually
	Proper use of heat shrinkable sleeve and fire retardant tapes at edges of the cable where conductor is exposed.	AOH/IOH & special repair
6.0	**Smoothing Reactor:**	
	Repair and maintenance of the smoothing reactors should be carried out as per RDSO Modification Sheet No. WAG5/15. Gaps between core and inner coil and gap between outer coil and inner coil should be maintained as per RDSO's SMI no. 0240 dated 06.10.06, besides the other routine maintenance practices.	AOH/IOH
	Use of the materials specially SRBGF wedges, sheets, stainless steel cross channels and pressing bolts should be used. This is as per TC No. 42 issued by ROSO.	IOH

	SL cover should be opened and blowing of SL should be done for removal of dust and dirt.	IC Schedule AOH
	During IOH/POH of locomotive SL should be taken out for cleaning, baking and varnishing and check the condition of insulation specially at the corners.	IOH
	All the SL30 should be checked for gaps between inner coil and core and outer coil and inner coil as per Modification Sheet No. WAG5/15. If gaps are not within the permissible limit specially between core and inner coil, the SL should be taken out for repairs. This is very much essential for proper cooling of SL.	AOH/IOH
7.0	**Relays & Circuits:**	
	QLM	
	All the QLM relays having mechanical locking arrangement should only be used.	All Schedules
	QLM relays should be taken out for testing and setting on test bench. During setting, following cares should be taken Relay should be set only after 20 to 25 pickup and drop out operation. After setting, the dial should be checked which may show the different current setting from the actual. The same should be written on the relay.	AOH/IOH
	The sealing of QLM relay has to be ensured during every inspection trip checking of locomotive. The breakage of seal is to be reported by the drivers.	All Schedules
	Thorough investigation of locomotive should be done for the cases having QLM dropped without any apparent reason. No locomotive should be allowed without proper trouble shooting and fact finding.	During Investigation
	Besides the QLM's appropriate setting, the operation of other protective relays should be ensured. RDSO SMI No. 0238 dated 20.03.2006 should be followed.	AOH/IOH
	The CT ratio of TFILM should be checked on proper test bench during IOH of locomotive. However, sheds are advised to have a drive for one round of this checking and keep the record of the same immediately. CT's with more than 5% of the ratio error should be discarded.	IOH + One cyclic check
	The condition of air flow relays must be ensured during every inspection including the trip inspection. No locomotive should be allowed in service with air flow relay isolated except for a very short run and with a continuous watch by the crew on the associated machine.	Trip + All Schedules
	Use of flap type air flow relays should be discontinued as per RDSO instructions and approved sources for air flow relays should be used.	All Schedules
	Transformer earthing connection (A0) with the locomotive body must be ensured whenever transformer is lifted and fitted back. Even sheds may ensure this connection during every inspection of locomotive visually.	All Schedules
	Q44 and Q118 relays should be checked for their timings in test bench during every inspection of locomotive. With the adoption of relays with electronic timer, complete replacement of timer unit should be done in lieu of going into the patch repairing work. The timer should be replaced by 100% during POH of locomotive irrespective of its condition.	All Schedules (Checking)
	Use proper gauges, tools for measurement and adjustment of contact gaps, contact pressure & dial setting and Relay room should be dust free.	

8.0	**Operational system:**	
	During multiple unit (MU) operation LSOL circuit should be maintained in proper functional order. In all the locomotives it should be commissioned.	All Schedules
9.0	**BA/TK panel(EPM contactors, CTF & Reversers):**	
	The traction motor line contactors tips should be replaced during AOH/ IOH/POH of the locomotive by sheds and workshops.	AOH/IOH
	The condition of reverser drum, fixed and mobile contacts pressure and matching of contacts must be ensured during every inspection of locomotive. All low capacity reversers to be upgraded to 1500 Amp.	All Schedules
	Proper fixation of healthy arc chutes should be ensured.	All Schedules
	Contactors should be checked for flash over.	All Schedules
	Use-proper size of shunts in good condition.	All Schedules
	Maintain proper contacts with respect to its condition contact pressure and good conditions.	All Schedules
10.0	**General (Locomotive body)**	
	Locomotive body:	
	Cleaning of side body filter with pressurized water jet and air blowing must be done.	All Schedules
	All the drain pipes meant for draining out of excess compressor oil, transformer oil should be maintained in proper condition and checked during every inspection of locomotives.	All Schedules
	Water leakage:	
	All roof gaskets must be changed during IOH of the locomotives.	IOH Schedule
	Condition must be checked during AOH of the locomotive also and same should be replaced, if found necessary.	Condition based
	The rubber gasket for central hood should be checked thoroughly with respect to its condition as well as proper placement during removal of central hood along with DJ/VCB.	Condition based
	All apertures and opening from doors, sky light glasses should be blocked by proper fitment of rubber gasket and sealing compound by the sheds and workshops.	All Schedules
	Proper securing of footplates in corridors and HT compartment area must be ensured with all fasteners intact, lest there would be physical damage to control or other cables coming into contact with the loose metallic footplates.	All Schedules
11.0	**Rectifier:**	
	The condition of capacitors, especially at the terminals should be closely checked during every inspection of locomotive against any symptom of loose connection or terminal is loose. The capacitors should be replaced immediately, if it develops sign of bulging, flashing etc	IC/AOH/IOH
	Proper indicating fuses of rectifiers should be used. In no case shorting by wires in lieu of fuse should be allowed.	IC/AOH/IOH
	The failed device of the rectifiers must be immediately changed.	
12.0	**Auxiliary motors:**	
	The rotation of MPH, MVSL, MVRH & MVSI should be carefully checked and ensured whenever the auxiliary machines are changed or disconnected.	All Schedules
	Even a slight oil leakage from MPH should not be permitted for long in service.	All Schedules

	Extra care should be given for cleaning of MPH area during all the inspection of locomotive and whenever, MPH is changed.	All Schedules
13.0	**Compressors:**	
	The replacement of spares during overhauling or otherwise should be in the form of kit, especially for HP & LP valves to avoid throwing of excess oil and leakage.	AOH/IOH
	Use of oil and heat resistant hoses for compressor delivery pipes should be used as per RDSO's Modification Sheet no. WAM4/137 and 130A.	All Schedules
	The filling up/topping up of the oil should be done with the help of proper funnel by the shed and outstation staff too.	All Schedules
14.0	**Traction Motors:**	
	V-cone cleaning of the armature should be done strictly in every IC schedule.	IC Schedule
	The condition of arching studs/horns should be closely monitored for their gaps and proper shape.	All Schedules
	The replacement of arching studs to be done during overhauling, if there is a sign of flashing or deterioration in its shape.	Overhauling
	As per practice in vogue, the use of anti-tracking varnish, cleaning of BHRR, proper spring tension of carbon brushes, proper use of carbon brushes etc should not only be continued but needs close monitoring and keep proper records.	All Schedules
	During overhauling of traction motor, ovality checking during commutator turning, proper mica under cutting and proper champheuring of commutator should be done.	Overhauling
15.0	**Under-frame and other equipment's:**	
	The under frame brake rigging items should be kept in cleaned condition, specially, in the vicinity of brake	All Schedules
	blocks and wheels. There should not be accumulation of polythene items, paper and animal dung to avoid smoke emission due to likely sparks from brake blocks or otherwise.	
	Traction motor body, junction boxes also should be kept in cleaned condition in every inspection.	All Schedules
	The removal of muck and foreign materials from the cable carrying ducts, junction box in the under frame of loco motive should be ensured during AOH, IOH and during Lifting of loco motive.	AOH/IOH & lifting of loco
	Cleaning of panto foot insulators, roof line insulators, insulators of DJ/VCB, lightening arrestor, bushing portion on the roof of the locomotive should be kept in cleaned condition during every inspection of locomotive. The accumulation or presence of any form of foreign material should be immediately attended.	All Schedules
	Extracts of RDSO's letter no. EL/0.2.2 dated 27.07.10	
16.0	**Condenser Bushing:**	
	These condenser bushings should be replaced with vertical take-off type Cable Head Termination Assembly as per RDSO specification No. ELRS/SPEC/BL/0003(Rev1).	One time activity
	Tan delta measurement of A-33 bushing of transformer can also be measured as and when the transformer core is lifted for repair/POH.	During TFP repair
17.0	**Transformer & GR:**	

	Transformer gaskets should be replaced during IOH & POH schedules. However, if transformer is opened for attending any break down maintenance/failure, the gaskets should also be replaced as the used gaskets get compressed/damaged at the locations of excessive pressure which may cause oil leakage.	IOH & During any repairs
	When the breather is first installed, the crystals have a blue tint and after a period of operation, the colour of the tinted crystals gradually changes to pink. This is an indication that the silica gel is becoming saturated and losing its absorbent properties. When there is a preponderance of pink crystals, the gel should be changed or reactivated.	All Schedules
	Check the condition of wire mesh provided on bottom of breather of transformer and cleaning of same should normally be done in every IC. However, the condition of wire mesh choking should also be inspected in IA & IB schedules and based on its condition, its cleaning should be undertaken. Ensure use of brass wire mesh only. Replace this wire mesh in every AOH, IOH and POH schedules.	All Schedules
	Working of PHGR should be ensured in every inspection of locomotive.	All Schedules
18.0	**Cables:**	
	Ensure use of 10 sq. mm cables from HBA to HOBA cables in place of 3 sq. mm cables.	
19.0	**Smoothing Reactor:**	
	SL cover should be opened during every IC and blowing of SL should be done for removal of dust and dirt.	IC/AOH/IOH
	All the cable connections of SL should be thoroughly checked and proper tightening ensured during IC inspection and during AOH of locomotive by sheds.	IC/AOH/IOH
20.0	**RELAYS**	
	Continuity of QLM circuits from TFILM to QLM should be checked during every IA, IB, IC inspection or whenever center hood of locomotive is removed for maintenance purposes.	IC/AOH/IOH
	Ensure that rating of CCPT fuse has been reduced to 10 amps from 16 amps. (CCPT fuse rating standardized as 16 amps for MPCS and relay based conventional 25KV AC tap Changer locomotive vide RDSO technical circular no. RDSO/2010/EL/TC/0118, Rev'0' dt. 22.10.12)	IC/AOH/IOH
	Ensure implementation of Modification Sheet No RDSO / 2OO9/ EUMS/O383(Rev'0')- Oct, 2009 on provision of LED indication near Q-50 relay for indicating status of C- 145 contactor.	AOH/IOH

Annexure. 3.03 B

Extracts of RDSO's letter no. EL/3.1.35/2(Elect.) dated 29.01.13

1.0 Fire Preventive Measures in 3-Phase Locomotives

Mechanical inter locking arrangement to be provided for primary over current relay (Modification sheet No. 420, dt.23/01/2013).	One Cycle all Schedules
The working of Primary Over Current Relay should be checked in every minor &major schedule.	All Schedules
Calibration of Primary Over Current Relay should be done in every major schedule.	MOH/TOH/IOH
Primary Over Current Relay in 3-phase electric locomotives is just like QLM relay in conventional electric locomotives and its operation should attract attention in the same manner as for QLM relay.	All Schedules
Check the signs of oil leakages from pipe lines, conservator and bushings of transformer as well as traction converter in every minor schedule and the same attended. Check the signs of any oil spillage/ accumulation at the top of transformer plate during every schedule by opening the front inspection covers of the converter and clean / attend the same.	All Schedules
DC link capacitors & Resonant circuit capacitors of power converter should be visually examined for any signs of oil leakage/abnormality in all minor/ major schedules.	All Schedules
The capacitance values of DC link capacitors & Resonant circuit capacitor of power converter should be measured in every major schedule.	MOH/TOH/IOH
Filter Cubicle capacitors should be visually examined for any signs of oil leakages in every Minor/Major schedule.	All Schedules
The capacitance values of Filter Cubicle capacitors should be measured in every major schedule.	MOH/TOH/IOH
DC link capacitors of Auxiliary converters should be visually examined for any signs of oil leakages in every minor schedule.	All Schedules
The capacitance value of DC link capacitors of Auxiliary converters should be measured in every Major schedule.	MOH/TOH/IOH
The capacitance of individual DC link as well as resonant capacitor should be recorded in every second MOH. In case of deterioration of capacitance, necessary action for their replacement should be taken.	2nd MOH i.e. alternate major schedule
Working of FDU to be ensured in all locos in every schedule.	All Schedules
FDU pipelines to be blown with air pressure during major schedules.	MOH/TOH/IOH
Care should be taken during replacement/attention of valve sets that any leakage of oil from hoses/valve set tank is avoided as all such oil accumulates on the top of transformer plate and is a potential fire hazard.	During Valve set changing/ attention
The HV (Micafil) bushing provided on the roof of 3 phase electric locomotives should be maintained as per guidelines issued by RDSO vide their letter No. EL/3.2.21/1,dt. 12/10/12.	
A cyclic check of Tan delta measurement of Micafil bushing has been started, the same has to be completed. Further, this will be continued during MOH after completion of one cycle in all locos.	One Cycle + MOH/ TOH/IOH

In addition to the above, CO2 fire extinguishers should be checked for availability of gas before the dispatch of the locomotives. In 22.5 Kg cylinders pressure of the gas should be recorded and in 5 Kg cylinders, weight of the gas should be recorded.	All Schedules
In any case of fire/smoke message from Fire Detection Unit (FDU) appearing on display screen with/without tripping of VCB, on arrival of loco to shed, maintenance staff should inspect the machine room thoroughly and look for any signs of smoke/fire/overheating/spark from equipment/joints and take further action accordingly.	All Schedules
Maintenance staff should be given training for swift and correct operation of fire extinguishers.	

Annexure. 3.04

Recommended Unit Exchange Spares

In order to reduce the downtime of locomotive Electric loco shed should maintain specified number of spares of important loco equipment termed as Unit Exchange Spares. **Railway Board vide Letter No. 2008/Elect.(TRS)/441/5 Dt: 13.05.14** recommended the percentage of UES to be maintained by shed as appended below.

Sl.No	Equipment	Norms %
	Conventional Loco:	
1.	**TM Armature**	
	TAO-659	5%
	HS15250	4%
2.	**TM Stator**	
	TAO-659	5%
	HS15250	4%
3.	**Transformer**	
	3900 KVA	1.5%
	5400 KVA	2%
4.	**Tap Changer**	**1.5%**
5.	**RSI block set**	**1%**
6.	**VCB**	**3%**
7.	**Bogie Frame**	
	Tri-mount	5%
	Flexi Coil	6%
	Fabricated	4%

Sl.No	Equipment	Norms %
	3-Phase Loco:	
1.	**TM Rotor**	
	6FXA7059	10%
	6FRA6068	7%
2.	**TM stator**	
	6FXA7059	10%
	6FRA6068	7%
3.	**Transformer**	
	WAP5	2%
	WAP7	2%
	WAG9	2%
4.	**Traction Converter**	**1%**
5.	**Aux. Converter loco set**	**2%**
6.	**Control Electronics set**	**2%**
7.	**OCB complete**	**15%**
8.	**Main CP with motor set**	**3%**
9.	**E-70 brake panels**	**2%**
10.	**Bogie frame:**	
	Bo-Bo (WAP5)	3%
	Co-Co (WAP7, WAG9)	3%

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30400 General

Para 30300, 30301 and 30303 will be applicable to EMU mutatis-mutandis as well.

30401 Scheduled Inspection

The motorman, after overnight stabling of EMUs, while taking over shall ensure draining off of the air reservoirs to expel accumulated water.

1. The Maintenance and Overhaul Schedules to be followed for AC EMUs will generally be as under-
   a. Daily Inspection
   b. Trip Inspection (IT)
   c. Monthly Inspection (IA)
   d. Quarterly Inspection (IB)
   e. Half Yearly Inspection (IC)
   f. Intermediate Overhaul (IOH)
   g. POH
2. The Daily Inspection is essentially an inspection to be carried out by the 'Running Section. It may also be carried out in a shed if convenient or at an outstation when the unit is stabled overnight away from the shed. IT, IA, IB, IC and IOH should be carried out in the homing shed for each EMU whereas POH should be carried out at the workshop nominated for this purpose for each Railway.
3. The details of work to be done during each schedule require periodical review in the light of local conditions and operating experience with each type of EMU. The details given in Annexure 4.01 are for guidance only.

30402 EMU Fitness Certificate

Instructions contained in Chapter III (Para 30304) for locos will apply mutatis-mutandis for EMU as well. (Proforma 4.01).

30403 Testing of Air Brakes

A brief description of Electro-pneumatic brakes is given in the Annexure 4.02, Test procedure for the air brakes is however given below:

1. Before an EMU train is issued for traffic from a shed after scheduled inspections, POH or unscheduled repairs, a supervisor of the M5 section should test the air brakes of the complete train formation. The brakes should be tested from the driving cabs at both ends of the train formation.

   A list of items to be checked in the case of Westinghouse brakes of ICF EMUs is given below for guidance. Detailed check lists on similar lines should be prepared for different types on EMUs and units fitted with Knorr brakes. These should be in the form of printed forms. The completed forms duly signed by the supervisor of M5 should be preserved in the PPO for a period of six months.

Check :

a. that all inter-car hose connections are made and all coupling, isolating the drain cocks are in the normal position.

b. that MR pressure is maintained between 5.8 and 7 kg/cm2 and the compressors start and stop respectively at these values of pressure.

c. that when the Driver's control switch, EP brake switch and isolating valve switch are put on, the green indicator light in the driving cab glows.

d. that the brake pipe pressure builds upto 4.57 kg/cm2 in approx, 90 seconds.

e. that when the brake controller handle is moved from position 1 to position II step by step (a minimum of 6 steps should be used), the brake cylinder pressure builds up to the value proportional to the handle position and is maintained at this value by the self-lapping mechanism. In position II the pressure should be 3.5 kg/cm2 for cast iron brake blocks and 1.5 kg/cm2 and 2.0 kg/cm2 for motor and trailer coaches respectively provided with composite brake blocks. When brakes are applied the orange lamp should light-up to prove the application of brakes in all the bogies.

f. that when the handle is moved back from position II to position I step-by-step (a minimum of 6 steps should be used) the brake cylinder pressure is reduced to the value corresponding to the handle position and is maintained at this value by the self-lapping mechanism.

g. that when the handle is quickly moved from position I to position II, the brake cylinder pressure will rise to the maximum set value.

h. that on moving the controller handle from position II to position I, the brake cylinder pressure drops to zero.

i. that during EP application and release the brake pipe pressure is not affected.

j. that when controller handle is moved from position I to position III and then to IV, the brake pipe pressure drops gradually with sound of escaping air, and brake cylinder pressure rises correspondingly. When the controller handle is moved back to III, the drop in brake pipe pressure and the rise in brake cylinder pressure should be arrested.

k. that when controller handle is moved from position I (after allowing full BP pressure to build up) quickly to 'Emergency' position V, brake pipe pressure is reduced rapidly and brake cylinder pressure rises to slightly more than 3.9 kg/cm2 within 2.5 seconds.

l. that with the brake controller in the driving cab in position II the brake cylinders on each bogie are functioning and there is no leakage. Check also that the manual release valves have wires attached to them to facilitate operation from the sides of the train.

30404 Maintenance of Vacuum Brakes (Deleted)

Annexure 4.01

1. Daily Inspection

During this inspection, the Engine Examiner should- ,

a. carry out detailed checks in regard to any unusual occurrence reported by Motormen in the log book.
b. visually inspect the auxiliaries for satisfactory starting and operation.
c. feel by hand that the temperature of axle bearings is normal.
d. visually inspect mechanical components like traction bars, pendular suspension, springs, dampers etc. and the brake rigging to detect any abnormality; and
e. check the controls and indication and alarm circuits for correct functioning. Every unit should be checked under the supervision of a Train Examiner (Traction), generally during night stabling. Similar inspection (in addition to attention to the unscheduled repairs) should also be carried out in a unit called to the shed for unscheduled attention, before it is declared fit for traffic.

The important items to be checked are:

a. Tap all wheels to detect for loose wheel s and wheel cracks. Visually inspect all wheels for defects such as cracked wheel s, flats etc. and also bogies and running gear for any abnormalities.
b. Feel all axle boxes by hand immediately after stabling. Check axle box covers,
c. Check axle guide helical springs for breakage.
d. Check brake blocks. Renew badly worn or cracked blocks. Adjust slack adjusters, if required, to obtain clearance of 12 mm between brake blocks and wheels. Look. for broken parts of brake rigging. Check the application of the brakes.
e. Check bolster helical springs visually.
f. Check look-out glasses and head code glasses. Clean look-out glasses,
g. Cushions to be checked and badly damaged cushions to be replaced,
h. Test check passenger alarm chain for operation from at least 2 coaches in a train,
i. Visually check the pantographs for any defect.
j. Check oil-level of air compressors and suspension bearings, top up if required,
k. Check operation of automatic drain valve of main reservoirs. Drain all other reservoirs,
l. Test the horns at both ends.
m. Check for noticeable air leakages in compressed air system.
n. Check inter-unit air hose couplings.
o. Test wind screen wipers (in rainy season).
p. Test brake controller at each driving position for correct operation. Particularly observe the brake-pipe pressure.
q. Test deadman's device in each driving cab
r. Test pantograph raising and lowering push buttons in each driving cab.
s. Check Master Controller in each driving cab.
t. Test auxiliary compressor.
u. Check battery voltage and trickle charge current.
v. Test signal bells.
x. Clean the compartments and cushions. Clean driving cabs.

y. Test headlights, flasher lights and tail lights including emergency lights.
z. Check that all the safety straps are in position.

2. Trip Inspection

1. The chief object of this inspection is to renew the worn-out brake blocks if necessary usually at Intervals varying from 5 to 8 days particular attenation being paid to differential rate of wear between motor coaches and trailer coaches.
2. The periodicity of this inspection will depend upon a number of factors such as daily Kilometrege, proportion of 'fast' and 'slow' trains, quality of brake blocks etc. The periodicity should be decided by each Zonal Railway depending upon its actual operating requirements. It is essential to ensure renewal of brake blocks before they reach condemning thickness.
3. In addition to replacing brake blocks and the items listed against Daily inspection, carry out the following checks:
4. Visually inspect the bogie frame for cracks or other damages,
5. Check helical springs of axle guide for breakage,
6. Check axle guide for excessive oil leakage,
7. Check tightness of axle guide oil filling cap.
8. Check axle guide safety strap.
9. Inspect axle suspension bearings of traction motors and check oil levels, particularly check pressure and tightness of drain plug and filler cap. Tighten bolts.
10. Check gear-box for lubricant level and tighten bolts,
11. Adjust brake pull rod, rigging and slack adjusters.
12. Inspect brake rigging components thoroughly particularly bushes, pins, split-pins and cotters,
13. Check centre pivot.
14. Inspect 'Schaku' couplers for cracks, deformation and damage.
15. Inspect buffers and lubricate buffer plungers.
16. Lubricate screw couplers.
17. Check all doors and windows, door handles, foot-steps, window safety bars and hand rails.
18. Check that protective screen for look-out glasses, where provided, is properly secured.
19. Clean driving cab window panes and swab clean cushions.
20. Inspect pantographs for flash-marks, wear of strips and cleanliness of insulators. Lubricate articulation joints, bearing joints and pans.
21. Check compressor crank case breather pipe.
22. Check oil level of auxiliary compressor and top up, if required.
23. Check operation of EP contactors and reverses by manual operation of the control magnet valves.
24. Check transformer oil level and top-up if required. Check transformer for oil leakages.
25. Check colour of silica gel and replace if required.
26. Open inspection covers and make a quick inspection of traction motors for flash-marks, broken brushes, damaged pig-tails or other damages.
27. Check that the auxiliary machines are running without any unusual noise.
28. Make a quick examination of all electro-magnetic contactors and relays.
29. Make a quick visual examination of air-blast circuit breaker and test its operation.

30 .Battery: Clean vent holes of filler caps, check intercell and main connection, record specific gravity and voltage of pilot cells, top up with distilled water if required and smear cell connections and terminals lightly with petroleum jelly after cleaning.

31. Check and attend to all defects of lights and fans.

32. Clean underframe equipment particularly at locations where fire is possible due to accumulation of oily matter; also clean filters, as required.

33. Check the correct operation of RGCP.

34. Check self lap feature of the EP brakes.

3. Monthly Inspection (IA)

In addition to the items listed against Daily and Trip inspections, the main items to be attended to during Monthly Inspections are - .

1. Measure wheel (root wear and flange wear) and record. (Refer to Annexure 3.01 item F) and reprofile if required and ensure that variation of diameters are within permissible limits.
2. Check axle boxes for leakage of grease, specially from back dust-guard and for any cracks or other damages.
3. Inspect reversible gear-box of speedometer.
4. Check suspension bearing housing fixing bolts for tightness.
5. Check gear-case securing bolts for- tightness.
6. Check motor coach friction damper liners and pads.
7. Check shock-absorbers for oil leakages.
8. Check centre-pivot bottom cover with its fixing bolts and nuts.
9. Inspect side-bearers for excessive oil leakage.
10. Inspect buffers for cracks and damages and tightness of fixing bolts.
11. Check cattle guard for security of fastening, deformation and clearance from rail level.
12. Check all seats, luggage carriers, strap hangers and door locks.
13. Check for leakages from roof (particularly prior to and during rainy season).
14. Check that hand-brakes are functioning effectively.
15. Gauge and change if necessary, pantograph strips and clean all roof insulators.
16. Inspect and clean suction strainer and centrifugal dirt collectors.
17. Overhaul and. test reducing valves and check that correct brake pipe pressure of 4.57 kg /cm2 is built up.
18. Check complete compressed air system for leakage.
19. Test EP, Auto and Emergency application from each driving position and brake cylinder pressure in each coach. Check Guard's Emergency valves in driving cabs.
20. Remove the arc chutes and inspect all EP contactors for flash-marks, contact wear, contact wipe etc. Check for air leakage at control valves. Lubricate cylinders.
21. Check pressure in control air reservoir,
22. Check operation of all pneumatic governors.
23. Check reversers for operation, finger pressure, wear of contacts, functioning of auxiliary contacts and for air leakage at magnet valves.
24. Inspect silicon rectifier cubicles and clean cubicles with dry compressed air.

25. Check cell-check device.
26. Check traction motors for condition of commutators, arcing homs, brush holders, wear of carbon brushes and condition of earth-return brushes. Renew brushes, if required.
27. Examine all other DC motors also as above.
28. Lubricate the bearings of auxiliary motors.
29. Clean air intake filters for traction motors and compressors.
30. Check tightness of all main cable connections.
31. Check the contacts and auxiliary contacts of circuit breakers.
32. Check for functioning of all indication circuits and lamps.
33. Check voltage stabilizer.
34. Check all lights and fans individually and test emergency lights.
35. Check the speedometers.
36. Wash coaches internally and externally by hand scrubbing.
37. Check head light focussing.

Train formation should finally be checked by El and Ml sections before release for traffic.

4. Quarterly Inspection (IB)

Items given below are required to be attended to in addition to the items listed against Daily, Trip and Monthly Inspections -

1. Check all axles with ultrasonic flaw detector.
2. Check distance between wheel faces using prescribed gauge.
3. Check axle guide oil level.
4. Check condition of axle guide spring lower rubber pads.
5. Check condition of speedometer reversible gear box. v
6. Traction motor suspension bearing lubrication pads to be checked.
7. Measure and record radial and lateral clearances of suspension bearings.
8. Inspect traction motor nose suspension bolts.
9. Inspect bogie frames, swing links and bolsters carefully, particularly welded, rivetted and bolted joints.
10. Check friction damper spring assembly.
11. Check compressed height of swing bolster springs.
12. Inspect draw-gear rubber pads.
13. Uncouple 'Schaku' couplers and inspect the assembly. Lubricate the couplers as prescribed.
14. Measure and record buffer heights.
15. Body panels to be checked for rust, corrosion and damage.
16. Check passenger alarm device in each coach.
17. Clean the suction strainers of auxiliary air compressor.
18. Inspect all brake cylinders; tighten foundation nuts.
19. For all EP contactors check air gap between main contacts, auxiliary contacts and spring pressure of auxiliary contacts. Clean all insulating surfaces. Check magnet valve stem with condemning gauge.
20. Check reverser and changeover switch "WCO

21. In silicon rectifier cubicles, slide out each rectifier tray and clean the cooling fins. Clean all air ducts, check power connections, check capacitor for oil leakage and inspect HRC fuses, particularly terminal connections.
22. Open and inspect Master Controllers. Wipe dry all insulating surfaces and check contacts,
23. Clean supporting insulators and check tightness of connections of transition resistances.
24. Clean traction motor brush-holder insulator and check earth-return brush-gear. Check junction box connections for tightness.
25. Check main compressor foundation bolts for tightness.
26. In all electro-magnetic contactors check the air gap between contacts, conditions of flexible shunts, knuckle spring pressure and hinge pins.
27. Inspect all push button switch contacts and terminal connections.
28. Check all knife switches.
29. Check current limit relay LT supply continuity.
30. Inspect voltage stabilizer transformer.
31. Clean headlight reflector.
32. Inspect commutator and carbon brushes of all fans. Renew carbon brushes if required.
33. Examine axle boxes. If required change the grease. (This item is normally required to be done during every third IB).

5. Half Yearly Inspection (IC)

In addition to the items listed against the earlier inspections, the important items to be attend to are

1. Check pantographs for upward pressure.
2. Renew oil in compressor crank-case and change the oil filter element assembly. Check oil pressure,
3. Decarbonize the valve assembly.
4. Renew crank-case oil of auxiliary compressor.
5. Safety valves in compressed air system including brake cylinder safety valves to be tested.
6. Check the suspension arrangement of all under-slung equipment.
7. In the brake controller, check self-lapping mechanism for correct functioning, regrease fulcrum pins and rollers and examine moving and fixed contacts.
8. Clean and regrease pilot valve in Master Controller.
9. Test and adjust operating pressure of all pneumatic governors.
10. Check the condition of cones and rollers of all EP contactors, measure knuckling springs tension, renew Gaco washers and inspect flexible shunts. Check tightness of power connections.
11. Attend to reverser and changeover contactor WCO as above.
12. Test oil Sample from conservator, reactor tank and transformer tank of main transformer for dielectric strength and filter the oil If BDV is below 40 kV for one minute.
13. Disconnect all inter-vehicular couplers and examine male and female pins.
14. In the main rectifier cubicle clean all insulators and examine for cracks. Check individual diodes for tightness with a torque wrench.
15. Examine Master Controller, lubricate interlocking mechanism and notching cam roller, check contact gap, contact pressure and cam to roller gaps.
16. Check traction motor brush spring pressures. Lubricate armature bearings. xvii)In MG set check bearings for grease leakage and lubricate bearings.

17. Overhaul and test all EP brake valves replacing all rubber component on a complete unit basis.

6. Intermediate Overhaul (IOH)

The following items should be attended to in addition to the items listed against earlier inspections -

1. Reversing gear-box for speedometer to be overhauled and speedometer to be tested on test bench.
2. Check 'Schaku' couplers for wear and damage and lubricate.
3. Overhaul servomotor of pantograph and check all adjustments.
4. Overhaul and test pantograph EP valves.
5. Remove main and auxiliary compressors and overhaul on bench. Test volumetric efficiency.
6. Overhaul and test brake cylinder.
7. Overhaul the motors of all AC and DC auxiliaries.
8. Remove air blast circuit breaker, overhaul and test on bench.
9. Check the setting of all relays and test their operation manually.
10. Overhaul all coach fans.
11. Remove battery set to battery room, examine carefully and subject the set to two cycles of charge and discharge. Take capacity test at normal rate of discharge.
12. Doors, windows and seats to be checked individually and all defects attended to. Upper class cushions to be repaired and badly damaged cushions to be replaced.

7. Periodical Overhaul (POH)

The POH of EMUs should be carried out in the nominated workshop. The work content and procedure to be followed should be on the same lines as for locos (Item D of Annexure-3.01 of Chapter 3).

8. Mechanical Safety Checks

The Train Examiner of EMU coaches will generally follow the manual and guides of TXR as modified from time to time for application to EMU coaches. The principal clearances as mentioned in (Item F of Annexure-3.01 of Chapter 3) should be checked.

9. Rebuilding and Recabling of EMUs

Activities as mentioned in (Item E(l) of Annexure-3.01 of Chapter 3) above may be carried out on EMUs during every 4th POH and activities mentioned in (Item E(2) of Annexure-3.01 of Chapter 3) may be carried out during every 8th POH.

Annexure 4.02

ELECTRO-PNEUMATIC BRAKES

1. All BG EMU stock have been provided with 'self-lapping electro-pneumatic combined with automatic' compressed air brakes. Two makes of equipment are in use viz. Westinghouse and Knorr-Bremese. Though the details of equipment differ appreciably, both systems are quite similar in principle. The description given below pertains mainly to the Westinghouse equipment provided in ICF-built EMUs.
2. Electro-pneumatic braking is normally employed for service stops. The 'automatic brakes' are used under the following circumstances-.-
   a. For automatic application of brakes on both halves of a train in the event of a parting.
   b. For application by the Guard in an emergency.
   c. For automatic application due to operation of the dead-man's device.
   d. For service stops by the Driver in the event of failure of control supply for EP brakes.
3. When Driver makes an emergency application both EP and Auto brakes apply.
4. The main components of the equipment are as under-
   a. A main reservoir system consisting of a compressor in each motor coach feeding into main reservoirs on motor coaches and supplementary reservoirs on trailer coaches interconnected from end to end of the train by a main reservoir pipe with flexible couplings at ends of coaches. The main reservoir is maintained at a pressure of 5.8 to 7.00 kg/cm2 by means of pressure governors controlling each compressor. All the compressors in a train are synchronized to start and stop together.
   b. A 'brake pipe' from end to end of the train with-flexible inter-connections between coaches. The pressure in this pipe is maintained at 4.57 kg/cm2 to keep the automatic brakes released.
   c. A 'brake unit' in each coach consisting of the control valves for control of EP and auto brakes.
   d. The brake cylinders on each bogie with automatic slack-adjusters and associated brake rigging. Usually the number of brake cylinders is four per bogie on motor coaches and two per bogie on trailer coaches.
   e. A brake controller in each driving cab. The controller in the driving cab in use being made operative by means of an 'isolating valve switch' operated by the Driver's key.
   f. A brake application relay in each driving cab, the one in the operative cab responding to the operation of the brake controller to control the supply to the brake control train wires carried along with the other control wires in the inter-vehicular couplers.
   g. Five train wires, viz. EP supply wire, brake application wire, brake holding wire, brake indication wire and EP return wire.
   h. A warning system to indicate to the Driver if EP brakes have applied and to warn him if a failure takes place.
   i. A pilot valve and emergency valve to operate the brakes if the deadman's device is released,
   j. Isolating cocks, pressure gauges and control switches.
   k. Release valves for manual release of brakes in individual bogies.
5. Each coach has an 'EP brake unit' which houses the control valves for both EP and auto- brakes. The "pipe-bracket' arrangement is used whereby the valves are bolted on to a casting which has the requisite inter connections between valves by means of cored passages in the casting itself, the only external pipe connections being from the main reservoir and brake pipes and to the brake cylinder and atmosphere.
6. The brake controller handle has five positions as under-
   a. I Release and Running.

b. II Full service EP.
c. III Lap(for auto application)
d. IV Service automatic.
e. V Emergency.

Lower brake cylinder pressures with self-lapping feature as explained later are obtainable for intermediate positions of the handle between positions 1 and II, the actual brake cylinder pressure being dependent upon the degree of handle movement away from position I.

7. Fig 4.01 is a block diagram explaining the functioning of the EP brakes. When an EP application is to be made, the controller handle is moved from position I towards position II. First the holding train wire is energized which energizes the holding magnet valves throughout the train, thus closing the exhaust from the brake cylinders. The application valves are then energized via the application train wire. This causes compressed air to flow to the brake cylinders from the main reservoir pipe, the rate of flow being controlled by a choke (not shown in the figure). If the application valve remains energized, the pressure in the brake cylinder 2 builds up to 3.5 kg/cm2, any rise of pressure beyond this value being prevented by the "limiting valve.
8. Between positions I and II the self-lapping mechanism controls the brake cylinder pressure. Fig 4.02 shows the self-lapping mechanism schematically. Movement of the controller handle towards II compresses a spring in a small control cylinder, the amount of compression depending upon the degree of handle movement. This spring acts on a piston at the back of which air pressure form the brake cylinders of the leading bogie is applied. When the brake cylinder pressure exceeds the value corresponding to the controller handle position, the mechanism de-energizes the application train-wire, thus limiting the brake cylinder pressure to the value corresponding to the handle position. If the brake-cylinder pressure dropson account of leakage etc. the application wire is re-energized. If the handle is moved backwards, the holding wire is de-energized till the brake cylinder pressure drops to the required value. The self-lapping mechanism thus automatically controls the brake cylinder pressure at a definite value corresponding to the handle position and enables graduated application and release, in position II and V the application and holding circuits are energized by 'positive acting' contacts bypassing the self-lapping mechanism, the pressure then being limited by the limiting valve as explained earlier.
9. Two indication lamps are provided on the Driver's desk-a green lamp to indicate that EP brake control supply is available and an orange lamp which lights up when brake application is made if pressure has built up in all the bogies, which is detected by a pressure switch, the pressure switches in all the coaches being connected in series. The extinguishing of the green lamp indicates total failures of EP brakes necessitating use of the automatic brakes to control the train. Failure of the orange lamps to light up when brakes are applied indicates partial failure of the EP brakes. The Driver has then to be very vigilant and should be prepared to control the train, if required, by using auto brakes.
10. Fig 4.03 is a block diagram explaining the function of the automatic brakes. When the brake controller in the driving cab is in position I and the controller is put into operation by putting on the 'isolating valve switch', compressed air is fed to the brake pipe from the MR pipe via a reducing valve in the brake controller which ensures that the pressure in the brake pipe is built up and remains steady at 4.57 kg/cm2.

    The vital component in the automatic brake system is the 'triple valve' which forms a part of the EP brake unit in each coach. Its functions are -

    a. When pressure in the brake pipe is 4.57 kg/cm2, it opens the brake cylinder to atmosphere thus releasing the brakes and at the same time connects the brake pipe to an Auxiliary Reservoir in each coach storing compressed air at a pressure of 4.57 kg/cm2 in the Auxiliary reservoir.

b. When pressure in the brake pipe is reduced either voluntarily by the Driver or the Guard or due to parting of train or operation of the deadman's device etc., it closes the exhaust from the brake cylinder and connects the auxiliary reservoir to the brake cylinders, allowing the stored air in the reservoir to flow into the brake cylinders. The volume of the auxiliary reservoir is so chosen that the maximum pressure in the brake cylinders is limited to 3.5 kg/cm2. The triple valve also has a lap' position whereby it is possible to control the brake cylinder pressure to values below 3.5 kg/cm2 by holding the brake pipe pressure at intermediate values making use of position III on the brake controller.

c. When the brake pipe is recharged by moving the controller to position I. the triple valve returns to the position indicated in (a), thus releasing the brakes and storing air in the auxiliary reservoir in readiness for the next application.

Not shown in Fig 4.03 is a 'triple valve stabilizing valve' which ensures that the triple valve does not react to small pressure pulsations.

11. In position V (i.e., 'emergency') of the brake controller, both EP and auto brakes apply together. Rapid application of the automatic brakes is obtained by quick venting of the brake pipe to atmosphere. A safety valve in the brake unit on each coach prevents excessive pressure in the brake cylinders. This valve is normally set at 3.9 kg/cm2.
12. Release of the deadman's device by the Driver results in quick venting of the brake pipe to atmosphere via an 'emergency valve1 resulting in full auto application.
13. A valve is provided in each driving cab to enable the Guard to vent the brake pipe to atmosphere and thus cause brake application. A gauge is provided close to this valve to indicate the brake pipe pressure to the Guard.
14. A pressure switch usually called the control governor' connected to the brake pipe prevents application of power to the traction motors till the brakes are kept ready. This control governor opens and cuts off traction control supply if the brake pipe pressure is reduced.
15. A 'duplex' pressure gauge is provided in the driving cab to indicate to the Driver the pressure in the main reservoir and brake pipes. Another duplex gauge indicate to him the pressure in the brake cylinders of the two leading bogies.
16. Isolating cocks are provided to isolate a defective brake unit form the MR and brake pipes and also to isolate brake cylinders in individual bogies.
17. The brake cylinders are equipped with automatic slack-adjusters to take up the slack in the brake rigging with wear of brake blocks, thus ensuring fairly constant piston stroke and obviating the need for manual adjustment of the brake-rigging between visits of the units to the shed. This is an essential feature of brake equipment for suburban services, when the brake block wear is quite high on account of frequent application of brakes.
18. The Knorr system is quite similar to the equipment described above. In this system, however, the automatic brakes become operative automatically on failure of the EP system. With this arrangement the brake controller has only three positions viz., release", 'full service application' and "emergency".

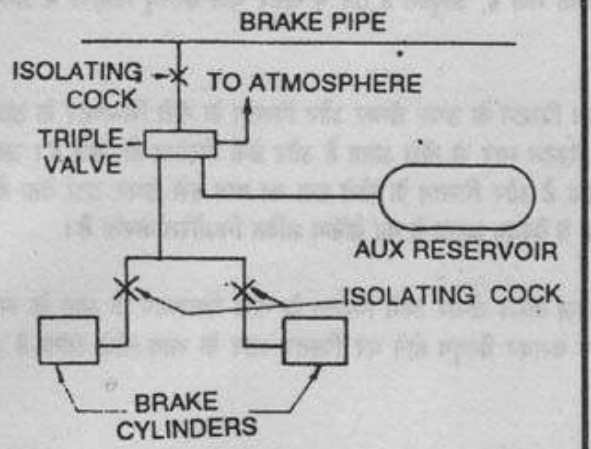


FIG. 4.03 AUTOMATIC BRAKES

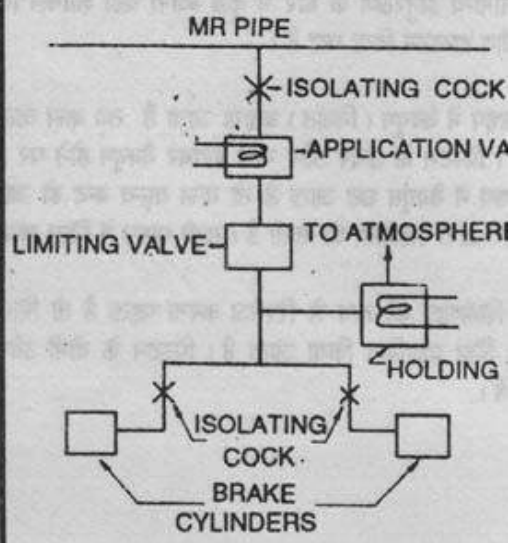


FIG. 4.01 EP BRAKES

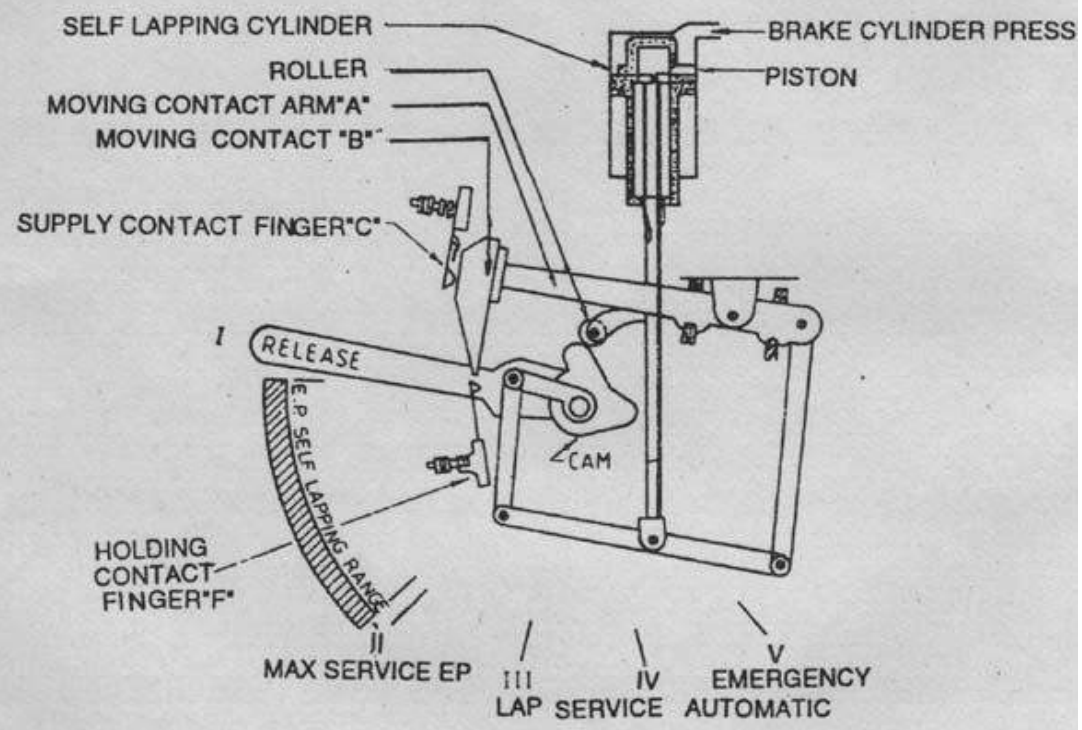


FIG. 4.02 **SELF LAPPING MECHANISM-SCHEMATIC DIAGRAM**

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30500 Divisional Organization

Senior Divisional Electrical Engineer /Divisional Electrical Engineer (Operations) shall be assisted by junior officer / officers and shall be responsible for operation of Electric locomotives and Multiple Units in a division.

30501 Duty of Chief Crew Controller (CCC)

In addition to overseeing work of the Crew Controllers, Chief Crew Controller shall

1. Exercise overall day-to-day control over staff in charge of loco operation
2. Ensure day to day availability of running staff for train services and exercise control over the booking of such running staff:
3. Arrange supply of uniforms, rule books consumable stores and tools to the running staff;
4. Arrange periodical vision tests of running staff as prescribed and maintain records for the same;
5. Maintain 'Road Knowledge Register' for running staff and ensure that no person is booked to work a train until He/She has thoroughly learnt the road and has signed a certificate that He/She is fully acquainted with the road;
6. Maintain the records of alcoholic loco pilots.
7. Arrange relief of running staff as required for refresher courses and other training schemes;
8. Ensure upkeep of running rooms so as to ensure that staff get adequate rest in the running rooms and are satisfied with the same. This may involve liaison with other departments;
9. Co-ordinate with supervisors of other departments which are in need.
10. Exercise control and maintain liaison with operating department over terminal detention in the yards
11. Cross check the CMS reports daily regarding abnormality observed on Run and ensure data is properly updated.
12. Ensure that the Combined Loco Pilot's and Guard's Report are collected daily filled after return of the crew to HQ.;
13. Scrutinize forms submitted by driving staff to the Statistical Branch;
14. Arrange adequate representation in minor joint inquiries in regard to accidents, detentions etc.;
15. Arrange supervisor for relief trains in case of accidents involving electric rolling stock and supervise relief operations at site;
16. Implement orders and tasks as directed by Sr. DEE/DEE(OP)

Types of Rest:

CREW REST:-

The hours of various types of rests are displayed by the system as per the rule configured by the Lobby. While the crew sign OFF at KIOSK they shall demand the rest and supervisor shall sanction it or modify it. This rule has been incorporated in the CMS system.

Crew is entitled for the rest at their HQ according to the place and hour of duty. The results can be best described in a tabular form as below.

Duty hours and rest at HQ

>= 8 Hrs 16 Hrs

Standard rests (particularly the outstation rest) have to be configured in the configuration manager to take effect. Refer configure a lobby for types of rest section for more information on the rests. In all the data entry forms standard rest that can be entered shall be 16, 22, 30, 44 and 60 only.

Long Rest

Crew shall select his long rest (22 hrs/30 hrs) at the time of sign Off. This will be approved by the supervisor, he can also change the rest hrs given by the crew while conveying approval of SIGN OFF. Once approved the crew shall avail his nominated rest.

Non Run Rest

The rest to be given to the crew coming from non-running duties are detailed in Non Run options available in the non-run activity option. There are to dates which have to be enter by the TNC.

1. Non run return date and time
2. Crew available time

The difference in time between the Non run return and crew available time is treated as rest period.

Normal Rest modification

A normal rest granted to crew to a long rest. The Supervisor can do so by going to the Modify rest link available in freight. All such rest which have been granted to the staff as normal rests can be converted to long rests of 22 or 30 Hrs duration. The form is for utilizing the opportunity of slack train movement and for converting crew normal rest to periodic rest for such train movements. The facility is not sanctioning Long rests. Long rests are sanctioned by the supervisor while giving Sign OFF approvals.

All such modifications of the long rest are communicated to the crew through an SMS confirming that his long rest has been modified by <Name of Supervisor> to value < 22 / 30> Hrs now.

Types of PR's: A). 22 Hrs PR B). 30/32 Hrs PR C). 44 Hrs PR D). 60 Hrs PR

PR (Periodical Rest): PR is considered only when full night in bed is ensured. Around 120 Hrs PR hours in a month to be granted to running staff. PR (i.e: 30 Hrs 4 PR's or 22 Hrs 5 PR's in a calendar month) be marked in CMS at the earliest so that information PR is given to the staff from CMS through SMS. CC to be proactive in granting of PR so that there will be no PR dues, regulation in working hours and reduction in over time. 30/32 Hrs PR is the suitable PR for running staff.

Out Station Rest:

Working Hours.	Sanctioned Rest
<=5 Hours.	Hours + 1 Hrs
>5 Hrs to <8 Hrs.	6 Hours
>8Hrs	8Hr

Crew Management System

All crew lobbies should have CMS terminals and every crew should be booked in CMS system only. Every activity of crew booking and its reports can be viewed in online reports of CMS. It increases

transparency in crew booking system and can be monitored at different levels. Data of muster, mileage, OT and other allowances can be directly transferred from CMS to personnel branch/accounts office through IPAS for the payment of Running Staff.

Booking of crew in CMS:

1. TA should be created for booking a crew.
2. Crew should be booked in that TA in "Fetch As Per Rule" option so that it will check the following mandatory requirements.
   a. Periodical Medical Examining
   b. Refresher Training at Zonel Training Center REFT (ZTC)
   c. Refresher Training in Electric (REFE) or Refresher Training in Diesel (REFD) (LOCO TRACTION)
   d. Rest Completion
   e. Learning Road (LR) details
   f. Loco Competency
   g. Safety Competency
3. Then crew will Sign on in KIOSK duly reading SOBs and duly conducting BA test in integrated KIOSKs.
4. Supervisor has to approve the SIGN ON.
5. After completion of trip crew will make Sign off on KIOSK duly entering Loco number, Train number, EMR, Regenerative, Crew taken over, Crew handed over, Train Dep, Train Arr and Abnormality details if any and also conducting BA test through KIOSK.
6. Then supervisor will make SIGN OFF approval and crew status will come to Rest position for further train working. If crew has to work as Spare, Shunting etc, then all such data should be fed in CMS manually.

In early 2020 CRIS developed Chalak dal application (app) under CMS , wherein Loco Inspector can enter crew counselling & monitoring particulars in CMS using this app in an efficient manner..

Different CMS reports can be viewed in different tabs which are as follows.

1. **CREW:** We can check the reports like mandatory requirement dues, periodical courses dues, bio-data particulars, retirement date particulars, LI nominations etc.
2. **MANAGE:** We can see crew PR count, PR due particulars, booked as rule/WO rule particulars, crew turnaround particulars etc.
3. **RUN:** We can see crew muster particulars, crew not return to HQ report, crew availability report etc.
4. **NON-RUN:** We can take the report of leave, sick, absent particulars of crew.
5. **MISC:** We can see breath analyzer report, abnormality report, CRIS communications, energy consumption report and VCD report.
6. **LR:** We can check the LR particulars of the crew.
7. **MILEAGE:** We can take the reports of over time particulars, mileage particulars and we can check IPAS-CMS mileage summary.
8. **SMS:** All types of SMS from/to can be given
9. **SUBURBAN:** Suburban reports can be viewed.
10. **CRIS:** CMS commissioned reports and working system of CMS, CMS help is available.

Duty of CCC/CC while booking of crew:-

1. Ensure the proper creation of TA i.e. Proper direction, traction and service.
2. Ensure to book the proper crew as per TA creation with in time.
3. Ensure to Acknowledge the crew before 30 Min. of crew Sign ON time.
4. Ensure crew to Sign ON in KIOSK with BA, BIO, and camera provided.
5. Approval of sign on/Off after ensuring of BA value.
6. After train departure train arrival and train departure should be feed in PAD/PDD option.
7. Check the abnormality report regularly for proper updation.
8. Swap the Crew /TA if required.
9. Ensure the CTR movements fed in CMS without any delay.

Sanction of leave/ PR:

1. CCC should know the staff working under him. CCC should be unbiased in sanctioning leave / PR. It will be helpful in efficient crew management at the time of major festivals.
2. While sanctioning of leave /PR, CCC should know Progressive hours, leaves / PR, staff has availed.
3. Sanctioning of PR / Leave should be twice in a day i.e In the First session and last session for getting clear forecast.

Medical check up for running staff:-

It is mandatory to qualify in A-1 Medical test for all Running Staff

Reference: Railway Board Letter No.88/H/5/12 , dt. 03.07.1989 & 29.01.1993

1. Normal PME from DOA to 45 years of age is every 4 years and at the age of 45 years (medical test at the age of 45 years is dispensed off when the last medical attended is below two years of attaining 45 years)
2. Normal PME from 45 years to 55 years: - Every two years and at the age of 55 years (medical test at the age of 55 years is dispensed off when the last medical attended is below one year of attaining 55 years).
3. Normal PME from 55 years to 60 years: - Every one year
4. Medical checks on promotions
5. Medical checks for crew working high speed trains
6. Medical checks for crew reporting after becoming Absent /involved in accidents/ or underwent surgery.

Procedure for reporting Abnormality observed on run

(As per Lr No. E.223/CMS/Vol-V Date: 23.03.2017)

The facility of reporting of abnormality in CMS by Loco Pilot is made available now. crew when signing off in depots under their jurisdiction will feed abnormality of signal/track in CMS. Divisional CTLC & CC of the depot where the LP has fed the abnormality has to do the following:-

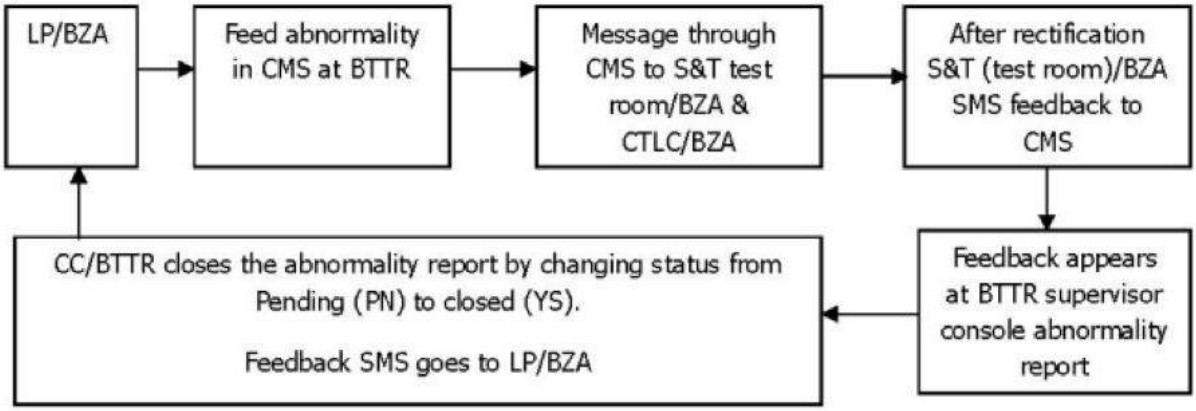
1. Divisional CTLC CUG number should be fed in S&T slot as well as Engineering slot available in CMS.
2. Divisional CTLC of the depot where LP has fed abnormality has to pass on the message to the divisional CTLC of that section where abnormality was noticed. The same to be passed on to signal test room or Engineering control as per the abnormality.

3. After rectification of problem, Engineering/S&T will give feedback to the divisional CTLC, who should further pass on the feedback message received from Engineering/S&T to the divisional CTLC from whom the concerned abnormality was received.
4. After receiving the feedback, CTLC should send by SMS the feedback report to CMS in the format ABNR (Abnormality ID) feedback. Feedback will appear in CMS supervisor console abnormality column for the depot where LP has fed the abnormality.
5. CC of the depot after observing the feedback received from Engineering/S&T in action taken column shall change the status column from PN to YS in supervisor console, then submit.
6. After that, SMS will be sent to the LP who has entered the abnormality through CMS. 7. Pictorial diagram is enclosed for more clarity.

Same Division

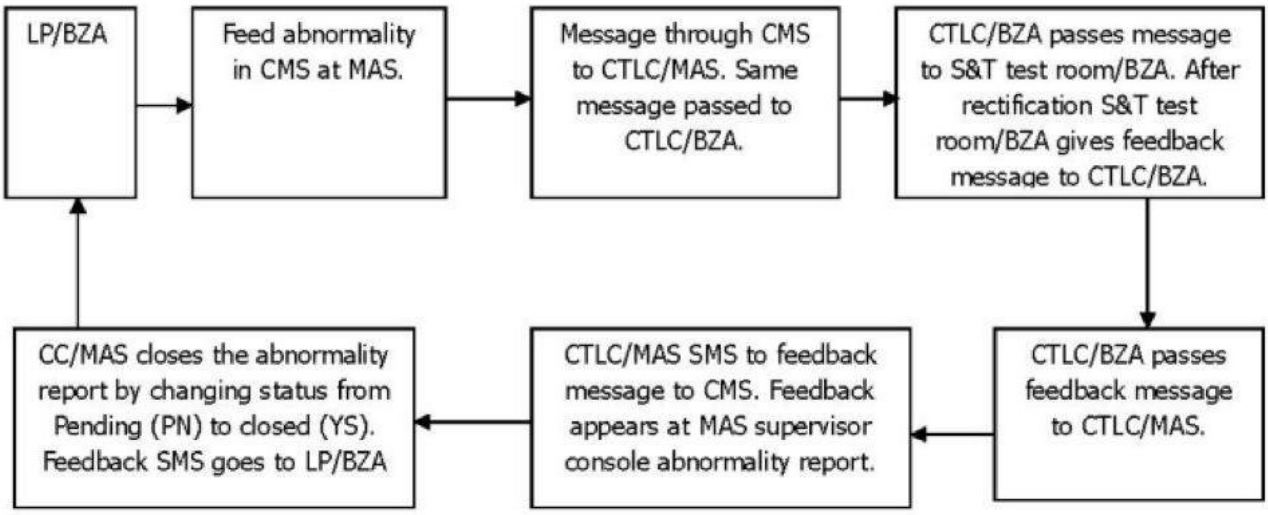
1. When abnormality section & sign off depot in same division

Ex: LP of BZA depot working a train upto BTTR, sign off at BTTR, feeds abnormality of S&T at Kavali station in major section BZA-BTTR



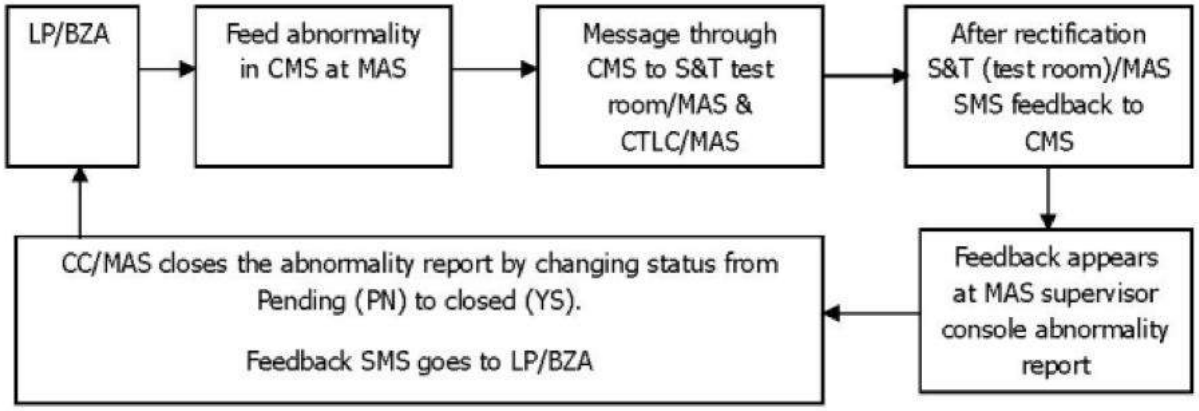
2. When abnormality section is in parent division but sign off in foreign division

Ex: LP of BZA depot working a train upto MAS, sign off at MAS, feeds abnormality of S&T at Kavali station in major section BZA-BTTR.



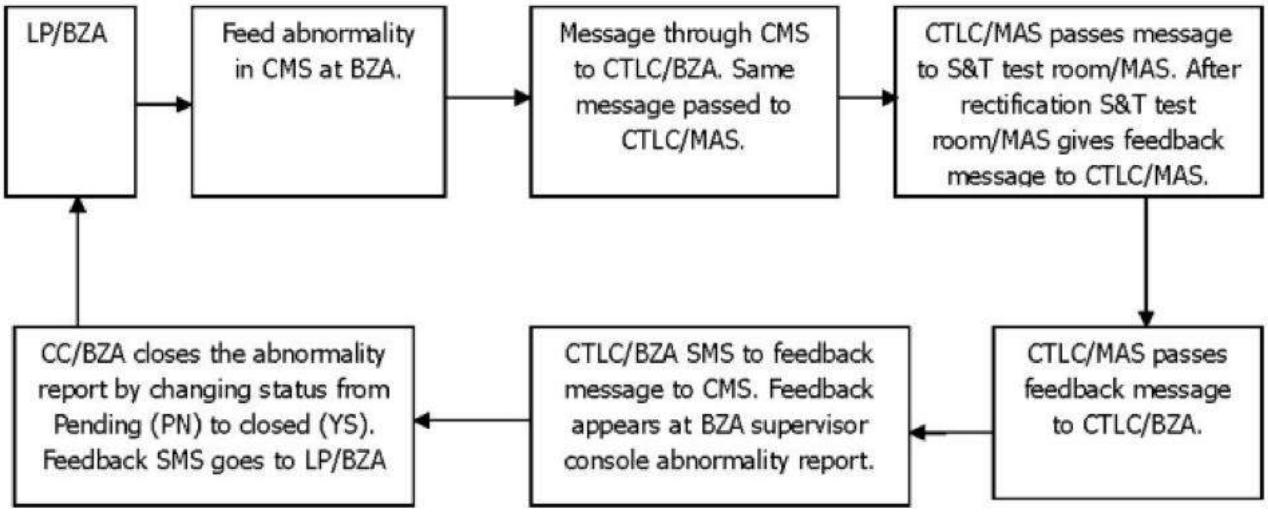
3. When abnormality section is in foreign division & sign off in foreign division

Ex: LP of BZA depot working a train upto MAS, sign off at MAS, feeds abnormality of S&T at Naidupeta station in major section GDR-MAS.



4. When abnormality section is in foreign division & sign off is in parent division

Ex: LP of BZA depot working a train from MAS to BZA, sign off at BZA, feeds abnormality of S&T at Naidupeta station in major section GDR-MAS.



Know about CMS

30502 Duties of Crew Controller - General Duties (CC)

In bigger lobbies, two CCs are allotted in one shift and duties are bifurcated as indoor and outdoor CC. In smaller lobbies, one CC will take care of indoor and outdoor duties. CC will

1. Ensure that the staff reporting for duty are sober and not under the influence of alcoholic drinks. All incoming staff will be subjected to breath-analysis before being allowed to perform the duty.
2. Ensure that all running staff possess valid competency certificates.
3. Display of temporary speed restrictions in a prominent manner at the booking offices.
4. Ensure display of names of Loco Pilot with spectacles in the lobby.
5. Arrange relief for running staff whenever asked for by the Traction Loco Controller (TLC)

6. To avoid running staff performing more than the prescribed hours of duty at a stretch.
7. Ensure filling of sand in sand-boxes of locos and availability of dry and clean sand..
8. In case of any problem faced by CC, He must report it to CCC
9. Ensure availability of portable BA test machine in working condition as per RDSO so that LI can carry them in case of accidents.
10. Prepare position of issue and return of Combined Loco Pilot's and Guard's report in the proforma as per Annexure 5.01
11. Ensure that the staff are availing adequate rest at headquarters and outstations.
12. Ensure crew are signing ON and signing OFF in CMS in time, duly filling up all the required data.
13. Book crew as per actual train arrival to avoid detention to crew.

I. DUTY LIST OF CREW CONTROLLER (INDOOR):

1. Upkeep BA equipment with valid calibration date. Daily testing & keeping of test records.
2. To ascertain that the called crew is as per turn fulfilling all the mandatory requirement viz. LRS in the direction of train ordering and training in the kind of loco ordered.
3. To ascertain the arrival of called crew i.e. LP, ALP and Guard in time.
4. To witness for breath analyser test and ensure sobriety of crew. If any crew found positive, requisite follow up action is taken, relaying incidence to control and concerned officials.
5. To ensure that the crew is updated with latest safety and technical literature under acknowledgment.
6. To ensure crew are signed ON/OFF in CMS as per the correct time and give approval to that effect for CMS updating.
7. To ensure crew utilizes waiting time to enhance their working knowledge through Gyan Kasauti software application provided.
8. To distribute walkie-talkies to the outgoing crew and collect them back from crew signing OFF and keep proper accountal. Ensure charging of used walkie-talkie for subsequent issues.
9. To ensure crew possess all the required tools along with correct competency certificates while going ON duty.
10. Computation of PAD & PDD along with train/loco detention and relaying the same to control office.
11. To ensure that the crew record S&T defects, loco defects, unusual occurrences observed on run, shut down hours, mobile phone usage on duty etc and they are relayed to the concerned control.
12. To monitor PR/leave position, 10 hours implementation by arranging relief crew in coordination with PCOR/TLC/SCOR.
13. Supervision over outsourced booking staff for correct booking, CTR feeding and creation of TA in CMS.
14. Supervision of crew vehicle movements in coordination with PCOR/TLC/SCOR and arranging transportation of crew in time at appropriate locations.
15. To ensure updation of caution order board, housekeeping of lobby, crew lounge and general cleanliness in the premises.
16. Issue of subsidized meals tokens to out station crew and arrangement of their accommodation in the running room.
17. To exchange messages with on duty PCOR/TLC/Guard control regarding day to day operational activities and act accordingly.
18. To ensure effective asset management viz working of CMS/CCTV systems, water RO plant with cooler, AC units in lobby & lounge and other electrical/electronic appliances.

19. To analyses to cases the crew who have not turned out from out station more than 36hrs, record it in the register and inform PCOR to plan and bring back to hqrs within 60 hrs. 20. To sound siren and arrange Loco and crew in time at the time of accidents/derailments and also ensure in time departure of ART/MRV.

II. DUTY LIST OF CREW CONTROLLER (OUTDOOR):

1. In charge of the shunters in the yard and allotted duty to them based on the demand and requirement by operating.
2. On receiving OTL (train ordering) to relay it to the outsourced BET for alerting appropriate crew as per the availability list.
3. To follow up with Dy.SS and control for correct expected arrival of the train and accordingly prompt the BET to give a definite call to crew to appear for on duty.
4. To ensure that the line boxes of the concerned crew are identified well in advance and are moved in time by the Box boys.
5. To mobilize the crew to collect appropriate caution order/BPC and keep them ready informing the line on to which the train is being admitted keeping close liason with Dy.SS on duty and indoor crew controller.
6. To ensure fuelling and sanding requirement in the locos and alert the concerned staff to act accordingly.
7. To coordinate with trip sheds (AC & DSL traction) staff to get petty online repairs, reported by incoming crew, if any attended to in time.
8. To coordinate with Dy.SS for shunting operations/Securing of idle locos and appropriate entries in register.
9. Monitoring the movements of crew being moved spare by various trains and by road. Crew vehicles in coordination with the indoor crew controller.
10. Assist the crew in relaying information to control regarding any shortfall in loco or trailing stock so that necessary arrangements can be made enroute or addressed to here itself.
11. To coordinate with the Dy.SS, PCOR/TLC/SCOR and indoor crew controller and ensure smooth movements in train operations.
12. To insure timely availability of crew for the movement of ART/MRV
13. To attend any un-usual regarding crew or train working in station premises.

30503 Loco Control Organization

Personnel manning the TLC Organization should be adequately trained. In addition they should be sent for refresher courses to the Training Schools and Sheds periodically as specified to keep themselves familiar with the current problems on locos so as to be able to guide loco crew effectively.

30504 Duty of Assistant Traction Loco Controller (ATLC) & Traction Loco Controller (TLC)

1. To maintain a list of passenger fit locos and watch the running of passenger trains, report after necessary investigation all cases of time lost on loco account as well as time made up by Loco Pilots;
2. To plan in consultation with the PPO of the shed and move the locos to the shed for scheduled inspections and unscheduled repairs and obtain forecast of locos likely to be made fit by the sheds and plan the movement of such locos for clearing traffic, in coordination with the Traffic Controller;

3. To keep watch on the detention to electric locos as well as. electrical running staff in yards and sections and take remedial action in coordination with the Traffic Controller;
4. To maintain liaison with contiguous divisions in respect of "balancing" of crews;
5. To keep watch on train operation in order to avoid excessive waiting duty for running staff and take remedial action as required in coordination with the Traffic Controller;
6. To guid staff in trouble shooting if they are stuck up on line;
7. To send back to the homing shed of foreign Railway loco due to scheduled inspection;
8. To study cases of running staff performing more than prescribed hours of duty at a stretch and take necessary remedial action to avoid recurrence;

DUTIES OF POWER/TRACTION CONTROLLER (MAIN LINE/ LOCO)

1. To keep a close watch and coordination with operating department to meet the day to day train operations.
2. To advise the loco pilots in time to run at maximum permissible speed to gain time whenever the coaching trains are running late.
3. To ensure the proper movement of ODS and dead locos to their respective sheds by close monitoring.
4. To ensure availability of locomotive for train as per the load table of working Time Table (WTT).
5. To keep a close watch of the schedule of each loco both home Railway/foreign Railway and plan to move the locos due for schedule, to their base sheds or to trip sheds in co- ordination with Dy. chief Controller ON duty.
6. To counsel the LPs in trouble shooting in en route in case of engine troubles.
7. To ensure prompt providing relief engines in case of engine failures on mail/ Express/ Passenger and goods services.
8. To collect information from loco pilots for all coaching trains and should note the time gained/lost by the loco pilots, it will help the PRC/TLC to defend any loss of punctuality if not actually lost of loco account.
9. To monitor the performance of shunting engine in yards, ballast train, etc.
10. To monitor the VIP specials if any, precautions to be taken to avoid unnecessary detention.
11. Should possess thorough knowledge of the outages of each shed, power plan, engine links, crew links and WTT etc.
12. To give feedback to official and head quarters in time regarding unusual occurrences if any so as to enable them to take immediate corrective steps.
13. To maintain various records regarding engine failures, loss of trains on loco account, outage, and utilization, ODS locos, trains ran without B.V/ without guard, double head working, LE kms, one hour detention, LSD etc.
14. To keep a close watch on the locos TO and FROM shops.
15. To keep watch on overdue schedule locos of Home and Foreign Railway.
16. To keep watch on outage as well as ineffective locos and calculate it as per statistical manual
17. To ensure rear loco shutting down/De-energizing in case of light loads/LE movements.
18. To ensure availability of locos/turn over at interchange points.

DUTIES OF POWER /TRACTION LOCO CONTROLLER (CO ORD & Coaching)

1. Updating the Shed outage by taking shed IN and OUT from main sheds & T/Sheds every four hours in a day.
2. Updating Divisional holding by taking interchange from control boards from time to time.
3. FOIS operation-Locos shed IN and shed OUT; changing of service, domain; loco position & loco holding tallying.
4. COIS operation-Daily attaching and detaching of locos for all coaching trains as per nomination, special trains (which are running with goods domain locos).
5. Loco wise outage and utilization calculation and daily reports to officers.
6. ODS locos location update, engineering locos. Dead loco movement, loco troll position, special drives.
7. Feeding and printing of daily reports and unusual.
8. Record maintenance of Signal and track defect, loco defect, loco inspectors movement, staff position.
9. PDD & PAD particulars, 10 hrs compliance by taking from all lobbies.
10. Daily HSD oil consumption and decanting particulars from all RCDs. Maintain the records of the HSD oil stock position, average issues per day and number of tank wagonswaiting for decanting. Monitor the movement of HSD oil tank; ensure to keep sufficient stock of HSD oil in various fuelling installations.
11. Fuel oil/ Energy consumption details to analyze crew performance for all trains through CUG phone.
12. To assist on duty TLC/PCOR in failure management on line
13. Punctuality, failure analysis if required to be put up for reclassification for failure/punctuality loss.
14. Liaison with operating, S&T, Engineering departments in day to day work.
15. To prepare daily positions for.
16. To collect Data of running room, lobby and RCDs.
17. To put up the unusual occurances reported by crew to Sr.DME/Sr.DEE.
18. To keep a close watch on the locos to and from shops.
19. To dispatch of break down cranes within the stipulated time as and when ordered.
20. ART: Position and movement of all relief trains inclusive of cranes, MFD, LUCAS, HRDs etc.

DUTIES OF POWER/TRACTION LOCO CONTROLLER (CREW)

1. To keep a close watch and coordination with operating department to meet the day today train operations.
2. To maintaining the liaison with diesel sheds, crew booking points for providing crews for various service and timely dispatch of loads.
3. To monitor the punctuality of train services by ensuring the prompt attendance of crew, crew changing, fuelling etc. are done within allowed time.
4. To advise the loco pilots in time to run at maximum permissible speed to gain time whenever the coaching trains are running late.
5. To ensure proper maintenance of engine links and crew links. Keep a close watch of late running of trains and set the links without dislocating the link.
6. To watch and monitor the VIP specials if any, precautions to be taken to avoid unnecessary detention.
7. To keep updated about crew link and working time table.

8. To give feedback to official and head quarters in time regarding unusual occurrences if any so as to enable them to take immediate corrective steps.
9. To ensure ensure that the crews are not allowed to work longer hours on duty by avoiding pre-departure detention and also see that the running staff does not get OT by allowing all the staff in each depot to work equally.
10. To plan of crew requirement for various services as per train ordering.
11. To ensure proper in booking of crews to avoid over time by allowing all the running staff in the depot equally.
12. To maintain discipline of his staff.
13. To ensure the sufficient rest is given as per HOER before booking out the crews.
14. To maintain liaison with adjacent divisions in respect of "balancing" of crews.
15. To keep watch on train operation in order to avoid excessive waiting duty for running staff and take remedial action as required in coordination with operating control.
16. To study the cases of running staff performing more than prescribed hours of duty at a stretch and take remedial action to avoid reoccurrence.

30505 Duty of Chief Traction Loco Controller (CTLC)

In addition to overseeing the work of ATLC/TLC, Chief Traction Loco Controller shall

1. Check of loco link charts, booking records and control charts and report all cases of avoidable detentions to electric locomotives in yards and sections;
2. Organize suitable relief loco in consultation with Section Controller in case of loco disablement;
3. Scrutinize daily loco operating statistics;
4. Organize trials of electric locomotives;
5. Arrange escorting staff for trains carrying VIPs and other important trains as per procedures specified by the Railway.

30506 Duties of Chief Loco Inspector

The Chief Loco Inspector will report to CCC and their main duties will be as given in subsequent paragraphs.

30507 Duties of Chief Loco Inspector

Duties of chief Loco Inspector shall as under

1. To plan out in advance that train Loco Pilots and other running, staff put under their charge 'learn the road' and become fully familiar with all the signals and layout of the track, en route and in yards; test the running staff for their knowledge of road as detailed in para 30615 and arrange for issue of Competency Certificate to them;
2. To train running staff in the correct methods of trouble-shooting, correct manner of operation of electric locomotives, inspection of locomotives in accordance with the prescribed rules;
3. To maintain records in respect of running staff allotted to his charge indicating the training imparted, refresher and promotional courses gone through, knowledge of safety rules, knowledge of troubleshooting procedures etc.; watch running staff of poor calibre with a view to improve them and in exceptional cases when a person fails to make the grade, submit report to TFR;
4. To make himself fully aware of the competence of each of the crew under his control. He should also be familiar with their habits, like drinking etc., traits, state of health and other personal problems. It

is the responsibility of the driving inspector to ensure that he has counselled all the crew under his control at least once a month. For this purpose he will maintain a proper calendar /diary;

5. To keep high morale of the driving crews and keep on reporting about the same to superiors;
6. To conduct enquiries into accidents, detention cases, disciplinary cases, etc., as directed by his supervisers.
7. To carry out any other duties assigned by Sr. DEE/DEE/AEE(OP).

30508 Duties of Senior Loco Inspector (SLI)

In addition to the duties assigned by Sr. DEE/DEE/AEE(OP), Senior Loco Inspector (SLI) will

1. carry out trials and checks on speed, signal visibility, riding quality of locomotives; test staff of other departments as prescribed for their knowledge of rules applicable to operation of Electric Locomotives and report to SR. DEE/DEE/AEE (OP), if any irregularities are noticed;
2. Inspect locomotives particularly in regard to safety items and take necessary action to get the defects attended by the home or outstation shed.

A nominated Loco Inspector designated as Senior Loco Inspector (TELOC) will collect and scrutinize the speedometer charts regularly- 100% for passenger locos and 25% for goods locos and bring irregularities to the notice of Sr. DEE/DEE/AEE/(OP) for appropriate corrective action.

The assigned SLI shall keep a watch on duty hours of the Running Staff and report the matter to Sr. DEE/ DEE/AEE (OP) for taking suitable corrective measures.

I. Counseling

II. Inspection

III. General.

IV. Diary

I. COUNSELING:

1. Train the running staff in the correct methods of trouble shooting, correct manner of operation of electric locomotives, inspection of locomotives in accordance with the prescribed instructions and observance of safe working rules. Train the running staff about new modifications carried out in electric locos and practical demonstration of various items.
2. Train the new loco pilots regarding how to apply air brake application on loco and on train.
3. To improve driving skills of loco pilots by adopting latest methods of energy conservation.
4. To arrange issue of competency certificate to running staff for working in automatic signalling sections after giving them one day intensive training and after testing their knowledge.
5. To advice Loco Pilot to reach Maximum Permissible Speed, as early as possible.
6. To ensure Loco Pilot has conducted Brake continuity test, brake feel test and brake power test as per procedure
7. To ensure Road learning of Tower Wagon Driver and track machine operator.

II. INSPECTION:

1. Foot plate inspection during day and night to check abnormalities on line and rectification of the same through concerned departments.
2. Inspect locomotives particularly in regard to safety items including proper functioning of flasher lights etc. and take necessary action to get the defects attended to by the home or outstation shed as per convenient.

3. Check out load, speed checks, intersectional running time, braking distance and signal visibility checks (joint inspection with S & T department), riding quality checks of locomotives, test staff of other departments as prescribed for their knowledge of rules applicable. If any irregularities are noticed with loco/ crew to be reported to Sr.DEE/TRSO & ADEE/ RSO.
4. To impart intensive training to Loco Pilots who are weak in various aspects of driving technique and when a person fails to make the grade, submit reports to Sr. DEE/ TRSO.
5. Foot plating by mail/express trains to make up lost time (to maximum permissible limits) lost due to loco defects or any other account.
6. To conduct punctuality drives to ensure punctual running of mail/ express and slow passenger trains and counsel loco pilots to make up time without exceeding maximum permissible speed.
7. To escort VIP and other important/ special trains.
8. To test and check the accurate working of the speedometers on run and arrange for attention to defective speedometer by shed staff as required.
9. The importance of punctual running of said train may be informed to the crew well in advance informing that loco inspector is coming in the Loco, other officials in the coach/ Saloon, if any.
10. To ensure that Loco Pilot came to on duty in time as per the Divisional Instructions.
11. To prevent unanchored travel in loco cab.
12. Loco Inspector should ensure that Loco Pilot and Asst. Loco Pilot checked loco thoroughly. LI may also check the loco, to ensure the loco is fit to work the existing formation and required amount of BP Pressure in Engine. (Also to ensure BP continuity test be conducted).
13. To ensure safety items of loco are in good working order such as Horns, wipers, Flasher Light, Head Light, etc.
14. To ensure all necessary documents were received and correct Authority to Proceed is given and starting signal from guard.
15. To conduct trails for energy conservations, modifications, and heavy hauled trains.

III. GENERAL

1. Inspection of allotted running room allotted to him, regarding facilities available for running staff and also conduct ambush checks to see whether LP/ALPs are taking proper rest at running room.
2. To conduct ambush checks in automatic signalling territory to see whether the loco pilots are following relevant rules as laid down in General & Subsidiary rules.
3. To carry out surprise inspection of out pits, crew booking offices including breath analyzer equipment, CMS for proper functioning, proper usage and to check that proper procedure is followed.
4. To conduct ambush checks with speed guns to ensure LPs observing caution order, loop line speed etc.
5. Joint checking of emergency telephone sets used on electric locos with supervisors of S & T department.
6. Periodical checking of loco pilot's personal equipment and stores.
7. To plan out in advance and train loco pilots and other running staff to 'learn the road' and become fully familiar with all the signals especially automatic signaling sections, signal located on right side and layout of the track, en-route and in yards, test the running staff for their knowledge of road and arrange for issue of competency certificate to them.
8. To scrutinize speedometers down load data removed from locomotives and report to superiors, if any over speeding or other irregularities are noticed. 100% scrutiny of charts from mail/ express

and passenger trains and 25% of charts from goods trains should be carried out.

9. To carry out special drives and trails as directed by head quarters/ division.
10. To maintain records in respect of running staff allotted to his control indicating the training imparted, refresher and promotional courses gone through knowledge of safety rules, knowledge of trouble shooting procedures etc.
11. To review of troubleshooting carried out by each loco pilot and impart necessary guidance if any incorrect procedure or irregularity is brought to notice.
12. Associate with training school and ensure the troubleshooting aspects that are taught in the classes are relevant to the existing problems, education of running staff regarding engineman- ship - loco failures and breakdowns.
13. To conduct of DAR enquiries and attending any other enquiries ordered by Officers
14. Ensure Headquarters/Railway Board's statements pertaining to engine performance, stalling cases are put up to concerned Officers in time
15. To keep watch on over implementation of 10-Hour Rule to running staff
16. Updating, monitoring and gradation of Loco Pilots in CMS.
17. To ensure LP/ALPs are signing on CMS, feeding of energy consumption, quick score program and VCD particulars in CMS.
18. To check call data of CUG phones of on duty LP/ALPs.
19. To attend meetings viz. Mechanical, Statistical, Safety, etc.
20. To conduct safety seminars at crew lobbies, interacting with family members of LP/ALP and counselling them on importance of taking rest by LP/ALP at home.
21. To perform any other duties that may be given from time to time by Officers of Diesel/Electric sheds and other officers of the administration.
22. To ensure Loco Pilot has gone through all necessary registers in crew lobby and signed wherever required.
23. To ensure Loco Pilot has collected all necessary documents, keys, if any, from in charge of crew lobby.

IV. Diary

All LIs should updated their diaries with the information as under

1. Personal bio-data of li
2. Instructions from officers
3. Loco Inspector diary inspection by officers
4. Instructions / Circulars issued during year
5. Safety drives
6. SOBs for the year
7. Counseling of sobs
8. Counseling of circulars lp/alp
9. List of nominated crew
10. Bio-data of nominated loco pilot /loco pilot (shunting)
11. Monitoring history of loco pilots / loco pilot (shunting)
12. Monthly overdue figure of nominated loco pilots
13. Monitoring details of nominated loco pilot

14. Quarterly checking of personal tools / equipment of nominated loco pilot
15. Surprise checks / ambush checks / mock drill
16. Alcoholism report, good / bad work / awards by nominated loco pilots
17. DAR enquiry details
18. Daily movement report
19. Performance assessment parameters for grading of drivers into 'a', 'b' and 'c' category xx.
20. Summary of grading in different parameters of nominated loco pilots
21. Major irregularities of crew lobby
22. Training or safety seminars given/attended
23. Gradation done and due details
24. Items to be demonstrated practically to lp/alps
25. Foot plate inspection details

30509 Vision Test Register

All running staff should undergo PME test. Different occasions where running staff has to undergo PME is given below.

In ''FETCH AS PER RULE'' option, CMS will take care of all the mandatory requirement for crew booking such as rest availed by crew, PME, Road learning, refresher courses and competency of loco

30510 Running Staff Passed Fit with Spectacles

1. A list of Loco Pilots, Assistant Loco Pilots, Shunters and Motormen who have been declared fit for A-l category with glasses should be prepared with the names of staff of each category arranged separately and in alphabetical order. This list should be exhibited prominently in the booking office for each category of staff, who are likely to be booked from his station. The CCC should ensure that this list is complete and updated in all respects
2. Each member of the running staff who is declared fit for A-l category with glasses must constantly use glasses on duty and in addition should carry a spare pair of spectacles with them always when on duty. During inspections, check should be exercised by officers and supervisors to ensure compliance.
3. Running staff passed fit with spectacles are also required to feed details of spare spectacles while signing on in CMS.

30511 Rules Applicable to Running Staff

The General Rules and the Subsidiary Rules issued by the Zonal Railways prescribe the duties of train crew. Running staff will also be abided by all the rules given in Operating Manual of Zonal Railways about their call, booking and liability for duty, etc.

30512 Acknowledgment of Circulars etc.

In addition to thorough familiarity with the General and Subsidiary Rules, Manual of AC Traction, Accident Manual, Working Time Table (in particular the permanent speed restrictions), Operating Manual for various types of electric locomotives and departmental circulars issued from time to time, every member of the running staff shall, when signing on duty, study circulars, notices, instructions, copies of the Gazette etc. displayed on the notice board or in the CMS. They shall particularly acquaint themselves with details of temporary speed restrictions imposed in the section in which they have to

work, details or Caution orders and advice of defective signals. If any person has not understood any of the instructions, He/She may seek clarification from the CC on duty.

30513 Availability of Dry Sand

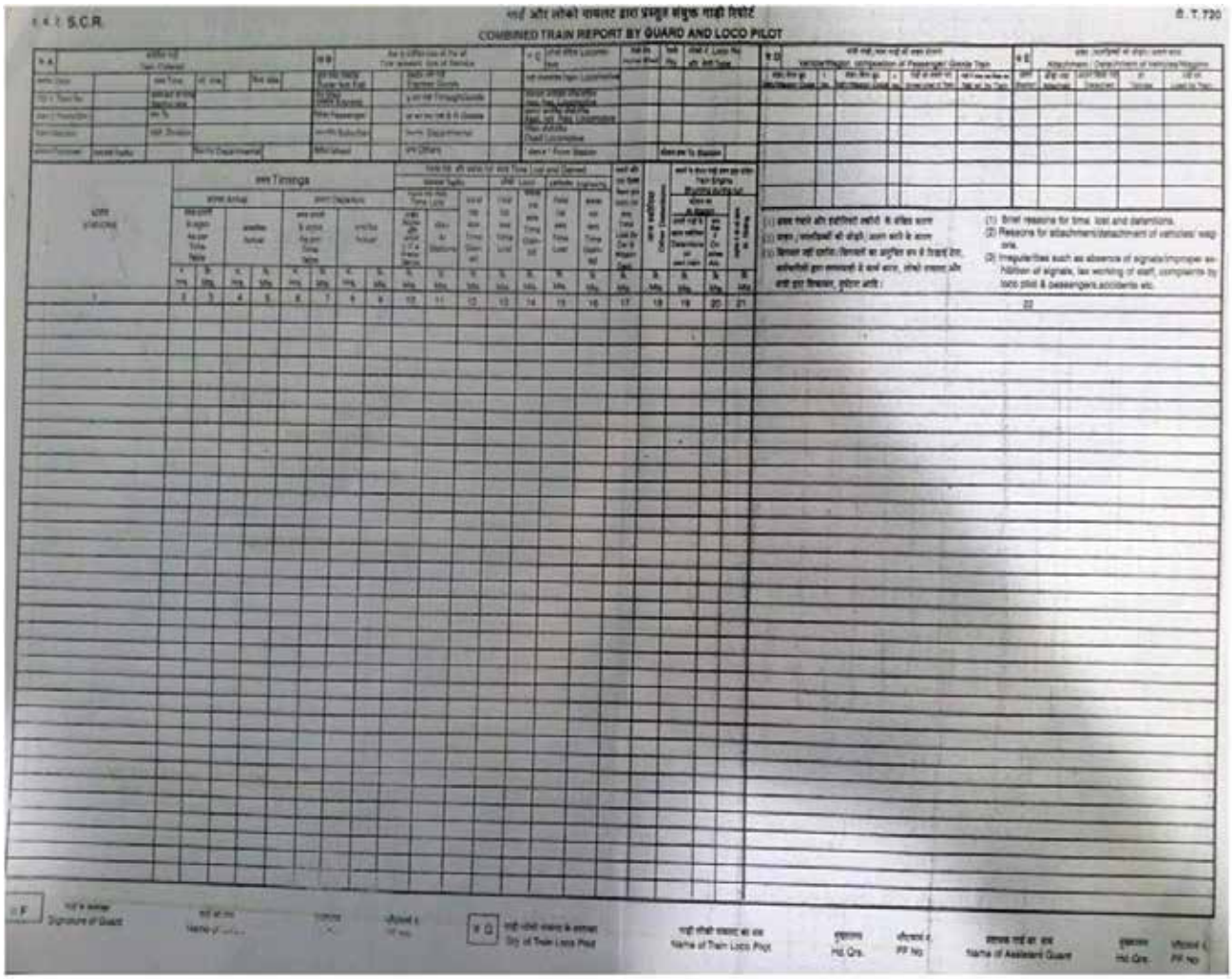
All electric locos are fitted with sanding equipments to improve adhesion and prevent wheel- slipping when starting under difficult conditions e.g. up-gradients or when rails are wet. Sanding is effected by means of electro-pneumatic valves to sand the front axles of each bogie in the direction of motion, the control being achieved by a pedal switch in each cab. Means are provided to adjust the height of the sanding nozzles. In modem locos automatic sanding takes place on the onset of incipient slipping.

The sand to be used should not cake in the sand box and should be dry, free from clay, loam, mica and other foreign materials. A detailed specification for the sand has been issued by RDSO. Facilities should be available in all loco sheds and such outstation depots as considered necessary for ensuring art adequate supply of screened and dry sand. Special care is also required during inspections to ensure the water-tightness of sand box covers.

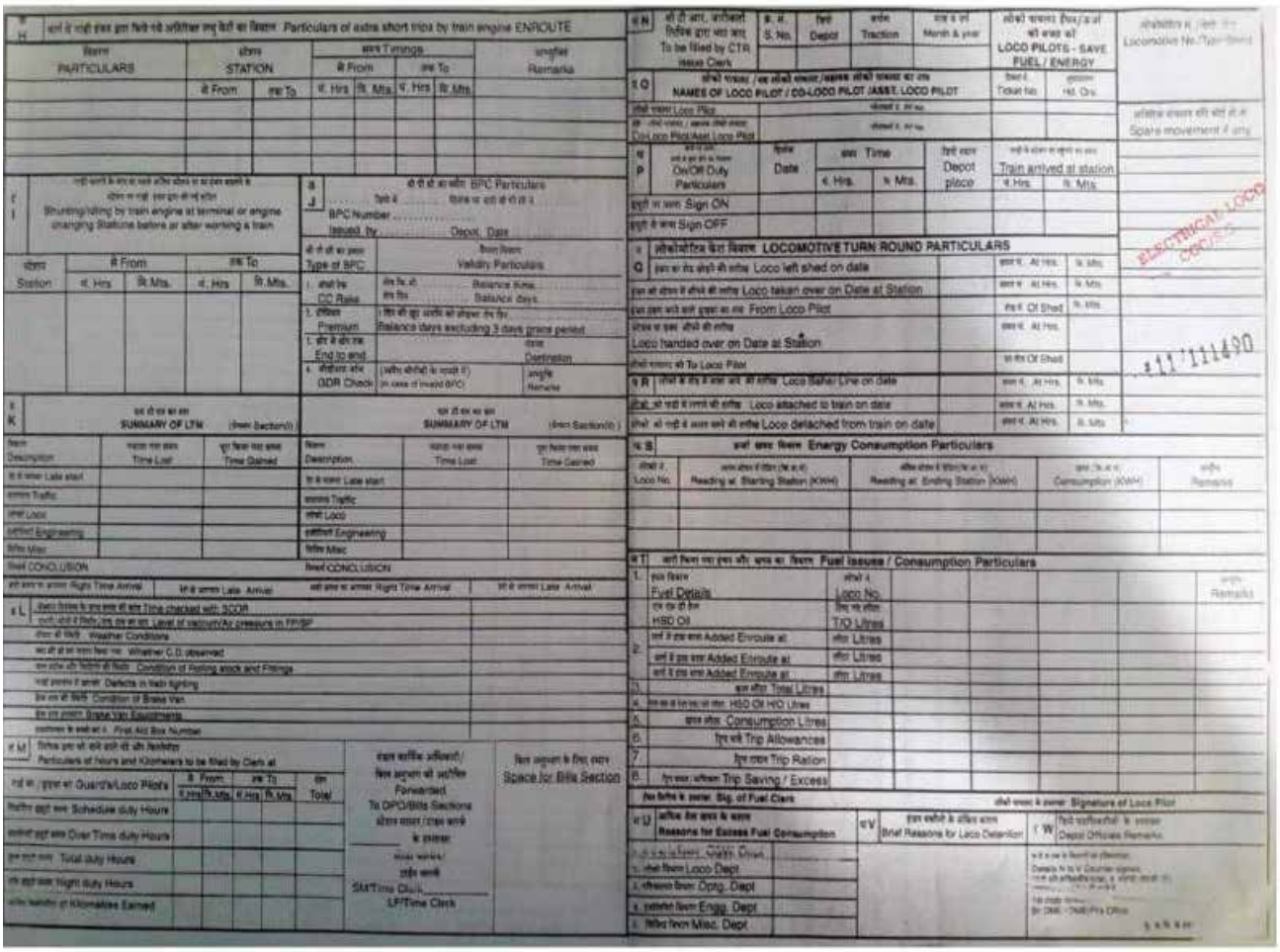
Annexure 5.01

COMBINED LOCO PILOT'S & GUARD'S REPORT

The only basis of the operating statistics which give the vital performance index of a particular type of locomotive or the shed emanates from Combined Guard's and Driver's Report Part -1 and Part - II (attached). This report in addition to being an instrument of payment of wages, running and overtime allowances to the crew, also becomes the basis of operating statistics. This goes to the statistical office and gets coded in the coded sheet for operating statistics. It is therefore important that the Crew Controller should check very particularly all the details given in the joint report so that the operating indices of the shed are not vitiated.


S.C.R.

COMBINED TRAIN REPORT BY GUARD AND LOCO PILOT



30514 Seasonal Precautions

(Railway Board Lr. No. 2005/Elect(TRS)/440/23 Dt: 24.02.2016, 11.05.2017 & 22.09.2017 and from Camtech Booklet No. CAMTECH/12-13/S&M-Precaution/1.0, August, 2012)

A few essential precautions required to be taken prior to the commencement of the monsoon, pre-summer season and pre-winter season are listed below. Local instructions may be issued to supplement these lists as required.

PRE SUMMER PRECAUTIONS FOR CONVENTIONAL AC ELECTRIC LOCOMOTIVES

1. Temperature checking of axle box, MSU and TM bearing through contact less digital temperature meter of each locomotive during shed/out pit visit. Proper record should be maintained for timely detection of any abnormality and to arrest failure of bearings on line.
2. All TMs to be checked for proper fitment of inspection covers. A cyclic check to be conducted on all locomotives for ensuring proper pressure in commutator chamber of all TMs.
3. A cyclic check should be done on all locomotives for ensuring proper cleaning of side body filters. Monitor depression inside loco by a manometer and it should not be more than 6 – 7 mm.
4. Transformer oil cooling radiator of all locomotives should be cleaned by blowing air, checked for proper cleaning and air suction through MVRH one cycle.
5. One cyclic check of SL coils cleaning and blowing to be ensured and intactness of SL covers both top and bottom properly must be ensured.
6. All relays must be provided with covers along with proper gasket to ensure dust free environment

for relay operation – one cyclic check.

7. A cyclic check to be taken in all locomotives to ensure modified oil dipstick/ cap on suspension bearing oil pump of all TMs.
8. All Trip sheds must be strictly instructed to top up suspension bearing oil up to maximum mark and for this purpose availability of oil in Trip sheds must be ensured at the level of Sr.DEE/TRS.
9. Nil oil leakage through suspension bearing must be ensured. One cyclic check to be completed by March.
10. All blowers must be checked for delivery of rated air output. In case of malfunctioning of blower relay, case should be properly investigated and working of blower properly shall be ensured.
11. Proper working of all blower relays in the locomotive must be ensured one cycle check by March.
12. RSI block Elmex and SBs at different locations must be checked for dust freeness to avoid any chances of tracking – cycle check.
13. WAG7 locos fitted with compact RSI blocks with 3 bridge design should preferably be utilized in MU formation. Similarly WAG5 locos for freight operation should work only in MU configuration.
14. SIV fan bearing should be replaced as per specified schedules. Ensure implementation of Reliability Action Plans for different manufactures of SIV.
15. Working of cab fans must be ensured in all locomotives - cycle check
16. All locos fitted with Cab-air conditioning should be in working condition.
17. All types of rubber hoses must be closely examined for their physical condition and should be changed on condition basis – cycle check.
18. SB oil pump to be opened, sump to be cleaned on all locos – cycle check.
19. Re-greasing of MVMT bearing during IC to be ensured.
20. Loco interior to be thoroughly cleaned of accumulated oil and dust - one cycle check.
21. Drivers must be alerted to feel the axle boxes as often as possible
22. There should be no leakage of grease from Axle box front cover and rear dust guard. Axle boxes should be thoroughly examined.
23. Earthing shunts should be intact.
24. Gear case half ring and half ring felt should be properly fitted - cyclic check do be done.
25. Sunvisors in both cabs should be secured. One cycle check.
26. Roof insulators should be cleaned thoroughly. One cycle.
27. Clean oil bath filters of CP & ensure proper fittings. Cyclic check.
28. Fuses with covers should be secured. Cyclic check.
29. Apply petroleum jelly on reverser contacts.
30. Cab heaters to be disconnected by providing insulating plate in fuse box.
31. Inspection covers, terminal covers and bellows of traction motors should be checked for proper fitting and tightened by providing necessary gasket.
32. Secure and properly clean Traction Motor expanded metal protective screens.
33. Transformer sealing gasket should be checked and replace if need be to avoid dust ingress.
34. No leakage of transformer oil from transformer GRMPH circuit and other accessories and proper cleaning in its vicinity. - Cyclic check.
35. Ensure transformer oil in gauge glass and oil level in tap changer not more than 20 deg.C.
36. Battery boxes should be cleaned. - One cycle.

37. Top up batteries with distilled water.
38. Petroleum jelly to be applied on battery connections.
39. There should be no leakage of compound from gear case & half ring.
40. There should be no oil leakage in the loco from CP.
41. Ensure cyclic check of cables, dressing, bunching, provision of gromets by March.
42. Check battery charger and adjust voltage / current.
43. RSI blocks should be checked & there should be no dust accumulation.
44. Secure dust proof transparent covering of Aux. Interlock assembly, RS assembly.
45. Ensure proper greasing of all TMs in IC schedule.
46. TM leads should be checked for proper cleating.
47. Proper greasing of bearings of all Aux. Motors to be done during inspection schedules.
48. Ensure that all the Aux. Terminal covers are intact.
49. Ensure no over-aged battery in service. A cyclic check to be completed.
50. Ensure availability of fire extinguisher in locos.

PRE SUMMER PRECAUTIONS FOR THREE PHASE AC ELECTRIC LOCOMOTIVES

1. Blowing of all filters during every schedule from 15th March to end of July.
2. Washing and blowing of radiators during every schedule from 15th March to end of July.
3. Reverse blowing of radiator in working condition of OCB1 and 2 in one cycle.
4. Checking and washing of MRB-1 and 2 filters by removing in every schedule from 15th March to end of July.
5. Ensure working of churning fan in CEL-1 & 2, SR-1 & 2 and BUR electronics. (Loco wise record shall be maintained).
6. There should not be any air leakage from duct joints of blowers.
7. Checking of overheating of 35 sq.mm cables and 70 sq.mm cables in HB-1 & 2 panels.
8. Checking of oil leakage in capacitors of DC link of SR- 1 & 2, BUR-1, 2 & 3 and FB panels.
9. Washing of OCB-1 & 2 filter by pressurized water until clean water delivering from filters from 15th March.
10. Check BA cables male and female contacts for any sign of flashing/overheating.
11. Ensure availability of 100% ceramic filters in batteries.
12. Clean vent plugs of Batteries. All vent plug holes should be clear.
13. Check oil leakage at following points:
    a. All flange joints of pipe, radiator, pumps, and conservators.
    b. Near SR-1 + 2 pumps
        i. At isolating cocks
        ii. At sensor joint
        iii. At bellow of pipes
        iv. At conservators
    c. All gate valves and pipes at under-frame.
    d. All pressure sensors/temperature sensors fitting points, gauge glass of SR-1 & 2, conservator 1 & 2.
14. Carry out a cyclic check on all locomotives for ensuring proper cleaning of TM blower filters.
15. Ensure Gear Case oil to ½ mark.

16. Check all blowers for delivery of rated air output.
17. Closely examine all types of rubber hoses for their physical condition and should be changed on condition basis - cycle check.
18. Thoroughly clean loco interior for accumulated dust - one cycle check.
19. Ensure securing of sun-visors in both cabs.
20. Clean filters of compressors (CP) and ensure proper fittings.
21. Check terminal covers and bellows of traction motors for proper fitting and also check bellow plates and bolts.
22. Ensure no leakage of transformer oil from transformer, converter, MPH circuit and other accessories and also ensure proper cleaning in its vicinity.
23. Ensure no oil leakage from gear case. A cyclic check shall be completed.
24. Ensure no over-aged battery in service. A cyclic check shall be completed.
25. Ensure sealing gasket of doors, windows, filters etc to avoid entry of dust inside Machine room. A cyclic check shall be completed.
26. Ensure transformer oil and SR oil in gauge glass between minimum and maximum level.
27. Check working of fire detection unit. In FDU one cycle check of potentiometer output value shall be done. Check RR section during pre testing and get it corrected from Relay section if required.
28. Ensure intactness of earthing wire connection with Traction Motor.
29. Carry out blowing of Harmonic Filter Resistance on roof.
30. Ensure proper cleaning of inter/after coolers of main compressors by compressed air.
31. Ensure cleaning of battery boxes.
32. Top up batteries with distilled water in all schedule inspections.
33. Ensure instructions contained in RDSO's letter no.EL/3.2.1/3-ph dated 30.07.09 for arresting oil leakage cases from transformers i.e.
    a. Oil leakage from Bushings and Bushing plates.
    b. Oil leakage from the Stuchi coupling & rubber hose pipe of conservator tanks. RDSO Technical circular No. ELRS/ TC/ 0076 dtd. 17.09.2002 on "Oil leakage from the transformer bushings and cover in three phase locomotives" may be referred.
34. Ensure provision of modified cooling radiators for better cooling of traction converter control electronics. (Ref: RDSO letter no. EL/11.5.5/5 dated 15.02.10).

    Refer RDSO purchase specification No. RDSO/ 2009/ EL/ SPEC/ 0100 Rev. (0) dtd Nov, 2009 for procurement of modified cooling radiator.
35. Ensure removal of interlocks of control circuit contactors No.126 from MCPA circuit (Ref: RDSO/ 2011/ EL/ MS/ 399 Rev. 0. dated 08.08.11)
36. Ensure partial blocking of opening duct of back side of auxiliary converter of three phase electric locomotives as shown in figure 1.

    Ref : RDSO MS no. RDSO/2009/ EL/ MS/ 0385 (Rev.0), Dated 15.12.2009)
37. Ensure implementation of modification sheet for shifting of the termination of 4GKW,1.8 KV, 70 mm2 cable and 2 x 2.5 mm2 cables housed in lower portion of HB-2 panel and provision of Synthetic resin bonded glass fiber (SRBGF) sheet for three phase locomotives as per MS RDSO/2011/EL/ MS/0400 Rev.'0' dated. 10.08.11.
38. Ensure implementation of modification sheet for relaying of cables in HB-2 panel of three phase locomotives to avoid fire hazards as per MS of RDSO/2011/EL/MS/0401, Rev.'0' dated 10.08.11.

39. Ensure implementation of modification sheet for auto switching of machine room/ corridor lights to avoid draining of batteries in three phase electric locomotives as per MS of RDSO/2011/EL/MS/0403,Rev.'0' dated. 30.11.11.
40. Carryout measurement of cable continuity for all four earthing brushes.
41. Ensure completion of modification for closure of two central ventilators in WAP-7 and WAG-9 locomotive in order to avoid ingress of dust, as per RDSO modification sheet No. RDSO/2009/EL/MS/0380(Rev0) dated 06.07.2009.
42. Modification in Auxiliary circuit of locomotives for isolation Air conditioner circuit, in case of earth fault in the air conditioning unit to avoid SIV tripping as per RDSO modification sheet No. RDSO/2011/EL/MS/0394 Rev'0' Dated: 09.02.2011.
43. Ensure cleaning of Oil Cooling Radiators in 3 phase electric locos, as a pre-summer activity prescribed by RDSO vide letter No. EL/3.1.35/16, dated 05.06.13.

PRE-MONSOON PRECAUTIONS FOR CONVENTIONAL AC ELECTRIC LOCOMOTIVES

1. Ensure completion of rainwater protection and pre-monsoon precaution works well before onset of monsoon.
2. Test the water-tightness of loco body including roof by means of a high pressure water jet and seal all leakage points. Water jet test facility should be as per RDSO SMI No. RDSO/2017/EL/SMI/0315 Rev '0' dt: 03.10.17. (It must be ensured that the loco is well away from live OHE to prevent the water jet coming into contact with live wires)
3. Special attention should be given to the following points and gasket for ensuring no water leakage:
   a. Loco body joints and hood joints.
   b. Joints of the mounting bases of roof equipment.
   c. Head light gaskets.
   d. Joints of look out glasses and corridor side glasses.
   e. Door gaskets.
   f. Sand box gasket and covers.
   g. Joints of marker light.
   h. Cover of multiple operation / coupler sockets.
   i. VCB cover joints.
   j. Side body filter joints with super structure.
   k. Glass shutters.
   l. Roof gasket.

   Note: After the first rain the loco should be inspected thoroughly to detect and attend to leakage points. Special attention should be paid to the above water leakage points.
4. Cleanliness of roof gutters and drain pipes and accumulation of water on the roof.
5. Roof bus bars clamps should be greased to prevent accumulation of water.
6. Check the Cab floor above sand boxes for any water leakage into the sand boxes.
7. Roof joints with super-structure-roof gasket should be in good fettle (condition).
8. Proper functioning of all eight sanders by providing sand of size between 2 microns to 20 microns should be ensured.
9. Ensure arrangements for filling good quality of sand on all crew changing points.
10. Ensure availability of register where acknowledgement of drivers is taken after filling up sand.
11. Ensure entry in log book regarding functioning of sanders and availability of sand.
12. Ensure working of sand drying plant and build up adequate stock of dry screened sand at sanding

points.

13. One cyclic overhauling of additional C-2 relay valve.
14. Proper working of wipers should be ensured.
15. Provision of head light dome and protection cap over horns and sand boxes.
16. Overhauling and Reconditioning of air drier in VCB locomotive on the basis of silica gel colour of desiccant.
17. Paraffin/ petroleum jelly should be applied to the terminals of lead acid battery.
18. Check TM inspection covers and terminal blocks cover gasket and replace them, if necessary. Apply leaguare varnish to TM terminal.
19. Check the bottom covers of the smoothing reactor for any damage, replace, if any cracking are observed.
20. Ensure proper functioning of water separation anddrain cock of the pneumatic pipe system. During monsoon, the pneumatic system should be drained more often to discharge the accumulated water.
21. Provision of RTV compound on MCP terminal box at cable entry point to restrict water entry. Ensure gasket on Terminal box cover or provide RTV.
22. Provision of RTV compound on axle box to restrict water entry in axle box. Ensure gasket on Terminal box cover or provide RTV.
23. Provision of RTV compound on SPM pulse generator (PG) to restrict water entry.
24. High flood marks 9" should be painted on the cattle guard to give the indications to the drivers of water levels over the rails.
25. The transformer oil and tap changer oil should be tested for dielectric strength in a cycle before the outset of monsoon, and filtered if BDV is less than 40 kV.
26. Dissolved Gas Analysis (DGA) of transformer oil.
27. Ensure adequacy of transformer/ GR oil levels and also ensure healthy condition of silica gel, replace if required.
28. Drain cock and sampling cock covers of transformers are to be sealed properly to avoid moisture entry.
29. Drain the compressed air pipe line manually where the automatic drain valves are removed and cocks are provided.
30. Apply a coat of anti-corrosive paint on the roof bolts while the loco comes to shed.
31. Ensure opening / closing of side window shutters.
32. Insulation resistance of vital equipment like TM, SL lying on shop floor to be improved by baking in oven, varnishing and proper covering.
33. All air dryers to be ensured in proper working order.
34. All EMU type After-Cooler to be regularly drained by drivers as well as at out pits.
35. One cycle calibration of QD relay setting for proper pickup and dropout current.
36. Ensure availability of fire extinguishers in locos.

PRE-MONSOON PRECAUTIONS FOR THREE PHASE AC ELECTRIC LOCOMOTIVES.

1. Check water leakage from machine room filter and TM blower filter joints during water tightness test.
2. Replacement of Silica gel of Converter.
3. The transformer and converter oil should be tested for dielectric strength in a cycle before the onset of monsoon, and filtered if BDV is less than 40 kV.

4. Dissolved gas analysis of transformer and converter oil.
5. Insulation resistance of vital equipment like TM, Auxiliary blowers lying on shop floor to be improved by baking in oven, varnishing and proper covering.
6. Ensure implementation of modification sheet no. RDSO/ELRS/MS/0328 (Rev.0) dtd. 29.10.2003 for provision of water discharge outlet in TM & oil Scavenge blowers.
7. Checking of Megger value of Harmonic filter Resistance and cleaning if found less.
8. Battery box covers to be made water tight.
9. Side body air filters to be cleaned and maintain dust free environment.
10. Provision of drain pipe in SCTM bottom half to drain out accumulated water.
11. Fire prevention measure issued by RDSO vide letter No. EL/3.1.35/2 (Elect), dated. 29.01.2013 for three phase locos should be implemented.

WINTER PRECAUTIONS FOR CONVENTIONAL AC ELECTRIC LOCOMOTIVES

1. During all trip inspections or roof inspections whenever carried out, proper cleaning of roof-line & pantograph insulators with a wet & dry cloth for maintaining shining surface finish to be ensured. Further, application of Silicon oil to increase the hydrophobicity of insulator porcelain surface after cleaning and rounding off work on sharp edges of roof bar connections & fittings as per instructions laid down in RDSO SMI No. RDSO/2012/EL/SMI/0274, Rev'0', dated 29.03.2012 to be ensured by homing sheds before November.
2. Ensure joint checking of loco roof equipment (including pantographs, cleaning of roof insulators and roof bars etc.) with TRD staff at sheds & trip shed as a preventive measure.
3. Also, check flashover of roof insulators and roof line fittings as per RDSO's SMI no. RDSO/2012/EL/SMI/0274 Rev '0' dated 23.03.2012.
4. Regreasing of the servomotor of pantographs.
5. Ensure that all the four cab heaters/blowers are in working order.
6. Terminal connections of cab heater cum blower assembly are to be modified as per RDSO modification no. RDSO/2011/EL/MS/0408 Rev'0', dt. 30.05.12
7. The window shutter sealing gaskets to be checked and made air tight.
8. Ensure Cab doors and corridor doors locking handles are in working order. The door sealing gaskets should be held tight in the position.
9. Cab ventilator cover sealing should be perfect.
10. Main power transformer, Traction converter and tap changer breather silica-gel condition to be checked and replaced, if necessary. Proper Oil levels in TFP, GR & Traction converter to be checked and oil tested for dielectric strength.
11. Compressor oil baths to be checked and oil replaced, if necessary. Ensure unloaders are in working order.
12. SMGR sealing gaskets to be checked to ensure that there is no air leakage.
13. SMGR servomotor cylinders to be cleaned and regreased with recommended grease.
14. Ensure that Air dryer is in working order and isolation should not be permitted.
15. Draining of moisture from all MR and free movement of drain cocks to be ensured.
16. Ensure proper function of auto drain valves and air dryers.
17. Servomotors of CTFs & reversers to be lubricated afresh.
18. TM inspection cover sealing gaskets be checked to ensure that there is no air leakage.

19. Brake cylinder adjustment to be carried out and regreasing done. Free movement of brake cylinders to be ensured. If found sluggish, then overhauling should be done.
20. Terminals of battery to be checked for sulphation, cleaned and petroleum jelly applied on the terminals.
21. Sand boxes to be checked, wet sand to be removed and dry sand to be filled. All eight sanders are to be kept in working condition. Provision of gaskets to be ensured for air tightness.

The pre-winter precautions- provision of fogpass /fogsafe devices:

Fog Safe device: Check its availability and ensure it is in working order. (Use of Fog safe device during foggy and inclement weather as per Railway Board letter no.98/safety (A&R)/19/16 Dt. 25/10/2019).

a. Instructions on train operation during foggy weather have been issued by Railway Board vide their letter referred above.
b. Fog Safe devices are in use in many zonal Railways such as NCR, NR, NER, ECR, etc and being deployed similar to walkie-talkie (VHF sets) where crew collects and deploy Device during commencement of duty and return in home lobby after completion of duty. Device being mapped to specific route, above procedure is appropriate. Same procedure to be adopted in Central Railway
c. Fog safe device is to be used in every winter season (usually spanning between November to February) and instruction have already been issued to ensure that running staff is properly trained & counselled in use of fog safe devices during foggy weather.
d. Fog safe device deployment should be similar to walkie-talkie (VHF Sets). Portable fog safe devices to be kept charged in lobbies and to be carried with by crew during train operation in foggy weather.
e. In this context, it is advised to ensure that adequate nos. of fog safe devices are available and in working condition for providing same to crew along with necessary arrangement for their charging, upkeep and operation.
f. Fog safe device is not failsafe device therefore it should be used as an assisting equipment only. Crew should work as per G&SR and instructions issued time to time.
g. LIs should monitor functioning of fog safe devices. If any correction is required for mapping it should be done on priority.

30514A DUTIES OF LOCO PILOT IN CASE OF CATTLE RUN OVER

When a Loco Pilot observes cattle on his track and according to opinion of Loco pilot the train's increased speed can result in cattle run over then Loco pilot shall control the speed of train by applying A 9 brake valve accordingly. Even after this cattle run over happens then Loco Pilot should stop the train and take the following actions to avoid the possible damages:

1. On the Flasher Light
2. Stop the train immediately
3. In case of any hindrance on the tracks remove it with the help of Railway Official and volunteers
4. Loco Pilot must inspect the Safety fittings of the engine and some side coaches for any damages or abnormalities caused due to run over.
5. In case of any damages or abnormalities seen, Loco Pilot must Report it to TLC and also mention the same in Loco Log Book.

30514B ESMON

Energy & Speed Monitoring (ESMON) System

In addition to energy & speed monitoring, ESMON also indicates and records distance. Hence, we can say that it is a Speed - Time - Distance - Energy Monitoring System.

It is a microprocessor based device. It records speed, time, distance and energy consumed data along with GR coasting and dynamic braking of locomotives. It also provides a graphical view of the data. It has digital display to show all the various parameters like OHE voltage, speed limit for over speed alarm, current data and time. Total distance traveled, energy consumed during halt, energy consumed by present driver. Distance traveled by present driver, duration of brake application, Dynamic brake distance by present driver, distance coasted by present driver, duration of coasting, OHE current, wheel diameter, driver ID train no, train load, loco no and power factor.

All the data are recorded in compact flash card (C.F. Card) i.e. memory card provided in the Speedometer and data can be downloaded by card reader unit, which is very useful for analysis

Type of Speedometer (ESMON) -

<table>
<tr><td rowspan="2">I. MEDHA</td><td colspan="2">Model- MRT 921</td><td>Model - MRT 922</td></tr>
<tr><td colspan="2">(0-150) Kmph (Master + indicator)
Indicator - MRT- 912, MRT - 912 C</td><td>(0-180)Kmph (Master + Slave)
(0-150) Kmph(Master + Indicator)
Indicator-MRT-912, MRT 912C</td></tr>
<tr><td rowspan="2">II. AAL</td><td>Telpro Z</td><td>Telpro ZC</td><td>Telpro -ELC</td></tr>
<tr><td>(0-180) KMPH (Master + Slave)</td><td>(0-180) or (0-150) KMPH - (Master + indicator)
Indicator - Hasler or SP-90's.</td><td>(0-150) KMPH - (Master + indicator) -
Indicator - Hasler or SP - 90's</td></tr>
<tr><td>III. LAXVEN</td><td colspan="3">(0-180) KMPH (Master + Slave)</td></tr>
<tr><td>IV. STESALIT</td><td colspan="3">(0-180) KMPH (Master + Slave)</td></tr>
</table>

Types of memory in SPM (ESMON)

1. Internal memory 2. External memory

Internal memory: internal memory is used in the event when memory card is not inserted in the slot or memory card not properly inserted or fault in the memory card. Data in the internal memory can be down loaded through the serial port connector or RS 232 port provided for the purpose by directly plugging into serial port of any PC /Laptop.

External Memory: it is in the form of a flash card which is inserted to record and down load the data.

Make	Model	External Memory(4MB)				Internal Memory(4 MB) Except MEDHA(2MB)			
		Short Term (hrs.)	Inter-val (sec.)	Long Term (days)	Inter-val (sec.)	Short Term (hrs.)	Inter-val (Sec.)	Long Term (days)	Inter-val (Sec.)
MEDHA	MRT 922/ MRT 921	10	1	90	30	05	1	45	30
AAL	Z, ZC & ELC	03	1	60	30	03	1	-	-
LAXVEN	2000 E2	06	1	120	30	06	1	120	30
STASALIT	-	>30 mts..	1	60	30	>30 mts..	1	60	30

Procedure to enter the PARAMETERS in SPM (ESMON)

a. Open the memory compartment, push the push button switch for configuration mode.
b. Press display button and set Speed limit, Time, Data setting, Wheel Dia. Setting - Type of loco setting - Loco no - Shed name - Equipment No. Setting. Set the parameters and press the enter key.

Note: Parameters to be entered by Shed staff / Authorized person. Parameters to be entered by Driver.

1. Train no. (Maximum 06 characters)
2. Driver ID (Maximum 16 character)
3. Train load (Maximum 06 character)

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30514C RTIS

Real Time Information System (RTIS) System & Onboard RTIS devices in Electric Locomotives:

Railway Board vide Rly Bd Letter No.2016/Elect (TRS)/225/Misc dated15.03.2019 &. RDSO letter NO. EL/3.1.28 dated 01.11.2018 are providing for provision of Real Time Information System (RTIS). CRIS is centralised for provision of RTIS devices in electric locomotive on Indian Railways.

On provision of RTIS device in locos, key information train/loco running information such as loco particulars (Loco No, Loco type, Base shed), Traction type, Train service, Loco locations/ Train Location, Train speed, etc on real time basis will be available in COIS / FOIS module. The real time monitoring is being enabled through ISRO Satellite.

Objectives of RTIS:

1. Automatic acquisition of train movement data & feed to COA for automatic control chart plotting and improved train control functions
2. Emergency messaging from loco pilot to control room
3. Accurate information to passengers regarding train movement delivered as a by-product since COA is already integrated with National Train Enquiry System (NTES)

Onboard RTIS has following components-

1. Outdoor Unit: Rail MSS Terminal (RMT) comprises of Mobile satellite service (MSS) transceiver module, secondary GPS receiver & antennae for all modules) provided on cab – 1 ALP side.

2. Indoor Unit: Indian Rail Navigator (IRN) comprises of following components Display processing Engine (DPE), Integrated Communication Module (ICM) & Power Management Unit (PMU) provided on driver desk Panel on ALP side near D panel.
3. 2A MCB for 110VDC supply in SB1 panel.

Crew Interfaces of RTIS:

1. Crew to confirm availability of power supply to onboard RTIS devices.
2. Crew to confirm healthiness & functioning of RTIS devices.
3. Enter train particulars using Virtual keypad of Display processing Engine (DPE) provided on driver desk Panel on ALP side near D panel.

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30601 Trailing Loads Assigned to Various Locomotives.

1. Trailing Loads Assigned to Various Locomotives will be governed by the load charts issued by RDSO
2. TC-27 RDSO letter No. EL/3.1.39 / 1, dt 27/31.07.1998

Sub: Tractive Effort requirement calculation for starting and hauling BOXN loads. The method for calculation of tractive effort required for starting and hauling loads at particular speed, gradient and degree of curvature and also horse power, OHE current calculation is given in the following paragraphs. The methodology and the various types of formula of Tractive calculation for different loads on various types of gradients adopted are given below.

I. Formula to be used as below :

1. Tractive effort (TE) required for hauling a load " T " tonnes on one in " G " grade and "S" degree curve is given by

TE (kg) = T1 + T2 + T3 + T4

Where T1 is Train resistance in kg/t. T2 is locomotive resistance in kg/t.

T3 is Grade Resistance for train and loco in kg/t.

T4 is curvature resistance for train and loco in kg/t.

2. Train resistance (T1) in Kg/t as applicable to loaded BOXN wagons is given by

T1= 0.6438797 + 0.01047218 V + 0.00007323 V 2

(For details please refer para II below).

3. Locomotive Resistance (T2) in kg/t is given by

T2 = 0.647+ (13.17 / W) + 0.00933 V + (0.057 / WN) V^2

where N is number of Axles.
W is axle load of the locomotive in tonnes.
V is speed in Kmph.

4. Grade Resistance (T3) in kg/t is given by

T3 = (1 / G) X 1000 X (Train load in tonnes +loco wt. in tonnes).

5. Curvature Resistance (T4) in kg/t is given by

T4 = 0.4 X S Degree of curvature X (Train load tonnes+loco wt.in tonnes)

6. Starting Resistance of BOX `N' and BOX wagon is taken as 4.0 kg/t and 5.0 kg/t respectively including Acceleration Reserve.
7. Starting Resistance of the locomotive is taken as 6 Kg/t including Acceleration reserve.
8. Rail Horse Power ` H ' is given by

H = (T.E. (kg) X V (Kmph) / 270) hp

9. Current 'I ' drawn from OHE is given by

I = { (Hx735.5) / (OHE Voltage X P.F. X n) } Amps.

Where **n** is the efficiency of the locomotive

P.F. is the power factor of the locomotive.

For conventional locomotive n is taken as 0.80 and P.F. is taken as 0.84

Note- It is the practice in Railways to take into consideration "Compensated Gradient", while deciding the ruling gradient, in such a case T4 is to be excluded.

II. The rolling resistance of BOXN/BOX wagons in kg/t is represented by the formulae:

i. R= 1.333973+0.021983V+0.000242 V 2
for empty BOX`N` wagons train.

ii. R= 0.6438797 + 0.01047218V + 0.00007323 V2
for loaded BOX `N` wagon train.

iii. R= 1.517+0.01074 V+0.000495 V2
for empty BOX wagons train.

iv. R= 0.870 + 0.0103 V + 0.000056 V2
for loaded BOX wagons train.

Where V= Speed of the train in Kmph.

R= Rolling resistance in kg/t

From the above rolling resistance has been calculated and summarised below for ready reference.

ROLLING RESISTANCE (Kg/t) AT VARIOUS SPEED

Speed kmph	BOX N Wagon		BOX Wagon	
	Empty	Loaded	Empty	Loaded
10	1.5780	0.7559	1.674	0.978
20	1.8696	0.8826	1.930	1.098
30	2.2113	1.0239	2.285	1.229
40	2.6005	1.1799	2.738	1.372
50	3.0381	1.3505	3.292	1.525
60	3.5241	1.5360	3.947	1.690
70	4.0586	1.7360	4.700	1.865
80	4.6414	1.950	5.560	2.052

III. SAMPLE CALCULATION

Load - 4700 t (BOX`N`)

Grade - 1/200 (Uncompensated)

Curvature - 2 degree

Speed - 50 Kmph

Locomotive - WAG7 of 123 t weight

1. TE required to start the load:-

TE = T1 + T2 + T3 + T4

T1 = Train load in tonnes x starting resistance of BOX`N` wagon Including acceleration reserve.

= 4700 X 4 = 18,800 kg.

T2 = Locomotive starting resistance including acceleration reserve x locomotive wt. in tonnes.

= 6x 123=738 kg.

T3 = Grade resistance

= 1/200 X 1000 (Train in tonnes load + loco wt. in tonnes).

= (1 / 200) X 1000 X (4700 + 123)

= 24115 kg

T4 = Curvature resistance = 0.4 X Curvature X (Train load in tonnes + locomotives in tonnes)

= 0 .4 X 2 X 4823

= 3858.4 kg

TE = 18800 + 738 + 24115 + 3858.4

= 47511.4 kg = 47.51 t

Note: 1: 200 gradient on 2 deg. curve is compensated to gradient of 1 : 172.4

{ (1 / G) X 1000 + (0.4 X S) } = 1000/X

where G is grade

S is Degree of curvature

X is compensated grade

2. RDSO haulage chart issued on June'2016 (vide RDSO's publication no. RDSO/2016/EL/PUB/0002 REV 0)
3. To check Emergency Braking Distance (EBD), it can be obtained for different types of locomotives for Goods trains, Passenger trains, LE, EMU & DMU in e-locos by selecting RDSO tab –EBD calculator.

30602 Time Tabling and Loco Link Diagrams

To achieve maximum utilization of locomotives, loco link diagrams should be prepared in such a manner that the locomotives are kept on the run for the maximum number of hours each day with the minimum detentions at terminal stations. This work has to be done by close co-ordination between Sr DOM/DOM and Sr DEE(OP)/ DEE(OP).

1. Loco links are prepared by HQ.'s office and circulated to the divisions. The objective of Loco Link is to ensure optimum utilization of locomotives.
2. Train timings should be as given in working time table.
3. Low-Link should be normally prepared before publication of next working time table.
4. Efforts should be made to send the loco to home shed for mandatory schedule maintenance within the stipulated schedule time

5. Minimum possible out station halt should be provided.
6. Ensure loco is permitted to run on the sections at the max. permissible speed of the train.

30603 Assessment of Operating Staff for Electric Locos.

1. POINTS TO BE KEPT IN VIEW WHILE PREPARING LOCO PILOT'S LINKS (Crew Links) Loco pilot/Crew links for Mail/Exp. trains are to be prepared by CCCOR/CTLC/CLIObjective of crew links is to ensure optimum utilization of crews.
2. Train timings to be checked from the latest working timetable.
3. Links to be prepared before Publication of new working time table.
4. Max. duty hours in anyone trip should not exceed 9 hours.
5. Max. duty hours in a fortnight should not exceed 104 hours.
6. Min. no. of rests in a month should be 5 of 22 hrs. or 4 of 30 hours including night in bed from 22 hrs. to 6 hrs. from sign off to sign on.
7. Efforts should be made to include all the sections in the crew links to avoid crew becoming overdue for learning road and needing frequent road learning as per rule.
8. Min. out of station rest in case less than 8 hrs. duty in the previous trip should be 6 hrs from sign off to sign on. In case duty is 8 hrs or more than 8 hrs, then 8 hrs. rest to be given. In case of short trips of less than or equal to 5 hours then duty performed plus 1 hrs. will be sufficient.
9. Min. home station rest (HQ rest) should be
   a. If duty performed in the last trip is less than 8 hrs., then 12 hrs.
   b. If duty is 8 hrs. or more. then 16 hrs.
   c. If staff is not given mandatory rest then breach of rest allowance shall be payable to running staff.
10. Crew Links having the maximum earning kilometerage should be worked by senior most loco pilots and so on.
11. Separate crew links should be prepared for superfast trains such as Rajdhani/Shatabdi Exp. Chronic late running trains should be kept in view to avoid crew links failures.

Half Yearly Review of Running Staff

FREIGHT TRAINS

1. The requirement of Loco Pilots (LPs) and Assistant Loco Pilots (ALPs) shall be calculated based on the average duty hours per fortnight for the corresponding period of last six months i.e 12 fortnights of preceding year. It shall be ensured that their duty hours are at least 90 hours in a fortnight from signing on to signing off as contemplated in Railway Board's letter No. E(MPP) 006/1/89 dt.4-10-06.

1.1 Information required to be furnished to Finance:

   a. Power Plan and actual workload.
   b. Certificate of the controlling officer that the calculations are as per the procedure and for the efficient working.
   c. Existing Sanctioned Strength of Loco Pilot (Goods)as certified by Personnel branch.
   d. Action taken by Personnel branch to fill up the vacancies.

1.2 Method of calculation of LP/ALP posts:

   a. Each Crew Booking Point shall maintain a Register for accounting the details of trains worked

and duty hours performed by crew for each trip section-wise. The working duty hours shall be reckoned from "Signing On" to "Signing Off. At the end of each month, the total duty hours performed by each crew, section-wise, shall be consolidated.

b. The bare requirement of LP/ALPs for working freight trains shall be calculated based on average duty hours per fortnight reckoned from "Signing On" to "Signing Off77 for the corresponding period of six months i.e. 12 fortnights of preceding year and divided by 104.

c. Percentage to be applied on bare requirement for Leave Reserve (LR), Trainee Reserve (TR), Allowance in lieu of Rest/Time Loss (ALTL) and Traffic Fluctuation (TF) is as under:

		LP/Goods	ALP/Goods
a.	Leave Reserve (LR)	30%	30%
b.	Trainee Reserve (TR)	10%	10%
c.	Traffic Fluctuation(TF)	10%	10%
d.	Allowance in lieu of Time loss (ALTL)	10%	10%

Note:

The bare requirement of ALPs shall be equal to the bare requirement of LPs. However care should be taken that no ALP shall be provided for LPs of DHMU/DEMU/ EMU/ MEMU trains

Method of providing LR, TF, AL:T&»arid TR on bare requirement is as follows:

		LP/Goods	ALP/Goods
i.	Bare Requirement	R	S
ii.	LR on (i)	Rx30%	Sx30%
iii.	Traffic Fluctuation on (i)	Rx10%	Sx10%
iv.	ALTL on (i)	Rx10%	Sx10%
v.	Total	(i)+(ii)+(iii)+(iv)	(i)+(ii)+(iii)+(iv)
vi.	Trainee Reserve on (v)	10%	10%
vii.	Total Requirement	(v)+(vi)	(v)+(vi)

Section-2 LP/Shunting (SHUNTERS) and CHIEF LOCO INSPECTORS (CLIs) common for coaching and freight trains

2.1 Requirement of Shunters

a. The bare requirement of Shunters should be worked out based on the activity wise workload in eight hours shift.

b. 30% Leave Reserve only should be provided on bare requirement of Shunters. %

c. Detailed justification together with activity-wise, shift-wise calculations should form part of the proposal-.

2.2 Requirement of CHIEF Loco Inspectors (CLIs)

a. The requirement of CHIEF Loco Inspectors should be worked out as per the norms mentioned below:

   i. 01 Loco Inspector for every 25 Loco Pilots,

   ii. 01 Loco Inspector for every 50 Shunters.

Note:

12.5% Leave Reserve on CHIEF Loco Inspectors (CLIs) to be added..

Loco Pilot/Shunter to check the locomotive in fettle condition and sign in Engine Fitness Certificate (proforma in ACTM Vol-III, Chapter-III)

30604 /30605 : Duties of Loco Pilot/Asst. Loco Pilot:

(Note Para 30606, 30610, 30622 , 30629, 30630, 30634 & 30635 are covered under above paras i.e 30604/30605)

Conventional locomotives:

I. For driving the locomotive ensure the following:

1. Before starting a train the following air pressure setting of brake system is to be checked

A. Air brake train:

SNO	Parameter	On Locomotive (Kg/cm2)	On BV/SLR (Kg/cm2)
1	Main reservoir pressure	8 - 9.5	
2	Brake pipe pressure Passenger Goods	 5.0 5.0	 4.8 - 5.0 4.8 - 5.0 4.7 - 5.0 (above 56 vehicles)
3	Feed pipe pressure Passenger Goods	 6.0 6.0	 5.8-6.0 5.8-6.0
4	Max.BC Pressure i. Brakes are applied Passenger coaches Goods wagons ii. Brakes are released Passenger Goods	3.5 All Elect locos & 5.5 WAP5 3.5 All Elect locos & 5.5 WAP5 0 0	
5	Air flow indicator	White and red needle should coincide.	

a. Observe the position of movable needle of air flow indication gauge.

b. Coincide red needle with white needle.

c. Audio visual indication system provided in locomotive should be in working order.

2. Working conditions for air brake train:

1. Check proper coupling of brake pipe and feed pipe of locomotive with trailing stock. For identification of air pipes, brake pipe angle cock and palm coupling are painted in green colour and feed pipe angle cock and palm coupling are painted in white colour. FP & BP are written on palm coupling of feed pipe and brake pipe respectively. Also both the couplings are in opposite directions.
2. All angle cocks of brake pipe and feed pipe of the locomotive and trailing stock should be open. While hauling single pipe braked stock the feed pipe angle cock should be in closed condition.
3. A9 & SA9 cut out cocks should be opened in working cab and should be closed in non working cab.
4. RGEB2 cut out cock should be opened.

5. Ensure that emergency brake valve/alarm chain pulling, airflow measuring device, light indication and buzzer sound indication are in working order.
6. Perform the BP continuity test on the train from leading locomotive to the last vehicle.
7. Check that the brakes are applying on the entire train.
8. Release the brakes and check that the brakes are releasing on all the stock.
9. Check the operating cylinder percentage. It should be 100% on passenger trains and 90% on freight stock.
10. Check that brake pipe and feed pipe angle cock of the last vehicle are closed and their respective hose couplings are kept on support carrier.
11. Ensure the proportional brake of locomotive is in working order

3 Phase Locomotives - (preparation and general check up)

Checking of underframe —

In front of cab —

1. Ensure that loco is standing on the rail and under the OHE
2. Ensure both side MR Eq., BC Eq., BP properly and their angle cocks are as per requirement. Also ensure that hoses are not hanging.
3. Ensure that rail guard, cattle guard has not any cracks and foundation bolts are properly fitted.
4. Ensure that CBC has no any abnormalities and locking pin is available and provided with operating handle.
5. Ensure that UIC connector (Jumper) socket are covered.
6. Ensure that flasher light, marker lights, head lights are glowing properly and their glasses are cleaned.
7. Ensure both end look out glasses are clean and no cracks on it.

Below Machine Room-1 (From Cab-1 to Cab-2)

1. Ensure that additional cocks of MR eq. & BC eq. are open.
2. Ensure that Air Dryer unit is in service. (D-IN & D-OUT open and D-OFF closed).
3. Ensure that there is no crack on any mechanical fittings.
4. Ensure that release plunger hook is provided on parking brake cylinder.
5. Traction link is fitted properly and their all 6+6 bolts are tightened.
6. Ensure oil level in CP-1 is above minimum mark and their foundation bolts are intact.
7. Bogie-1 isolating cock is in open condition.
8. Battery cover is locked & unloader isolating cocks are open.
9. BP and FP additional cocks are in open condition.

Below Machine Room-2 (From Cab-2 to Cab-1)

1. Ensure that additional cocks of MR Eq. & BC Eq. are open.
2. Ensure that there is no crack on any mechanical fittings.
3. Ensure that release plunger hook is provided on parking brake cylinder.
4. Traction link is fitted properly and their all 6+6 bolts are tightened.
5. Ensure oil level in CP-2 is above minimum mark and their foundation bolts are intact.
6. Bogie-2 isolating cock is in open condition.

7. Battery cover is locked & unloader cocks are open.
8. BP and FP additional cocks are in open condition.

In Cab —

1. Cab and look out glasses are clean.
2. All switches are normal, ZBAN-OFF, BLCP-AUTO.
3. Water is filled in windshield washer unit.
4. Spare hoses, wooden wedges are provided inside locker.
5. Fixed and handy both fire extinguisher are in good condition and filled with gas.
6. ALP side RS flap valve is closed.
7. Ensure that emergency push button is released.

In Machine Room —

1. All circuit breakers provided in SB-1, SB-2, HB-1 & HB-2 are in normal position.
2. Switches provided in SB-1 are at normal position.
3. Oil level of converter 1-2 and transformer 1-2 are above minimum mark.
4. Outer cover of any power equipment is not opened.

Pneumatic Panel —

1. Panto selector switch is at 'AUTO' position.
2. Cock No. 70, 74, 136 are in open condition and cock no. 47 is in closed position.
3. PAN-1, PAN-2, VCB and sanders isolating cocks are in open condition.
4. Distributor valve is in service.
5. IG 38 key is inserted and kept 'ON' (Horizontal).
6. CPA drain cock is in closed condition. (Parallel to pipe)
7. Parking brake apply/release plungers are not in locked condition.

Energisation of Loco –

1. Switch on 112.1 of battery.
2. Put battery circuit breaker 112.1 and CHBA circuit breaker 110 to 'ON' position provided on SB-2 panel.
3. Insert A 9 handle at 'Neutral' position and keep it in 'RUN' position by lifting lock in driving cab.
4. Insert BL key in 'OFF' position and turn it to 'D' position on 'A' panel.

a. Screen provided on 'C' panel & Speedometer screen will get 'ON'.
b. If pressure is less, then MCPA will start.
c. UBA will deviate to 110 volts.
d. LSDJ will illuminate.
e. All above indications indicates that control electronics is 'ON'.

5. The message 'Configuration running please wait' will appear on screen and self-testing is done for 20 seconds.
6. During self-testing all pilot lamps will illuminate and extinguish, Bogie-1 & 2 meter will deviate both in TE/BE mode and will come to '0' and flasher light will illuminate & extinguish.
7. After testing FLG 504 node will be displayed on the screen. Now press ZPT switch downwards in 'UP' position & release for raising of pantograph. If pressure is less, then MCPA will start automatically. After creating pressure rear panto will go up and also U meter will deviate & indicate the value of OHE voltage.

8. FLG 550 node will be displayed on the screen. Now press BLDJ downwards & release to close DJ. 01 will close and lamp LS01 will extinguish and all auxiliary will get start automatically.
9. FLG 570 will be displayed on the screen.
10. Ensure that BLCP is at 'AUTO' position.
11. After creating MR pressure up to 6.4 kg/cm', operate reverser to FOR or REV as per requirement. FLG 590 node will be displayed on screen. If the reverser is set without confirming the MR pressure is above 6.4 kg/cm' then priority-1 message 'Low pressure Main reservoir' will come on screen
12. Apply loco brakes via SA 9 and confirm in gauge it registers 3.5 kg/cm,.
13. Release parking brakes by pressing BPPB switch, red indication in BPPB switch will extinguish and parking brake gauge will register 6.0 kg/cm pressure. If parking brakes are not released and throttle is operated then priority-1 message 'Traction with Parking Brake not allowed' will come on screen.
14. Ensure BP pressure is 5.0 kg/cm'.
15. Now operate throttle to TE direction, FLG 596 node will come on screen and then TE/BE meter will deviate towards TE side.
16. Check the loco brake power.

3. General instructions:

1. Place MPJ on position F and observe that the lamp LSB is extinguished.
2. Ensure sufficient BP pressure is created, conduct BP continuity as per instructions.
3. Ensure other normal conditions according to G & SR are fulfilled for starting the train..
4. Release SA9 and also release the hand brake and ensure all the brake cylinders are released.
5. Move MP from '0' to position N and then move MP to '+' position.
6. LSGR will extinguish, ammeter needles will deviate, notch repeater needle will move to 1 and the loco will tend to move.
7. Progress traction notches one by one and observe the maximum current rating limit.
8. If necessary, press BPQWC and operate PSA for sanding.
9. With in the yard, after speed picking up 15kmph, conduct brake feel test.
10. If the train does not move within 5 to 10 seconds after application of normal current rating, bring back MP to '0' and try to find out the cause (brake binding or excess load).

Note:

1. BPQWC to be pressed before taking 2nd notch.
2. After picking up 50 kmph speed, conduct brake power test.

4. Normal Current Ratings:

Loco Motive	Type of Transformer	Type of TM	Short time current rating (Amp)			Continuo us Current (Amps)
			2 Min	10 Min	60 Min	
WAP1	HETT3900	TAO659	1100*	1000	840 *	750*
WAP4	HETT5400	HS15250	1250	1150	960	900
WAM4 (6P)	HETT3900	TAO659	1100* *	1000	840	750
WAG5 ABC	HETT3900	TAO659	1100* *	1000	840 *	750*
WAG5 H	HETT3900	HS15250	1200*	1100	840 *	750*
WAG7	HETT5400	HS15250	1300	1100	960	900
WAG9	LOT 6500	6FRA6068	--	--	290	270
WAG9H	LOT 6500	6FRA6068	--	--	290	270
WAP7	LOT 7500/7775	6FRA6068	--	--	290	270
WAP5	LOT 7500/7775	6FXA7059	--	--	396	370
WCAM3	5400 AC/DC	HS 15250A	--	--	960	900
WCAM2	5400 AC/DC	TAO 659 A1	--	--	870	840
WCM 6	---	HS 15250A	--	--	960	960

*Limited by transformer capacity

**Limited by reliability condition.

Note:

1. In case of TAOCHI motor, TAO motor Current ratings to be fallowed.
2. Voltage is 750 V for TAO 659 & HS15250 TMs.

During Rheostatic Braking:

Maximum current rating -for vertical DBR 600 Amps and for roof mounted DBR 850 Amps up to 15 notches.

5. For handling of train observe the following:

A. Quick acceleration:

1. After the train has started, progress the notches gradually without exceeding the current limits.
2. Use sanders when required.
3. After applying the maximum voltage 750 V, if the acceleration of the train is still required, use shunting contactors if provided.

B. Speed increasing by field weakening :

1. MPS can be used at 20 notches and above (after giving maximum voltage) when the speed and

current rating have not reached the maximum.

2. Take one field weakening notch and observe ammeters and speedometer. Ammeter needle will shoot up and gradually come down and speed will increase.
3. If the speed is to be increased further, progress the shunting notches duly observing the ammeters for stabilising and watching speedometer.
4. While releasing MPS, first regress 2 or 3 traction notches by holding MPS and then release field weakening notches to '0' step by step.

C. Balancing speed:

After the train has reached the required speed, MP and MPS (if provided) should be adjusted to maintain the speed constant.

D. Observation on run:

In addition to road (track) and signals, the Loco Pilot should observe the following while on run -

1. Observe MR gauge, and BC gauge, BP gauge, FP gauge, and airflow indicator, speedometer, ammeter and voltmeter needles.
2. Test the brake power of the train/LE at the first available opportunity/ within the block section where ever the load composition / crew is changed.
3. For attacking an up gradient, loco pilot shall attain adequaltely (by observing speed restriction if any) high speed at the foot of the gradient so as to enable to negotiate the full length of the gradient.
4. Apply brakes judicially with A9 for controlling of train.
5. Just before stopping when the train speed is 5 kmph, release PVEF, so that the loco brake can be applied partially.

Note:

In air brake train: For applying the formation brake, Loco Pilot operates A9 valve handle to application position in the loco and reduces the BP pressure in four graduated steps as given below.

a. Minimum reduction. In this position 0.5 kg/cm2 B.P pressure is reduced.
b. In full service application 1.5 kg/cm2 BP pressure is reduced.
c. In over reduction position the BP pressure is reduced to 2.5 kg/cm2.
d. For emergency application brake pipe pressure is reduced to zero so that the train will stop within minimum possible distance.
e. The maximum pressure that can be built up in the brake cylinder is 3.5/4.5/5.5 kg/cm2 to obtain Max. braking force in wagons or in coaches.

E. Stopping of the train:

On level track:

1. When the train (passenger/freight) is to be brought to a stop on level track, first apply brakes with a small reduction of brake pipe pressure in the train pipe by auto brake valve (A -9). This will allow the rear portion to run smoothly.
2. A heavier reduction of brake pipe pressure may then be made in order to make the final stop very smooth, the brake application should be gradually reduced by increasing the brake pipe pressure as the train is about to come to stop.

Note:

Heavy reduction of BP directly may leads to train run in.

On down gradient:

1. Drop brake pipe pressure partially on trains (passenger/freight) by automatic brake valve except in case of emergency stop.
2. The application of air brake being increased till the speed comes down.
3. When speed comes down, if proportional brakes are in operation, the train shall be brought to stop with train and loco brakes on.
4. Heavy brake application should be avoided as the rear portion is liable to run in violently and damage to rolling stock may occur.
5. Similarly quick release will cause front portion to run out resulting in service jolts.

On up gradient:

1. Control the train with minimum application of BP pressure.
2. Apply sand to few meters before stopping the train.
3. When the train (Passenger/Goods) is brought to stop, the brake should be kept applied by the A9, till the train actually stops.
4. After stopping of train keep brakes on locomotive and train applied by SA9 and A9 brake valve. It will prevent rolling back of train on gradients. Do not leave the train with only SA9 in applied condition.

F. Action to be taken after stopping a train:

1. The blowers for traction motors and transformer should continue to run for 15 minutes especially after long runs with heavy trains to cool the motors.
2. The place and duration of stop permitting; the Loco Pilot or Assistant Loco Pilot shall check the following.
   a. Axle box, traction motor and gear box bearing temperature (by feeling). In case the running staff observes abnormal temperature, he will report the matter to TLC for suitable action. TLC will arrange its checking through maintenance staff at the appropriate point.
   b. Working of all blowers.
   c. Oil level of main transformer and tap changer whenever possible.
   d. The air reservoirs shall also be drained off to expel accumulated water.

G. Rheostatic brake:

An additional electrical braking called Rheostatic brake is provided, to control the goods trains on long failing gradients with heavy loads and to reduce speed in coaching trains also.

Whenever RSI-1 or RSI-2 or any one of the traction motor is isolated, Rheostatic braking should not be used.

Instructions for working during rheostatic braking:

When MP is brought to P, LSB will glow and extinguish and the following sequence of operations are ensured. To allow for electrical current delay and to prevent a surge of dynamic braking, follow these dynamic braking rules.

1. Pause for few seconds before changing from power to dynamic braking.

2. Drop BP pressure slightly, for bunching of formation.
3. Ensure LSDBR extinguishes on or before 5/10th notch. If LSDBR does not extinguish on 5/10 th notch do not use RB.
   a. When operating over a diamond crossover Reduce the dynamic braking level before the train reaches the crossing.
   b. Wait until the entire locomotive passes over the crossing before increasing the dynamic braking level.
   c. To stop while operating at speeds below 15 Kmph, apply the conjunction brakes as necessary to prevent slack run out.

Note:

1. For WAP4 and WAG7, RB equipments are provided in RSI-2 circuit
2. The maximum current for rheostatic braking for Vertical DBR is 600 Amps.
3. In case of Roof mounted RB The max current is 850 Amps up to 15 notches.

Starting of train after stopping:

1. Move the brake valve handle (A9) to release position.
2. Ensure BP pressure is recreated, press BPQWC, press sander pedal (PSA) and take two to three traction notches and release SA9.
3. Progress the traction notches without exceeding the starting current rating and apply sand to avoid slipping.
4. After starting the train, accelerate the train beyond stalling speed.
5. If the train is not moved even after applying full starting current within 10 to 15 seconds, apply SA9, bring MP to '0,'recreate full BP pressure and check for any brake binding. If everything is normal, try to restart the train in the above said manner.
6. If the train cannot be started, contact TLC and follow GR 6.03.

II. LOCO EXAMINATION ON RUN:

This examination is to be conducted by Assistant Loco pilot every one hour and make entry in the logbook. Assistant Loco pilot shall not carry out this examination when the train is approaching gate or station or any stop signal in absolute block system and while approaching manual or semi automatic stop signals in case of automatic block system.

1. Check the working of VMT-1, VMT-2, VRH, VSI-1, VSI-2, VSL-1, VSL-2, CP1, CP2, CP3, (if working), and ARNO.
2. Check the temperature of Arno, MVMT-1, MVMT-2, MCP-1, MCP2, MCP3.
3. Check the transformer and GR oil levels.
4. Check for any abnormality in Arno, motor chests and HT compartments.
5. Check the working of PHGR, drain out moisture from RDJ.
6. Check the working of CHBA and Ammeter charging rate.
7. Give signal through BPT to the Loco pilot and note the readings in ammeters, voltmeter, notch repeater, speedometer, BP and MR gauges.
8. Look for any abnormality in the rear cab.
9. Check UBA reading.
10. Compare the rear cab readings with leading cab and make necessary remarks in the log book as per

standard instructions.

11. In case any abnormality is noticed and if it requires attention at crew changing points/trip shed enroute, inform at the first opportunity to the TLC/LPC.

ALP has to check for any wheel skidding sound in rear truck before

III. Duties of Loco Pilot and Assistant Loco Pilot at neutral section (With single loco) :

1. While approaching a neutral section, ensure MR pressure, if it is less put BLCPD "ON" and build up to 9.5 Kg/cm2.
2. Accelerate the train speed if necessary without exceeding the speed limit.
3. On reaching 500 Metres board check the air pressure, BP gauge and speed.
4. On reaching 250 Mts. board bring MP to '0' and be prepared to open DJ.
5. On reaching DJ OPEN BOARD, open BLDJ and observe LSDJ. If LSDJ does not glow, immediately lower panto by placing ZPT on '0'.
6. After opening DJ, open BLCP and BLVMT. (Not required to open in case of SIV fitted Locos)
7. Ensure contactors C105, C106 and C107 are opened fully.
8. On reaching DJ CLOSE BOARD close DJ, by closing BLDJ and pressing BLRDJ.
9. After closing DJ, close BLVMT. After starting of blowers, close BLCP.
10. Progress the traction notches observing ammeters and voltmeters.

While working with MU:

At 500 Mts. warning board: Do same as on single.

At 250 Mts. warning board: Keep MP ON '0'. After LSGR is glowing, place BLSN switch DOWN position and if possible ensure rear loco panto is lowered. LSDJ, LSB and LSCHBA along LSOL will glow in the working cab and UA needle will not drop to '0'.

At DJ open board : At DJ open board open BLDJ, UA meter comes to "0".

After passing one mast of DJ close board: normalise BLSN(upwards), close DJ in both locos at a time.

By assistant loco pilot:

1. While approaching neutral section, Assistant Loco Pilot should ensure 8 kg/cm2 air pressure in RS.
2. At the time of opening DJ, Assistant Loco Pilot should remain in Cab-2 and check that contactors C105, C106 and C107 are opened fully after DJ is opened and give signal through BPT to the Loco Pilot.
3. Check the battery voltage and safety relays after DJ is opened.
4. After DJ is closed check the contactors C105, C106 and C107 are closed fully.
5. Check all the items (1 to 11 - Ref: 11.5) mentioned for loco examination on run.

Note:
Assistant loco pilot should not leave the leading cab for the above purpose, when the train is approaching gates or station or any stop signal in absolute block system and while approaching manual or semi automatic stop signals in case of automatic block system.

IV. Examination during short stoppages enroute:

1. Stop the train and apply SA9 and keep the blowers working.
2. Drain out moisture from main reservoirs, centrifugal dirt collector, DJ oil separator control reservoir, EP and Graduator Control board.

3. Check the temperature of axle boxes.
4. Check the condition of helical springs, equalisers, tie-rods, stay plates, sand pipes, brake riggings, speedometer gear case fittings, resillent block pads, vertical / horizontal bolts for each TM.

   For WAG-7 loco examine, W-BRACKET, LINKS, BULBs and its cotters pins, equalising beams, helical springs (inner and outer), dampers (horizontal , vertical), 'D' shackle , side stoppers, side bearers to be checked additionally.

   For WAP-4 loco examine H-TYPE BOLSTER, helical springs (inner and outer), friction dampers, to be checked additionally.
5. Check for any oil or cardium compound leakage and also check the condition of traction motor inspection covers.
6. Check the air flow from SL blowers and for any oil leakage from transformer oil tank and drain plug.
7. Check the condition of air bellows for any leakage.
8. Check the condition of battery boxes and SL covers.
9. Check the cattle guards, rail guards & buffers for any abnormality.
10. Ensure front coupling is secured in the hook and rear coupling is tight and safety pin is intact.
11. In case of Exp./Pass trains ensure U clamp is intact.

V. Checking of CBC coupling in loco shed/trip sheds

1. Proper closing and opening of CBC.
2. Free operation of screw coupling.
3. After closing of CBC by complete dropping of lock lift indicated by proper insertion of lock pin.
4. Availability of split pins for clevis-pin and knuckle pin.
5. Availability of operating handle without bend.
6. After locking of CBC by proper insertion of locking pin, ensure inability of operating handle to open the CBC.

VI. Examination during crew changing by loco pilot:

A. By incoming loco pilot:

1. Incoming loco pilot after stopping the train, apply SA9.
2. Operate PSA with MPJ in 'F' or 'R'.
3. Keep the blowers working and build up 9.5 kg/cm2 pressure.
4. Switch ON head light and flasher light.
5. Mention all the important repairs and abnormality observed on run, in the log book and also inform the outgoing loco pilot.
6. In case of abnormal detentions in enroute, it should be informed to TLC on duty.

B. Check :

1. Go through loco log book for any abnormality.
2. Outgoing loco pilot should check the working of head light, flasher light, air flow indicator and temperature of axle boxes. 'Switch OFF' head light and flasher light after testing.
3. Check for any abnormality in the helical springs, equalisers, tie-rods, stay plates, brake riggings, speedometer gear boxes and bogie frame, in case of WAG-7 and WAP-4 check as per 11.7.4 .
4. Check for any oil leakage from suspension bearings, transformer oil tank and drain plug and cardium compound leakage from gear cases.

5. Check the condition of air bellows, battery boxes and SL covers.
6. Check for any air leakage from traction motor inspection covers and air bellows.
7. Check the air flow from SL blowers.
8. Check the cattle guard, rail guard, buffers and CBC fittings for any abnormality.
9. Ensure that front coupling is secured properly and locking bolt is properly fixed.
10. Check the adequate fall of sand on rail under every sand pipe.
11. Check the loco log book and enquire the particulars regarding any defective apparatus or unusual occurrence from incoming Loco Pilot.
12. Check the BP level and compare it with BPC.
13. Conduct AFL test , battery on load test
14. Conduct BP continuity test if required.

C. By assistant loco pilot :

1. Check CP1, CP2 and CP3 oil level after opening of BLCP (switch ON BLCP after checking the oil level).
2. Check the transformer and GR oil level.
3. Check the working and temperatures of auxiliaries, Arno, SIV, Traction Convertor 1&2) , Auxiliary convertore (BUR 1, BUR2, BUR3), CHBA and RTPR/DC-DC Converter.
4. Check the air flow from VSI-1, VSI-2, VRH, VMT-1 and VMT-2.
5. Check for any abnormality in high tension compartment (arc-chutes, CGR, RGR, C118).
6. Drain out the moisture from RDJ and centrifugal dirt accumulator and in RS.
7. Check the position of cut out cocks in leading cab, rear cab, cab-1 center locker, side locker, back panel and HT compartment.
8. Check the position of rotating switches, tightness of fuses in sockets, condition of spare fuses and relay seals.
9. Check the working of flasher light in rear cab.
10. Check the fire extinguishers tool box (if provided)& PT box if provided are intact.
11. Check logbook for any missing fittings, repairs and unusual occurrences.
12. Drain out the moisture from main reservoirs, centrifugal dirt collector, DJ oil separator, panto pipeline, control reservoir, EP and GR board.
13. Enter the particulars in speedometer.

VII. Change of power at loco inter change point :

1. Before detaching the locomotive, close BP and FP angle cocks of locomotive and first vehicle after placing A9 to emergency.
2. Disconnect hose couplings between locomotive and first vehicle.
3. Open screw coupling/CBC and electrical coupler and detach the locomotive.
4. Keep locomotive hose coupling on support carrier.
5. Move the outgoing locomotive for attaching on to formation.
6. Couple screw coupling/CBC, brake pipe, feed pipe, and electrical coupler (in case of passenger train) of locomotive with first vehicle.
7. Ensure correct coupling of the locomotive hose pipe with the trailing stock.
8. Open feed pipe and brake pipe angle cocks of first vehicle and attached locomotive.

9. Check the continuity of brake pipe and feed pipe of the train.
10. Ensure that locomotive and stock couplings are not loose.
11. Ensure that locomotive proportionate brakes are in working order.
12. Ensure that audio visual indication device and indicating light and buzzer are in working order.
13. Ensure that air flow indicator reading is normal and its needle is coinciding with white needle.

Note :

On arrival at terminal station, if shunter is available the incoming Loco pilot should hand over charge to shunter after ensuring his identity.

VIII. Incoming examination in shed:

This examination is to be carried out after the loco arrived in shed on examination pit.

1. Conduct loco side, under gearing, cab, corridor and roof examination.
2. Enter the repairs and deficiency in the loco logbook and performance register.
3. Build up 8 kg/cm2 air pressure in RS and close RAL cock.
4. Apply SA9 and hand brake. Destroy BP to '0'.
5. Open DJ and lower pantograph. Remove MPJ, ZPT and BL keys.
6. Close all the shutters, corridor and cab doors.
7. Hand over the loco keys, log book to CC or Shunter on duty.
8. Any important repair or deficiency to be informed to TLC or JE concerned for immediate action.

IX. Stabling of the loco in station yard / Stabling line /Running line:

1. Berth the loco at a convenient place (ensure OHE while moving towards sidings).
2. Build up air pressure up to 8 kg/cm2 in RS and close RAL cock.
3. Apply SA9 and hand brake. Place wooden wedges. Release SA9 and ensure loco not moving with only hand brake applied and wooden wedges placed. Then destroy BP to '0'.
4. Ensure MP is on '0' and open BLDJ, check the glowing of LSDJ.
5. Lower the panto and ensure it is fully lowered.
6. Remove ZPT, MPJ and BL keys from the sockets.
7. Check the battery voltage and make necessary remarks in loco logbook.
8. Close window shutters, cab and corridor doors.
9. Switch OFF all the light and fans and open HBA.
10. Drain out moisture and air pressure duly securing the loco with skids in non-platform side.
11. Hand over all keys to the on duty CC or SM or any authorised person.
12. Ensure providing of LV board/lamps.

Note:

On arrival at terminal station, if shunter is available the incoming Loco Pilot to hand over charge to shunter after ensuring his identity.

X. Making the loco dead for moving as dead with formation:

1. Build up pressure up to 8 kg/cm2 in RS and close RAL cock.
2. Place MP on '0', MPJ neutral, A9 on release position and open DJ and then all auxiliaries BL switches.

3. Lower panto, remove ZPT, ground the loco, enter in HT1 and HT3 compartments and place the reversers J1 and J2 in neutral position and lock them with the help of locking bolt.
4. Lock the HT compartments, replace the fitchet keys and remove the ZPT key.
5. Close all shutters, cab and corridor doors.
6. In both cabs keep SA9 on release position and check that loco brakes are released. Then close SA9 supply and apply cut out cocks on both cabs.
7. Release air pressure from brake cylinders of loco with the help of C3W distributor valve releasing handle, if loco brakes are not released, close bogie COCs and after releasing open the same.
8. Open the drain cocks and release the air pressure.
9. Switch OFF all the lights and HBA to be kept on '0'.
10. Keep the loco keys and log books in safe custody.
11. Close IP COC.
12. If C2N type feed valve is provided, close inlet and out let COCs for C2N.
13. Isolate DV as per instructions

XI. Movement of dead locomotive:

Points to be ensured by the loco pilot:

Fit to run certificate should issued by Section Engineer/CLI/TLC/Loco Pilot of failed loco.

1. A dead Loco may be attached to a Goods/Pass/Mail/Express trains except Rajadhani or shatabdi express.
2. Maximum permissible speed of the dead locomotive as certified by the above persons is not less than the MPS of the train to which it is attached.
3. In case the Maximum permissible speed of the dead locomotive is less than the maximum permissible speed of the train, suitable speed restriction shall be imposed on the train while attaching dead loco.
4. As a result of attachment of dead loco, maximum permissible length and Load of the train should not be exceeded. On the dead locomotive all the operating keys i.e. ZPT, BL, MPJ, etc are removed after de energising the loco motive and HBA is kept in zero.
5. Supply and Apply cut out cocks for A9 and SA9 in dead locomotive is kept in closed condition.
6. A-8 (L&T) cock & IP coc is kept in closed condition and MU2B in lead Position (MU2B kept in trail when MR & BC equalizing pipe is connected).
7. J1 & J2 reversers are placed in neutral and locked.
8. BP & FP pipes should be connected between the locomotives and the respective angle cocks should be kept open.
9. If the dead locomotive/locomotives are attached next to the working locomotive, the MR equalising and BC equalising pipe of the locomotives on the inter connection side should be connected with the respective angle cocks open, except when otherwise mentioned below.
10. In case brakes are not functioning on the dead locomotive it shall be hauled as a piped vehicle duly ensuring the brake power the train. Only one dead loco is permitted by train.
11. When the piped dead locomotive is attached as the rear most vehicle of the goods train, the competent person not less than Asst. Loco Pilot provided with suitable equipment including walkie-talkie set, flags, detonators etc. accompanying the dead locomotive.
12. It will be the duty and responsibility of the competent person to switch on flasher lights (after switching on HBA) and apply hand brakes judiciously in case of a runaway occurring.

XII. Train parting/hose pipe disconnection:

Tractive force is exceeding the tensile strength of the coupling material or coupling open on run or worked out coupling or large buffer height or difference in rail level.

1. Switch on FLASHER LIGHT or ensure Flasher light is functioning if Auto flasher light system is provided on loco.
2. After stopping of both portions apply, A9 to emergency to avoid MR dropping.
3. Bring MP to 0 and ensure GR is on 0.
4. Ensure that guard has protected the rear portion of the train.
5. Ensure that train brakes in applied condition to avoid roll back of the train.
6. Check the train to identify defective coach/wagon.
7. After ensuring there is no abnormality on formation switch off FL.
8. Heavy sound of air leakage will indicate the affected hosepipe.
9. Close the angle cocks of adjacent ends of two coaches where hose pipe disconnection have taken place.
10. Inspect the hosepipe, which has got disconnected.
11. In case the hose pipe is damaged replace them. In case there is no damage, reconnect the existing ones.
12. In case train parting has taken place, reconnect the parted portion of the train as per prescribed procedure.
13. Now open the closed angle cocks, no leakage should take place from the reconnected hosepipe.
14. Ensure the continuity of the brake system and train.
15. In case the brake hose is damaged or cannot be replaced the pipe of the last wagon of the front portion should be put on dummy and the angle cock closed. The brakes of the portion in rear should be manually released and the train brought to the next station at restricted speed.
16. Ensure that screw coupling of affected coaches is not loose.
17. Observe the position of movable needle of airflow indication gauge; it should coincide with the fixed red needle. Audiovisual indication system provided in locomotive should stop giving indication.

XIII. Precautions to avoid train parting:

1. Crew should have proper Learning Road of the section where he is required to work the train.
2. Ensure BP is charged fully and AFI needle comes to preset value before starting.
3. Ensure no brake binding, before starting a train.
4. Start the train without Jerks, smoothly.
5. Progress notch by notch gradually.
6. Maintain uniform speed, notches, where the formation negotiates over Ups and Downs (undulating area).
7. Avoid unnecessary, frequent progression/regression.
8. After brake application do not put into traction mode suddenly, sufficient time should be given.
9. Always avoid sudden start, sudden brake application and sudden stopping of train.
10. While restarting train from level crossing etc., push back the train formation 2 to 3 meters, to ensure proper locking of CBC in case of goods train. (To ensure tampering if any).
11. Synchronize working if banker is provided.
12. Control your train in case of wheel slip, by reducing the notches.

13. Avoid loco independent brakes to stop the train.
14. Ensure engine coupling is properly tightened/locked before starting a train.
15. Apply brakes by moving automatic brake valve handle to stop the train.

XIV. Duties of loco pilot in case of accident:

1. In case of accident or abnormality in the train, on double line section, Loco Pilot should immediately switch ON the flasher light and after stopping, depute Assistant Loco pilot to protect the adjacent line as per G & SR 6.03. Give four short whistle and exhibit red hand signal towards the guard.
2. Break the memory freeze glass on SPM and switch on memory freeze switch.
3. Note the time and place of accident in the journal book.
4. Consult the guard and quickly assess the cause and other particulars of accident.
5. Try to secure the gathered information and convey the nature of assistance required by quickest means. Use emergency telephone or other means like train engine, adjacent line train, PWI trolley, Gate Phone, Assistant Loco pilot or Guard to convey the information to the section controller/all concerned.
6. The following information to be conveyed to controller, TPC or nearest Station Manager .
   a. Train No.
   b. Date.
   c. Loco No.
   d. Load of train.
   e. Site of accident.
   f. Time of accident.
   g. Nature of accident.
   h. Cause of accident.
   i. No. of persons killed.
   j. No. of persons injured.
   k. No. of wagons bogies derailed, capsized, telescoped.
   l. Damage of track and OHE.
   m. Types of assistance required.
   n. Loco pilot and guard's name.
   o. Whether the Engine is fitted with headlight and cattle guard.
   p. Time of dispatching the message.
7. After conveying or despatching the message Loco pilot should render first aid to the injured if any.
8. Loco Pilot should try to preserve the evidences at accident site.
9. Give information to the nearby village and take the assistance of the Doctors, Government officials and Police in safe guarding the Railway and public property and rendering Medical aid.
10. Gather the Railway staff present at the site and distribute some relief work.
11. Inform particulars of accident to the first officials visiting the site of accident and assist them.
12. Should not leave accident spot until relieved.

USE OF FIRE EXTINGUISHERS:

A. General:

1. Loco pilot should ensure that the fire extinguishers (4 Nos. ,) are provided on the loco with its locking clip, nozzle and spring valve and seal are intact before leaving shed.
2. Ensure that the hole on the nozzle is clear.

3. Check that the fire extinguisher is not due for re-filling.
4. DCP or CO2 fire extinguisher should be used for putting out electrical fire.
5. LP and ALP should aware the instructions for using fire extinguishers

B. While using:

1. Whenever any smoke or fire is noticed on any equipment on loco, Loco pilot should take the following actions.
2. Open DJ, lower panto, switch OFF HBA, switch On flasher light and stop the train.
3. Remove the fire extinguishers from the bracket, take it nearer to the equipment on fire and cover your nose with a wet cloth.
4. Break the seal and remove the locking clip.
5. Stand opposite side to the smoke, press the spring valve and face the nozzle towards the base of fire.
6. Strike the knob by hand.
7. Direct the jet towards the base of fire with a sweeping action.
8. Use other fire extinguishers as per need in same way.
9. If the fire is uncontrollable, inform the section controller or station master to arrange fire engine and observe G & SR 6.03 & 6.10.
10. After putting out fire, discharge the remaining pressure from fire extinguishers, in case of DCP fire extinguishers.
11. Isolate the affected equipment, inform TLC and work onwards if possible.
12. Make a remark in the logbook regarding fire extinguisher and affected equipment.

Precautions to prevent the fire on AC loco:

The following precautions to be taken by engine crew to prevent the fire on AC loco.

1. Ensure arc chutes are properly secured for EM contactors, EP (Line and shunting) contactors and CGR1, 2 & 3.
2. Ensure no oil leakage from compressors and pipe lines in HT2 compartment.
3. Loco pilot has to use rheostatic and regenerative braking if provided in the loco on graded section. (Preventing the heavy mechanical braking which may cause the sparks from brake shoes).
4. Do not leave any cotton waste/paper in HT2 compartment.
5. Do not put HQOP in OFF position without proper trouble shooting.
6. When HQOP is in OFF position, carefully watch the power circuit equipments and SLs and Traction motors on stoppages.
7. Do not put HQOA on ‘0’ position without proper trouble shooting.
8. When HQOA is placed on ‘0’ carefully watch the auxiliaries.
9. When HBA is kept in Off position for any reason, check traction power circuit equipment and auxiliary power circuit equipment frequently.

XV. First aid in case of electrical shock:

1. Whenever a person comes in contact with live wire, switch OFF the source of supply if known.
2. If the source of supply is not known, attempt should be made to remove the person from contact of live wire by using non-conducting materials i.e. dry wooden stick, dry blanket, rubber rod or paper whichever is readily available on the spot.

3. Never touch the body with bare hand when the person is in touch with the live wire.
4. After the removal of affected person from the contact of live wire, send for the doctor at once and in mean time give him artificial respiration, 'Silver burd method' and 'Shepherds method' whichever is convenient.
5. Before giving artificial respiration ensure that no bones are broken, there are no fracture near the lungs.
6. Avoid violent operation during artificial respiration since it may cause injury to the internal organs.
7. Also special care should be taken if there is a burnt injury.
8. Serious burns should be treated with proper oil dressing and avoid exposing the patient to the cool atmosphere.

XVI. Safety rules concerning 25 kV AC traction:

1. Do not approach 25 kV limits directly or indirectly within 2 meters radius.
2. On line before going on the roof of the locomotive, ensure power block taken or not with TRD staff who are available at spot, ensure earthing cables provided on either side of loco. Ground the loco then only go on the roof of loco.
3. To carry out roof inspection in the shed, always check and confirm that the correct isolating switch corresponding to the line, where the loco is standing is opened by electric Shunter. Ensure isolation switch is properly opened and blade of the earthing heal is properly engaged in the clip for earthing the OHE.
4. Ensure loco isolating switch handle is locked with personal pad lock and retain the key in the personal custody.
5. Do not direct any part of the body above roof level of loco while changing the head light bulb.
6. Do not walk in between track under OHE.
7. Do not direct any jet of water or foam towards OHE.
8. Do not touch any conductor lying close to electrified line.
9. Do not stretch hand or any conductor on the OHE from a over bridge.
10. Do not enter into HT compartment until such time, the loco is brought to a stand and grounded.

XVII. Emergency telephone:

The emergency telephone taps with sockets are provided at every one km in the section. The location of the nearest telephone tap is indicated on the OHE mast by an arrow.

How to use emergency telephone:

1. Open the emergency telephone tap by the key provided for the purpose.
2. Insert the plug of the portable telephone in the emergency telephone tap socket.
3. Press the switch provided on the portable handle and also press the button on the side of portable telephone box. Then call out TPC in the following manner a number of times 'Hello Emergency' and after TPC's response, give your message.

XVIII. How to take emergency power block:

1. In case of damage to panto or OHE, lower the panto immediately and stop the train if possible near the emergency telephone tap, put on FL.
2. Protect the train as per G & SR 6.03.
3. Contact TPC through emergency telephone.

4. Inform TPC about the particulars of defect or damages with km No. between stations, Loco No., Train No., up or down line, time etc.
5. Ask for OHE staff to take emergency power block.
6. After emergency power block is taken and OHE contact wire is earthed on either side of the loco by OHE staff, ground the loco and do the roof work duly fixing the ladder.
7. After completion of roof work, keep concern HPT in earthing heel, remove all the materials from the roof and remove the ladder.
8. After earthing poles are removed from contact wire and power block is cancelled by OHE staff, unground the loco.
9. Close PT COC of defective panto.
10. After power is restored, raise the good panto, close DJ and resume traction.

XIX. Loco log book and failure report:

A. How to write the loco log book:

Give the following particulars in the loco log book.

1. Date.
2. Loco No.
3. Train No.
4. Brake Power %
5. Load details
6. Journey started from ……. For destination station ……..
7. Loco Pilot's Name.
8. Assistant Loco Pilot's name.
9. Speedometer km starting & ending.
10. Energy consumption Reading Starting and ending
11. Energy regeneration Reading Starting and ending
12. Do not write 'refer previous booking' in the loco logbook.
13. The Loco pilot must write all the repairs or failure particulars in the loco logbook.
14. Any previous repairs unattended for the last 48 hrs to be informed to TLC/LPC
15. While working MU / double head locos, mention the same in the loco logbook. Also mention as to which loco is leading and which is trailing. In case of single loco, mention which cab is leading.

B. How to write the defects / failures in the loco log book:

In case of a failure or defect of the loco on line the Loco pilot should enter the following particulars in the loco logbook and report the same to TLC on duty.

1. Tripping at km No.
2. Between stations.
3. Date.
4. Time.
5. Loco pilot's cab.
6. Speed.
7. Notch No.

8. UA reading.
9. Voltmeter reading.
10. Ammeter reading.
11. Position of MPS.
12. MPJ position.
13. Mention abnormal sign.
14. Name of the relay which is showing red indication (if target dropped).
15. Name of operation in which tripping took place.
16. Apparatus handled or isolated.
17. Time resumed traction.
18. Informed TLC/LPC at station :
19. Private No.
20. Total time lost.

Note :

While informing TLC/LPC, furnish loco No. train No. load of the train, Loco pilot's and Assistant Loco

Traction Failure:

1. Nature of defect (Total loss or partial loss of tractive effort or slipped pinion or locked axle or smoke emission or unusual noise from traction motors).
2. Place of occurrence.
3. Km No.
4. Time.
5. Driving cab.
6. Traction motor.
7. Apparatus handled or isolated.
8. Traction resumed observing standard instruction.
9. Observed any smoke emission or unusual sound.
10. Informed TLC/LPC from station.
11. Total time loss.

Note:

If relief is asked, give details of relief loco arrival and the time when the block section is cleared.

Miscellaneous failures:

1. Nature of defect.
2. Between stations and km No.
3. Time.
4. Notch No.
5. Cab No.
6. Speed.
7. MPJ position.

8. Apparatus handled.
9. Informed TLC from station.
10. Total time lost.
11. Private No.

Note:

Preferably give the breakup of the total time occupied in the block section or at station as following.

1. Time taken for trouble shooting.
2. Time taken to inform TLC/LPC at a station or in block section. Extra time occupied on run if any, due to isolation of equipment on the loco (RSI, traction motors, MPH, Traction convertor etc).

XX. How to make use of the flasher light:

Flasher light should be used in case of emergency to attract the attention of the Loco pilot of a train coming in the opposite direction. Working condition of the flasher light should be ascertained while taking over charge of the loco at crew changing point/shed.

To put on flasher light, ZFL switch should be closed at the working cab. Switch OFF the headlight when the flasher light is put ON for better viewing of flasher light.

2. GUIDE LINES TO RUNNING STAFF FOR OPERATION OF BOX-N, BCN RAKES AND COACHING RAKES

Instruction for loco pilots

Before attaching locomotives to trains, the engine should be thoroughly tested to ensure that it is free from leakage and MR/BP pressure is properly maintained to the order of 8 to 9.5 kg/cm^2 and 5 ± 0.1 kg/cm^2

2.1 Brake continuity test:

The Loco Pilot and Guard must carry out this brake continuity test as soon as possible after the locomotive is attached on train and BP pressure is created to 5 ± 0.1 kg/ cm2.

Occasions for conducting BP continuity test:

1. Before going to sign fresh BPC.
2. While clearing any stabled load from way side station.
3. After completing of power interception.
4. After completing of shunting.
5. After reversing the loco.
6. After attaching/detaching dead loco.
7. During GLP check.
8. If train parted, after recouping the formation.
9. Locomotive or additional locomotive attached to the rear or fully fitted train.
10. After attending BP related problems on formation.

Need not carried out

1. When locomotive other than train locomotive is detached from extreme front of the train.
2. When locomotive is used for complete brake test of the whole train and is not thereafter detached before starting.

3. When locomotive or vehicle is detached from the extreme rear of the train.

Procedure for goods trains:

1. This test to be conducted with the cooperation of Guard.
2. Create 9.5 kg/cm2 of MR pressure and 5.0 kg/cm2 of BP in the locomotive.
3. Ensure 4.8 / 4.7 kg/cm2 of BP pressure in the BV.
4. Apply A9 automatic brake valve and reduce BP pressure by 1 kg/cm2 without pause(gauge reading 4kg/cm2.)
5. Confirm from the guard for corresponding reduction of 1.kg/cm2 in the BV.
6. LP has to ensure at least 10vehicles brakes applied.
7. Loco pilot has to close A8 Cock (70 COC/ MODE switch in test in KNORR brake loco In case of 3 phase locos).
8. Guard shall open the BV emergency valve and the loco-pilot shall observe the drop of BP pressure to zero.
9. If the BV is not the last vehicle, Guard shall open the BP angle cock in the rear side of last vehicle.
10. LP to ensure dropping of BP pressure completely to “0”.
11. Guard has to close the BV emergency valve.
12. LP has to ensure BP is no raised and open A8 Cock /70 COC, release A-9.
13. Ensure recreation of 5.0 kg/cm2 of BP in the locomotive and4.8 / 4.7 kg/cm2 of BP pressure in the BV.
14. For originating trains after turn around examination (where SSE/SE-C&W is posted) continuity test will be done by the loco-pilot and guard in the presence of SSE/SE-C&W who shall make endorsement on the reverse of the original BPC.
15. Where SSE/SE-C&W is not posted/ ALP emergency brake valve, loco-pilot and guard will check the continuity and make endorsement on the reverse of original BPC.
16. If banker loco available, the test to ensure by guard from banker loco by applying banker loco A9 handle. (banker loco A8/70 must be close position, or mode switch in help).

Note:

If any problem is noticed regarding B.P Pressure drop by loco pilot or by guard, should inform to concern for further attention.

Procedure for coaching trains:

1. The Loco Pilot must charge the BP to 5 Kg/Cm2 and must confirm from the Guard that minimum 4.8 Kg/Cm2 in SLR .
2. The LP must move the A9 automatic brake valve to reduce BP pressure to 4.0 Kg/Cm2(gauge reading) and must confirm from the Guard that BP pressure in SLR is reduced in the range of 3.6 to 4.0 Kg/Cm2. (If BP pressure in SLR does not show reduction in BP pressure in the range of 3.6 to 4.0 Kg/Cm2, it indicates discontinuity in brake pipe, which must be looked into by TXR staff.)
3. The LP has to ensure, train brakes are applied.
4. After that, the LP must move A9 automatic brake valve to ‘running’ position and check that 5 Kg/Cm2 BP pressure is registered in BP gauge in loco and must confirm from the Guard that minimum 4.8 Kg/Cm2 in SLR..
5. After the BP pressure has stabilized in the locomotive, air supply for the BP should be cut off by closing A-8 COC or E-70 COC (Ignore the message appeared in 3-φ locos).

6. In case of KNORR brake locos place mode switch in test.
7. Then the Guard shall immediately open the Emergency brake valve to vent out the BP by 1.0 Kg/Cm2 and LP should observe that the pressure in the BP gauge in the locomotive is within in the range of 3.6 to 4.0 Kg/Cm2, otherwise it indicates discontinuity in brake pipe, which must be looked into by TXR staff for rectification.
8. After confirmation of continuity, open the A-8 COC/E-70 COC / mode switch in lead and restore the BP pressure in the loco/SLR.

2.2 Before starting a train:

1. A train should not be started until brakes of the entire train including hand brakes are fully released. Conduct BP continuity test if required.(Ensure authority to proceed has been received to start trains before starting)
2. At the originating point of train, C&W staff should ensure this. At wayside stations, for the clearing of stabled loads it should be ensured by Loco Pilot, Guard and Station Staff.
3. If the train is started with the brakes released partially, wheel skidding or breakage of coupling may take place.
4. Empty/load handle should be set in the correct position (i.e.) when the wagon is empty. The handle should be set in 'empty' position and for loaded wagons in 'load position'.

   In BMBC wagons in place of load/empty handle operation, APM (Auto pressure maintainer) is provided
5. If the empty / load handle is not set in the correct position, a serious accident can take place as in the loaded condition the train will have inadequate brake power. On the other hand when it is empty severe application of brake will skid the wheels and cause irreparable damage.
6. The train examiner will be responsible for the correct setting of the empty/load handle at all originated stations and way side stations where the trains are examined by TXR staff. At way side station where TXR staff is not available, any shunting is done or when a stabled train is picked up, it should be ensured by the Guard and LP that the above handle is set in correct position in all the wagons and also ensure DVs are in service.
7. The Loco Pilot will personally check the position of all angle cocks of all air hoses of the leading, trailing locomotives and wagons of the load.
8. MR pressure should not be allowed to fall below 8 kg/cm2 to achieve optimum advantage of charging brake pipe. In case MR pressure drops below 7 kg/cm2, stop the train and investigate the cause and rectify the fault.
9. In case a heavy leakage or mal-functioning of the distributor valve or any brake binding is noticed, the release of the wagon brake should be ensured by pulling the quick release valve of the distributor valve. In case the brake binding problem repeated or brakes not released at the first instant, the distributor valve of the concerned wagon should be isolated by changing the position of isolation cock handle to horizontal, operate QRV till the brakes are fully released.
10. In case of disconnection of air hose in enroute, apply A9 emergency or close the lead/trail (A8) cock for maintaining MR pressure in loco. Then the attention should be given by closing the angle cocks of the defective wagon and if necessary replacement of damaged hoses with spare hose pipe, if spare hose is not available may be done by removing the air hose either at the front of loco or rear of the brake van, if unsuccessful, request for TXR assistance.
11. Loco Pilot should report all problems and unusual events noticed by him on run in respect of functioning of air brakes and wagon movement etc., immediately to CHC/CTLC/CLPC. The procedure to be adopted in such cases shall be reported through a 'Memo' jointly signed by both Loco Pilot and Guard.

Note:

while replacing BP hose pipes, shell etc. LP should ensure no obstruction, plastic caps in palm end side and shell side and should conduct BP continuity test after attending any BP related problems.

12. Under no circumstance the angle cocks of the wagon should be closed expect for the attention period and after the attention the concerned angle cocks must be opened before any movement is made.

Note:

After closing angle cocks of the loco/wagons, an interval of about 30sec should be given, so as to allow the trapped air in the air hose to leak out through the exhaust and then only the air hoses should be uncoupled.

13. The Loco Pilot should see that the brake pipe and feed pipe connection are not mixed up either between the locomotive and the first wagon of the load.
14. The Loco Pilot shall ensure that BP gauge is showing 5 ± 0.1 kg/cm2 and FP gauge is showing 6 kg/cm2.Then after ensuring the continuity of the air pressure, through the Guard of the train and in his absence, through the attending TXR, Loco pilot shall sign the break power certificate presented by the TXR. The brake van or last vehicle pressure should not be less than 4.8 kg/cm2 for a load up to 56 BOX-N/BCN and 4.7kg/cm2 for the load of beyond 56 BOX - N/BCN wagons.
15. At wayside stations while picking up stabled load, it should be ensured by both Loco Pilot and Guard of the train.
16. Isolating cock on distributor valve and angle cocks of BP and FP of all wagons should be in open position which should be ensured by C & W staff at the originating point and at wayside stations while picking up a stabled load, by Loco Pilot and Guard of the train.

2.3 While on run:

1. As far as possible, the train should be controlled by service application of brakes up to 0.5 kg/cm2 and in exceptional cases where the train brake power is inadequate; the BP pressure may be reduced up to 1.6 kg/cm2.
2. Over reduction of BP pressure to 2.5kg/cm2or emergency brakes should be used only in emergency situation. Because heavy breaking force will result in skidding, excessive wear of wheels and train parting.
3. Faulty braking can cause skidding of wagon wheels. To avoid skidding, the braking and starting should be smooth. If the train is running hard, the LP should stop immediately and attend the same. Working in the same condition may cause the skidding of wagon wheels or other damages like breakage of CBC parts etc.
4. CBC of loco and BOX-N/BCN can break due to high coupler force, which can arise either while starting or stopping or accelerating to avoid breakage of couplers, the instructions laid down below should be rigidly followed after application of brakes.

2.4 While stopping a train:

1. Stopping of a train should be smooth (without jerks) which is to be done by releasing the brakes just before final stop.
2. It should be ensured that handle of A9 is put to released position, when the speed is about 3 to 5kmph prior to stopping.
3. When stopping at a station on the falling gradient, the rheostatic brake is to be kept in 'ON' position and should only be cut off after an application of A-9.

4. In case of stopping a train on a rising gradient, the GR should be maintained on at least 2 notches and only after application of loco brakes, the GR should be brought to '0'.
5. Loco Pilot and Assistant Loco Pilot should release the moisture from main reservoirs by opening the drain cocks as frequently possible to prevent moisture entering in the loco pneumatic system as well as in the air brake system of BOX-N/BCN wagons.
6. Before uncoupling the locomotive from the rake make an emergency application and wait till BP pressure reduced to '0'.There after close the angle cock of the brake pipe on the loco and 1st wagon and after a short pause of about half minute, uncouple the BP air hose.

2.5 Specification of brake power for goods train:

1. At originating station not less than 90% of total number of cylinder must be operative for goods train.
2. On ghat sections, 100% of the brake cylinders must be operative for goods trains.
3. Piston strokes in the empty and loaded condition shall be as follows.

	EMPTY	LOAD
BOX-N	85±10mm	130±10mm
BCN	85±10mm	130±10mm

4. There should be at least 4 fully air braked vehicles including brake van with operative cylinder at the rear end of the train.
5. While checking brake power of the train en route at a wayside station, it should be first ensured that the BP pressure on the loco and brake van/last vehicle is 5 kg/cm2 and 4.8 kg/cm2 respectively. If the BP pressure in the brake van/last vehicle is inadequate, the position of angle cocks in between in the entire train should be checked and ensured that they are open. If any is found closed, open it.

Note:

Before uncoupling the locomotive from the rake make an emergency application and wait till BP pressure reduced to '0' thereafter close the angle cock of the brake pipe on the loco and 1st wagon and after a short pause of about half minute ,uncouple the BP air hose

Pneumatic test instructions of electric locomotives.

3.1 MU OPERATION OF WAG-5 & WAG-7 LOCOS

A. General:

Whenever more than one loco are coupled together and locos are worked by a single crew, then it is known as MU Operation. (Maximum 4 LOCOS)

1. The front driving loco is known as "Leading Loco" and rear loco is known as "Trailing Loco".
2. In MU operation, 3 electrical jumpers (B C D) are connected between locos to operate control circuits of trailing loco in synchronizing with leading loco.
3. During MU operation control circuits of trailing locos are operated from leading loco except Q-118, Q-44 and Q-100. For closing DJ, HBA should be on "1" in both the locos.
4. BLSN switch is provided on the BL box, which controls the feed to VEPT and MTDJ of trailing loco from leading loco. Its normal position is "UP", on switching it "DOWN" the supply to MTDJ

and VEPT gets cut off and thus DJ of trailing loco gets tripped and panto also lowers.

5. Closing of DJ can be done for all the locos in multiple operation (MU) together or leading loco only. Similarly opening of DJ can be done for all the locos in MU the locos or of the rear loco only.
6. Trailing loco DJ can be closed from the trailing loco by pressing BP2DJ, but cannot be opened by BP1DJ. In case of emergency, DJ of the trailing loco can be opened by removing its CCPT fuse.
7. Opening of DJ for leading loco alone is not possible.
8. For disconnecting B, C, D jumpers, de-energise both locos and switch off both locos HBA.
9. During coasting/ braking always keep MP on "0".

B. Definitions LSGRPT:

The RED lamp provided on the ceiling of both driving cabs, this lamp indicates the existence of a defect on the loco in which it glows. LSGRPT glows along with defective indication (LSDJ, LSCHBA, LSB & LSRSI).

Note:

1. When MPJ is brought to "0", LSGRPT will glow.
2. When troubleshooting in MU locos do not bring MPJ to "0".
3. LSGRPT glows in defective loco only.

LSOL:

The orange lamp provided on the driving desk of both cabs, the lamp will glow on the loco indicating the defect is in other loco. LSOL glows along with defective indication. (LSDJ, LSCHBA, LSB & LSRSI).

Note: LSOL glows in good loco only.

QVLSOL:

Relay for recapitulation lamp. When there is any abnormality in leading /trailing loco, this relay will pick up and make the lamp LSOL to glow in the good loco.

Q-49:

This relay is called as synchronizing device relay, which synchronizes the tap changer operation in both leading and trailing locos during running and braking of MU operation.

Note:

1. After taking first notch only Q-49 will come into service.
2. During progression/regression with MP, progression with EEC only Q-49 will be active.
3. Q-49 will ensure progression/regression at a time in both locos. It will not ensure difference of notches if any due to auto regression.

BLSN 1/2 - Neutral Section Switch:

This BLSN switch enables to loco pilot to open DJ and lower pantograph of the trailing loco from leading loco.

While passing through neutral section, first put BLSN "DOWN" to open DJ, lower panto of trailing loco and observe the glowing of lamp LSDJ, then switch off BLDJ to open DJ of leading loco.

Note:

1. Normal position of BLSN during MU operation is upwards. At neutral sections BLSN to be put downward position to trip DJ and to lower panto in trailing loco.

Use 2 or 3 compressors on leading loco and one on each trailing loco with normal Working instructions for Loco Pilot during MU operation.

1. Do not wedge any EM contactor or relay (Except Q 100 and QRS) in trailing loco. If necessary make the trailing loco dead.
2. If HOBA of one loco is to be kept on OFF position due to fuse melting then HOBA of the other loco should also kept on OFF position otherwise fuse will continue to melt.
3. In modified ZSMS locos, keep ZSMS of both locos in EEC position. MP will work irrespective of MP position.
4. Whenever HQCVAR is kept on '0' in leading loco then never close DJ separately. Close DJ of both the locos together.
5. During coasting keep MP on '0'.
6. If DJ trips, in defective loco LSGRPT glows and in good loco LSOL glows.
7. While working with leading loco only, RB should not be used. For using RB, rear loco IP(M) COC is to be closed.
8. While attending trouble shooting, keep ZLS in 'OFF' in good loco, ensure ZLS in 'on' position in defective loco and pick up abnormal sign from defective loco.
9. GR struck up on notches, keep MP on '0', auto regression takes place in good loco and DJ trips in defective loco.
10. If leading loco is failed electrically, close PT1&2 COCs of leading loco. Energise trailing loco from leading loco. Clear section with precautions and contact TLC (CHBA of leading lo co will not work).
11. In CCMUBA provided locos, in rear loco, even VCB in tripped condition, rear loco batteries are charged from leading loco CHBA, provided rear loco HBA is 'on'.
12. If CCPT of leading loco melts, VCB will trip, Pantos will lower in both locos.
13. If CCPT of trailing loco melts, VCB trips in trailing loco only. Panto will not lower.
14. If CCDJ of leading loco melts, VCB will trip in both locos.
15. If CCDJ of trailing loco melts, no indication will be there. After changing cab, we experience ICDJ in both locos.
16. If CCA of leading loco melts, auxiliaries will not work in both locos.
17. If CCA of trailing loco melts, auxiliaries will not work in trailing loco only.
18. If MU locos with SIV and Arno combination, while closing VCB at a time in both locos, release BLRDJ after 4 seconds of extinguishing of LSCHBA. Q-45 is provided with time delay for late closing of VCB in SIV loco.

Note:

In modified ZSMS locos no need to change ZSMS for EEC operation in MU locos

C. Important items to be ensured while taking over charge of WAG-5 & WAG-7 MU locos.

1. Both locos are coupled properly.
2. All air hose pipe are connected with their respective pipes and their angle cocks are opened.
3. All electrical jumpers (B C D) are connected between the locos and secured on the ends.

4. SA-9, A-9 cut out cocks are open only in driving cab and closed in other cabs.
5. BP charging cock (A-8) is opened in leading loco only and closed in trailing loco.
6. MU2B valve is on 'LEAD' position on leading loco and on 'TRAIL' position on trailing loco.
7. RGEB-2 cut out cock is open in both the locos.
8. Ensure HBA on '1' on both locos.

D. Condition of apparatus on leading loco:

1. Keep A-9 handle on release position and keep A-9 inlet and outlet COC s 'OPEN' in working cab and 'CLOSED' in non-working cab.
2. Keep SA-9 handle on release position and SA-9 apply and supply COCs 'OPEN' in working cab and 'CLOSED' in non-working cab.
3. A-8 COC to be kept 'OPEN'.
4. MU2B should be on 'LEAD' position.

E. Condition of apparatus on trailing loco:

1. A-9 handle on release position and keep A-9 inlet and outlet COC to be closed in both cabs.
2. SA-9 handle on application position and keep both supply and apply COCs closed in both cabs.
3. A-8 COC to be kept closed.
4. MU2B should be on 'TRAIL' position.

F. Conditions for coupling of locos:

a. In the front end of leading loco:

1. Ensure the following self locking angle COCs are closed.
   a. MR equalizing pipe.
   b. BC equalizing pipe.
   c. Brake Pipe (BP).
   d. Feed Pipe (FP).
   e. Ensure Add. BP COC is 'OPEN'.

2. In between locos:

Ensure the following are coupled properly and their self locking angles COCs are opened.

   a. MR equalizing pipe.
   b. BC equalizing pipe.
   c. Brake Pipe (BP).
   d. Feed Pipe (FP).
   e. Add BP COC.
   f. Ensure both locos are coupled properly.
   g. Ensure BCD jumpers are connected properly.

3. In the rear end of trailing loco.
   a. Close MR equalising pipe and straight air brake pipe self locking angle COC.
   b. Close BC equalising pipe self locking angle COC.

G. Energiation of MU locos:

1. Do the preparations of both the locos separately and also ensure that everything is normal as per the requirement for MU locos.
2. Start CPA of both the locos and build up 8 kg/cm2 pressure in RS of both the locos.
3. In the working cab, unlock BL, insert ZPT in the socket and place it on '1', check the proper raising of rear pantograph of the both locos.
4. Close BLDJ and press BLRDJ. Check that LSDJ extinguishes, UA meter deviates and LSCHBA extinguishes. After LSCHBA extinguishes, release BLRDJ.
5. Close BLCP, MR gauge needle will deviate. Wait for MR pressure to build up. In case MR pressure does not build up more than 2 kg/cm2, check IP valves of both the locos. If any one of IP valve is leaking, close the cut out cock.
6. When MR pressure builds up to 9.5 kg/cm2 ensure that the unloading or auto-draining takes place in both the locos.
7. Close BLVMT and check the working of all auxiliaries in both the locos.

Note:

If CPA of one loco is defective then first energize the MU locos from the loco in which CPA working by taking the following precautions.

1. Open RAL cock of both the locos.
2. Start CPA and keep it working even after building up 8 kg/cm2, pressure in RS.
3. Unlock BL of loco in which CPA is working and put BLSN down.
4. Put ZPT on'1' and check the proper raising of pantograph.
5. Close DJ (LSDJ will remain glowing but UA meter will deviate), release BLRDJ after 4 sec onds, close BLCP and build up MR pressure to 9.5 kg/cm2. Through MR equalising pipe, in defective loco also MR pressure will be charged
6. Put ZCPA on '0' to stop CPA.
7. Keep BLSN "UPWARDS" and check the proper raising of pantograph of the other loco.
8. Press BLRDJ once again and release BLRDJ after LSDJ and LSCHBA extinguished.
9. Change over to leading loco if required (adopt proper procedure).

H. Cab changing procedure in MU locos:

Driving Cab (of the loco which is to be working as trailing loco):

1. Build up MR pressure to 9.5 kg/cm2.
2. Keep A-9 on release position and SA-9 on application position.
3. Check that BC pressure gauge indicates 3.5 kg/cm2 .
4. Apply hand brake/ wooden wedges towards falling gradient.
5. Do not change pneumatic COC position.
6. Open DJ, switch off all auxiliary switches, lower pantograph, put MPJ to '0', lock BL and remove all the keys.
7. Proceed to other loco.

In the other loco (which is to be working as leading loco):

1. Apply loco brake through SA-9 and keep A-9 in release position. Then open A-9 and SA-9 supply and apply COCs. Ensure BC gauge is showing 3.5 kg/cm2.

2. Put MU2B on 'LEAD' position and open BP charging COC A-8.
3. Unlock BL, raise pantos, close DJ, start auxiliaries.
4. Proceed to rear loco. Change MU2B to 'TRAIL' position and close A-8 cock, A-9 and SA-9 supply and apply COCs.
5. Close the cab doors and windows.
6. Then return to leading loco. Check the working of A-9 and SA-9.
7. Release hand brake/ remove wooden wedges of trailing loco.
8. Before moving loco, conduct loco brake power test.

I. Passing neutral section with MU locos:

The procedure of passing neutral section is same as single loco but the following extra operations have to be done.

1. At 250 mts board, put BLSN 'DOWN' and ensure DJ trips and panto lowers in rear loco.
2. One mast before DJ open board, open BLDJ watching UA meter. If UA meter does show '0', lower pantograph.
3. After passing neutral section, at DJ close board, open BLSN, after ensuring rear loco panto is raised, close VCB in both locos as a single loco.

J. Making one loco dead:

1. Whichever loco is to be made dead, open DJ of that loco and keep HBA switch on '0' (if CCMUBA is not available).
2. In dead loco put ZLS on '0' and close IP COC.
3. If trouble persists, remove the electrical jumpers between the locos and secure them on clamps.
4. If unsuccessful make lead loco as trail loco and change trailing loco as working loco.
5. If trailing loco failed, don't change position of any COC in LEAD loco and work onwards if road and load permits.
6. If leading loco failed clear the block section with trailing loco and contact TLC (Close panto COCs of LEAD loco). In this condition, in leading loco CHBA, Ammeters will not work.

K. Working the train from trailing loco when leading loco fails:

1. In case leading loco (other than CCPT) fuse melting, do not change any COC position and work from leading loco (Close panto COCs and observe BA voltage is above 90 v) carefully to clear section.
2. If not possible, make the leading loco dead and work from the trailing loco.
3. Resume traction from trailing loco and clear section without exceeding the speed limit of 15 KMPH and contact TLC.
4. If the load and road permits, request TLC for remarshalling of the loco (changing trailing loco as leading loco) and work onwards with single loco.
5. If load and road does not permit, contact TLC.

L. Working the train from leading loco when trailing loco fails:

1. Put BLSN 'DOWN' to de-energize the rear loco and work with the leading loco. If trouble persists remove the electrical jumpers between the locos and secure them on clamps. Keep HBA on '0', close IP COC of rear loco and work the train from leading loco.
2. Put ZLS on '0' in trailing loco and ensure GR on '0'.

3. Don't change any COC position.
4. Clear section and contact TLC.
5. If the load and road permits, work onwards with single loco. Otherwise contact TLC for advice.

M. Low Tension Test (LT TEST)

I. Preparation :

1. Stop the train. Build up 9.5 kg/cm2 of air pressure in MR and RS by working MCP.
2. Check the BA voltage. It should be above 90V.
3. Open DJ and lower pantograph and ensure both pantos in lowered condition.
4. Ground the loco as per procedure.
5. Close DJ and release BLRDJ after LSDJ extinguishing (UA needle does not deviate, no auxiliary sound and LSCHBA does not extinguish).
6. Ensure all rotating switches on '1' position.

II. Testing :

1. Close BLCPD. Watch the closing of compressor contactors according to HCP position.
2. Close BLVMT; watch the closing of contactors C-107, C-105 and C- 106 one after another with a time delay of 8 seconds each.
3. Move MPJ to F or R position. Watch the Reversers J1 and J2 are thrown to proper direction.
4. Cab-1 forward - J1 & J2 UP direction, Cab-1 reverse - J1 & J2 DOWN direction.
5. Cab-2 forward - J1 & J2 DOWN direction, Cab-2 reverse - J1 & J2 UP direction.
6. Check working of CTFs i.e keep MP traction, CTF 1,2,3 up, MP braking, CTF 1,2&3 down.
7. Place MP on 'N' position and watch for the closing/opening of line contactors according to HMCS position as given below :
   a. HMCS-1 in '2', Watch for L1 to open and L2 & L3 to close.
   b. HMCS-1 in '3', Watch for L2 to open and L1 & L3 to close.
   c. HMCS-1 in '4', Watch for L3 to open and L1 & L2 to close.
   d. Normalise HMCS-1, Watch for L1, L2 & L3 to close.
   e. HMCS-2 in '2', Watch for L4 to open and L5 & L6 to close.
   f. HMCS-2 in '3', Watch for L5 to open and L4 & L6 to close.
   g. HMCS-2 in '4', Watch for L6 to open and L4 & L5 to close.
   h. Normalise HMCS-2, Watch for L4, L5 & L6 to close.
8. Bring MP from N to + Watch for one traction notch progression and LSGR to extinguish.
9. Take two traction notches and Watch for CGR-1, 2 & 3 to close according to GR notches.
10. Watch the working of PHGR after taking 6 traction notches. If MPS is in service, take 20 traction notches and operate MPS to '1','2','3', and '4' positions, Watch the closing of shunting contactors step by step. Bring back MPS to '0'.
11. For testing QWC, press BPQWC before taking 2nd notch, one shunting contactor will close in leading pair of traction motors circuit. Take 11 traction notches and watch the opening of shunting contactors.
12. Take few traction notches and place A9 on emergency position. GR should return to '0'.
13. Place MP on 'N' and ZSMS on '0' and test EEC working also.

NOTE:

1. In Microprocessor locos no need to change ZSMS switch position. In conventional Locos change ZSMS switch to EEC working position.
2. Check for any air leakages in HT compartments during LT test.

4 GENERAL INSTRUCTIONS

1. Whenever any trouble is experienced on loco, try to clear the section either by coasting or with minimum notches.
2. If it is not possible to clear the block section, stop the train clear of bridges, cuttings, curves and preferably near a manned level crossing gate or at a flag station where communication facility is available.
3. In case of DJ tripping, do the general checking given in the TSD, before reclosing DJ.
4. In case of error or doubt while troubleshooting, start the trouble shooting from the beginning to the stage concerned.
5. Make an entry of the trouble experienced, defect noticed and action taken in the logbook.
6. If any smoke or fire is noticed on any equipment open DJ, switch on FL, stop the train, switch off HBA and put out the fire with approved type (DCP) of fire extinguisher available in the loco.
7. Whenever any auxiliary motor is isolated ensure that its EM contactor (if provided) is opened fully.
8. Inform the unusual occurrence to TLC through the available source of communication.
9. When stopped in en-route by LP of train in opposite direction either for issuing any message or for seeking advice for trouble shooting, occupy minimum time, give necessary instructions and should start train within 5 minutes.
10. Whenever the train is detained or likely to be detained in section for more than 5 minutes, give information to TPC/TLC through CUG Phone / emergency telephone tap, or from a flag station or through the adjacent line train Driver and also arrange to protect the train as per GR 6.03.
11. Before removing the fuse trip DJ, keep IP coc close, put HBA in 'OFF' position and before replacing a fuse it should be checked that it is in good condition.
12. In case of manual operation of a relay, operate the relay gently with the help of wooden stick.

    On run if BP pressure drops suddenly or if any lurch/jerk is experienced or DJ tripping with drop in BP pressure, suspect some abnormality on the train. Immediately "switch on" the flasher light, stop the train, check the formation and appraise the Guard by giving two short and one long whistle and protect the train if necessary.

4.1 Do's for Loco pilots :

1. Do check the loco properly while taking over charge. Ensure availability of safety equipments in their nominated / respective places.
2. Do ensure that you go through logbook while taking charge of a locomotive.
3. Do keep the C3W distributor valve (isolating handle towards valve side) in service.
4. Do release the brakes and start the blowers before starting a train.
5. Do keep a watch on BP gauge, pressure gauge, airflow indicator speedometer, ammeters and voltmeter.
6. Do keep a watch on Pilot lamps.
7. Do keep a watch on OHE and track ahead.

8. Do check battery voltage while taking over charge and every hour thereafter.
9. Do check the condition of all the spare fuses provided before starting the train.
10. Do ensure that the line is wired while entering a turn out.
11. Do take the advantage of fall-in gradient by coasting.
12. Do check the MR pressure and BP/vacuum before approaching 500 m warning board.
13. Do create full BP before notching up after passing neutral section.
14. Do keep the blowers running for 15 minutes even after stopping the train after heavy-duty operation to ensure that you start with cool traction motors.
15. Do drain out moisture from reservoirs and check the temperature of suspension bearings and axle boxes at halt stations if stopping time permits.
16. Do keep a full record of indication of OHE voltage, speed, notch, current, kilometre etc, in case of a trouble in loco.
17. Do lock BL only after opening all BL switches.
18. Do book the current repairs to enable the shed staff to attend the same.
19. Do ensure MP and NR on 'O' before applying brakes.
20. Do take out MPJ (reverser handle) handle every time while leaving the cab.
21. Do ensure personally the pantograph is lowered before operating HOM.
22. Do ensure the availability of arc chutes.

4.2 Don'ts for Loco pilots:

1. Do not exceed the current rating limit of traction motors.
2. Do not allow to blow the MR safety valve, when RGCP is not in service.
3. Do not exceed the maximum permissible speed of the loco under any circumstances.
4. Do not operate the reverser handle (MPJ) when the loco is running.
5. Do not operate battery main switch (HBA) when the loco is in energised condition, in normal position.
6. Do not stop the blowers, if the halt is for less than 15 minutes.
7. Do not enter into HT compartment unless the loco is grounded.
8. Do not lock the loco on road side stations unless asked to do so.
9. Do not open the corridor doors without closing the cab windows, when the blowers are working. 10.Do not climb on to the loco roof without obtaining Power Block and without grounding loco. 11.Do not adopt short cut methods as it may lead to serious consequences.
12. Do not perform shunting without coupling BP hoses.
13. Do not operate rotating switches when the DJ is in closed condition. 14.Do not leave the loco in un-manned condition.
15. Do not switch on CUG phone while on duty. In case of emergency stop the train and then switch on CUG phone.

4.3 Train stranded due to stall, loco failure or any other such reason and the train cannot proceed further:

I. When loco is alive:

1. Apply A9 to Full Service and ensure train brakes are applied.
2. Apply SA9 and ensure BC gauge is showing 3.5 Kg/cm2 and loco brakes are applied.

3. Apply parking brakes if available.
4. Apply SA9 to maximum in Trailing loco/ banker loco if provided.
5. Do not desert the locomotive.

II. When loco is not alive :

1. Apply A9 to Emergency and ensure train brakes are applied.
2. Contacting T Apply SA9 and ensure BC gauge is showing 3.5 Kg/cm2 and loco brakes are applied.
3. Apply parking brakes if available.
4. Apply hand brake also.
5. Apply SA9 to maximum in Trailing loco/ banker loco if provided.
6. Apply hand brake in Trailing loco/ banker loco if provided.
7. Keep the wooden wedges at wheels of loco against the falling gradient.
8. Do not leave the loco un-manned.

In addition to above instructions pertaining to protection and securing of trains as per GR 6.03 and 6.04 should also be followed by crew. These instructions should follow for coaching trains also.

Note:

Sensitivity of the brake system (Distributor valve) demands a minimum brake pipe pressure reduction of 0.6 kg/cm2 in 6 seconds for brakes to apply. If a train is stalled or comes to a halt for any reason with coach brake pipe fully charged, no brakes will apply even if brake pipe pressure reduces to '0' due to normal leakage in the system. Loco Pilot must therefore ensure that brakes are applied by a positive act of placing A9 at full service / emergency, so as to avoid rolling down of the train on its own on gradients.

4.4 Contacting TLC for advice :

1. Stop the train at a station or near a telephone tap or at a flag station or at a manned level crossing gate where telephone is available.
2. Find out the cause of failure or trouble and give information to TLC within 5 minutes. After asking for relief or if train is detained for more than 15 minutes in mid section, protect the train as per GR 6.03.
3. Act as per the instructions given by TLC.
4. Enter in the loco logbook, the location and time at which TLC is contacted.

Summer & Monsoon preparedness and general instructions to loco pilots on three phase electric locos

i. Feel the axle boxes temperature during stops.
ii. Check availability of fire extinguishers in locos.
iii. Check for any leakage of transformer oil from transformer, traction converter, MPH circuit and other accessories.
iv. Check transformer oil and traction converter oil in guage glass between minimum and maximum level.
v. If one auxiliary converter is isolated, then as per TSD, switching OFF & ON electronics is advised once for normalizing the working of auxiliary converter. Since the isolation of auxiliary converter reduces the ventilation level, it is prudent that, in summers, switching OFF & ON of electronics should be tried again later on during stops, to normalize the working of auxiliary converter.

Besides above, following instructions are also to be followed by Loco Pilots while working on three phase electric locos to curb the loco failures on line.

i. DJ should be immediately closed once again if it trips on run after reading and acknowledging the fault/disturbance message on DDS.
   a Should the DJ trip again on converter disturbance and no automatic bogie isolation is observed, manual isolation of the culprit bogie be done in running condition without switching OFF/ON electronics and loss of time.

ii. Slow creation of pressure could be because of leakage from Air drier. In such a scenario, the air drier be isolated immediately.

iii. Pressure drop may also occur due to VCD getting activated due to being defective. Isolate the VCD and look for reasons for malfunctioning at the next stop station to avoid further detention in the block section. VCD isolation can be done using switch 237.1.

iv. In case Angle transmitter goes defective, immediately switch over to manual mode using switch 152 in running condition. There is no need to stop.

v. MCB 127.7 in SB2 needs to be checked first during Brake Electronics failure.

vi. Application/release of parking brakes can be through pneumatic panel, BPPB, release spindle at the time of starting or engine on train.

vii. Regulated use of sander (PSA) instead of continuous use is recommended. Continuous use of sander is not only ineffective but could also lead to MR drop.

viii. Timely attention to P2 battery message so that loco does not shut down with P1 message later on. Tripping of battery charger MCB 100 invariably leads to P2 battery messages. Switching ON MCB 100 has to be done with DJ in OFF condition.

ix. Any fault message in DDS should not be acknowledged without reading and follow up as suggested. Once acknowledged, the message gets lost.

x. Any such messages requiring train to stop, efforts should be made to clear the block section in coasting and then attention to the message can be given.

xi. 3-phase MCB in HB-1/HB-2 in tripped condition can be put in ON once to restore an equipment. Two different mechanisms to put ON tripped MCB are available for ABB and MG make MCB's which should be clearly understood. Restoring the MCB does not require switching OFF/ON of the electronics system.

xii. P1 message have to be immediately acted upon & course of action is also available in DDS. P2 message need not be acted immediately except for battery voltage low/MCB 100 tripped. P1 message come with a red flashing of LSFI in addition to BPFA.

xiii. Configuration switch 160 restricts loco speed to 15 kmph & can be corrected without switching electronics OFF/ON in much lesser time. However, the loco has to be dead stopped before operating switch 160.

Fire prevention measures

1. Whenever the VCB trips while hauling a train with 3-phase electric locomotives, the LP & ALP should immediately check/read the DDS message carefully on the display screen of computer in the cab for the associated fault. In case the VCB has tripped through Primary Over Current Relay with Priority 1 fault message, the Loco Pilot/Assistant Loco Pilot (LP/ALP) should immediately inspect the Machine room carefully looking for any signs of fire/smoke, spread/spillage of oil especially near converter/transformer area and extinguish the same by using portable fire extinguisher. Primary Over Current Relay in 3-phase electric locomotives is just like QLM relay in conventional electric locomotives and its operation should attract attention of the running staff in the same manner as for

QLM relay. In case of larger fire specially over traction converter and transformer area, the cocks of 22.5 kg CO2 cylinder provided in the locker on ALP side should be operated in both the cabs, keeping the Machine room door in closed condition.

2. If no signs of fire/smoke are observed, LP should close the VCB only once more. If the same trips again with Over Current Relay, the control electronics will be automatically switched off and panto lowered by software. The LP/ALP should not try to switch ÓN' the control electronics or close VCB again and they should immediately ask for assistance from TLC.
3. Any case of fire/smoke message from Fire Detention Unit (FDU) appearing on display screen with/without tripping of VCB should not be ignored and crew should inspect the machine room thoroughly and look for any signs of smoke/fire/overheating/spark from equipment/joints and take further action accordingly.
4. It should be ensured that the LP & ALP running 3-phase electric locomotives are fully conversant with the display message of fault available in the display screen of the computer. Refreshers courses should be arranged for new LP/ALPs at shorter intervals initially and later on based on this experience, this amy be increased. The importance of priority 1 and priority 2 faults and their consequences should be explained to them.

Duties of Loco Pilots and Assistant Loco Pilots in 3-Phase locomotives:

1. Loco Preparation and Inspection

Before commissioning Journey, perform an inspection check of the locomotive and through the machine room. In particular, check the following items:

In front Of Cab:

1. Ensure that loco is standing on the rail and under the OHE.
2. Ensure that both side MRE, BCE, BP, FP hoses are connected properly and their angle and additional COCs are as per requirement. Also ensure that hoses are not hanging.
3. Ensure no damages to rail guard and cattle guard.
4. Ensure that CBC having no abnormalities and locking pin is available and provided with operating handle.
5. Ensure that UIC connector sockets are covered.
6. Ensure that flasher light, marker lights, headlights are glowing properly and their glasses are clean.
7. Ensure that both look out glasses are clean and wipers are wiping properly.

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

1. Ensure that all sand boxes are filled with dry fine sand, sanders are working properly and sand pipes are aligned correctly.
2. Ensure that additional angle COCs of MRE & BCE is opened.
3. Ensure that Air dryer unit is in service that (D-in open, D- out open & D-off closed).
4. Ensure that all suspension dampers; helical springs having no abnormalities like, crack etc.
5. Wheel set Guide rods are fitted properly and its bolts are tightened.
6. All brake rigging; brake block, brake shoe, sleeve rod, assembly hanger arrangement are OK.
7. Wheels are not skidded.
8. Return current bushes are connected properly.
9. Parking brakes cylinders are provided with manual releaser hook.

10. Traction link is fitted properly and their all 6+6 bolts are tightened and its safety slings are intact.
11. Oil level in MCP-1 is above min mark; also ensure that CP foundation bolts are tightened and safety sling is slack.
12. Bogie brake -1 COC is in open condition.
13. Battery box cover is fixed properly.
14. Safety slings, bolts, fixing link, gear case assembly are intact for all Traction motors.
15. BP and FP additional COCs are in open condition.

Below Machine Room No. 2

1. Ensure that all sand boxes are filled with dry fine sand, sanders are working properly and sand pipes are aligned correctly.
2. Ensure that additional angle COCs of MRE & BCE is opened.
3. Ensure the all suspension dampers, helical springs having no abnormalities like, crack etc.
4. wheel set Guide rods are fitted properly and its bolts are tightened.
5. All brake rigging; brake block, brake shoe, sleeve rod, assembly hanger arrangement are OK.
6. Wheels are no skidded.
7. Return current bush are connected properly.
8. Parking brakes cylinders are provided with manual releaser hook.
9. Traction link is fitted properly and their all 6+6 bolts are tightened and its safety slings are intact.
10. Oil level in MCP-2 is above min mark; also ensure that CP foundation bolts are tightened and safety sling is slack.
11. Bogie brake -2 COC is in open condition.
12. Battery box cover is fixed properly.
13. Safety slings, bolts, fixing link, gear case assembly are intact for all Traction motors.
14. BP and FP additional COC are in open condition.

In Cab

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

In Machine Room

1. Control and power Circuit breakers in cubicle SB-1 / SB-2, HB-1 / HB-2 are normal in (up) position.
2. Switches provided in SB-1 are in normal (vertical) position.
3. Oil level of Conv-1/2 , transformer-1/2 and MCPA are above min mark.
4. All fittings and connections are normal.
5. Outer cover of any power equipment is not opened.

Pneumatic Panel

1. Panto selector switch is in “auto” position.
2. COCs 70, 74,136 are in open condition and COC 47 is in close position.
3. COCs of panto 1, panto 2, VCB and sanders are in open condition.
4. Distributor valve is in service.
5. IG 38 Key is inserted and kept ‘ON’.
6. CPA drain Cock is in closed position if available.
7. Parking brake apply/release plungers are not in locked condition.

2. Energising of Loco:

1. Check the machine room and cubicle HB1/2,SB1/2 and pneumatic panel and ensure that all Circuit breakers, rotating switches and cut out cock at Pneumatic Panel are at Normal position and ensure that key ‘IG-38’ is inserted and kept ‘on’ in pneumatic panel. Also ensure that panto selector switch is at auto position.
2. Switch ON compartment light, it ensures closing of main circuit breaker 112 of battery.
3. 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.

1. Go in operating cab.
2. Insert A-9 handles at ‘Neutral’ position and keep it in ’RUN’ position by lifting lock.
3. Insert ‘BL’ key at ‘OFF’ position and turn it to ‘D’ position
   a. Light of screen (panel-C) and Memotel will get ON.
   b. MCPA will start (if pressure is less).
   c. UBA will indicate (it should be above 92v).
   d. LSDJ will glow.
   e. Cab will activate.

All above indications indicates that Control Electronics are ‘ON’.

4. The message “Loco is in configuration, please wait” will appear on the screen and self testing is done for 10 seconds.
5. During testing, all pilot lamps will glow and extinguish, Bogies-1 & 2 meter needle will deviate both in TE/BE mode and come to -0.
6. 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.
7. Node No. FLG 550 will display on the screen, now press BLDJ for closing VCB and check ‘LSDJ’ is extinguished.
8. Now DJ will close, loco will energise and all the auxiliary motors will start automatically.
9. Ensure that BLCP is at AUTO position.
10. Node No. FLG 570 will appear on the screen.
11. 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.)

Note:

If the reverser is set without confirming the MR pressure above 6.4 kg/cm2, P 1 message will be there on screen- indicating wrong operation.

12. Conduct loco brake power test before moving.

Release the parking brakes, remove any woodges if any under the wheel Ensure BP pressure is 5 kg/ cm^2

Ensure AFI is at Zero.

Set the screen in 'Simulation Mode'.

1. Now operate throttle in TE direction.
2. TE /BE meter will deviate in TE side indicating that traction is available. No. "596" will appear on the screen.
3. Check the loco brake power (should not move upto 150KN for WAG-9 and WAP-7 /100 KN for WAP-5).
4. Now Loco is ready to work.

Note:

Priority -1 message will appear on the screen if: -

1. If Reverser is put on position F or R when MR pressure is below 6.4 kg/cm2
2. If throttle is operated without releasing parking brakes.
3. If throttle is operated without recharging BP to 5 kg/cm2. Information message will appear on the screen:-
5. If throttle is operated

3.Operation Of BL Key

BL key is operated in the following modes:

DRIVING MODE	: Off - D
SELF HOLD MODE	: D - Off
Switching OFF control electronics	: D - Off - C - Off
COOLING MODE	: D - Off - C - Off - C

Driving Mode:

This mode is used to drive the loco. To achieve this mode Loco pilot has to:

1. Insert BL key in 'OFF' position.
2. Turn it clockwise from 'OFF' to 'D'
3. By doing so, following indications will confirm the driving mode:

a. LSDJ will glow
b. UBA will show battery voltage.
c. Display screen will activate.
d. Memotel screen will activate.
e. Control electronics will ON.
f. Cab will activate.
g. MCPA start if less pressure.

Self Hold Mode:

1. Open DJ , lower the pantograph
2. Rotate 'BL-key' from 'D' to 'OFF': Now control electronics will remain 'ON' for 10 minutes and

then CE will become 'OFF' automatically. This mode is used while changing the cab.

a. Screen will display with information message as "Self hold mode active. After 10mins MCE will switch OFF".

Switching Off - Control Electronics:

Loco pilot has to switch off control electronics in many cases like;

b. Making the loco dead.
c. During troubleshooting.
d. To bring back the isolated sub system into service.
e. Before resetting circuit breakers in SB-1/2 panel(except 310.1/1 head light ,310.7/1 marker lights and 127.92 SPM)
f. Before operating 237.1 rotating switch in SB-1 panel.
g. Before going to cooling mode.

To switch off the control electronics do the following:

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

Note :

1. CE gets automatically 'off' after 10 minutes if BL-key is rotated from 'D' to'OFF' (as explained in self hold mode)
2. 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.
3. If the key switch is moved from "D" to "Off" without opening VCB and lowering panto graph, results in automatic shutdown of the loco (VCB TRIP and PT lowers).

Cooling Mode:

Whenever temperature of control electronics is increases above 700C then lamp LSCE glows on Panel 'A' and throttle will not respond.

1. Ensure MACHINE ROOM MCBs are not in tripped condition.
2. Try to coast in to station or stop the train at suitable place and secure the formation.
3. Inform TLC/SCOR regarding cooling.
4. Open VCB and lower the pantograph.
5. Switch off CE as per procedure.
6. 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).
7. Now raise the panto, close the VCB- LSDJ will extinguish and loco will energise in cooling mode.
8. Machine room blowers & their scavenging blowers will start automatically to cool the machine room.

9. Ensure working of machine room blowers.
10. When the machine room temperature goes below 70OC then LSCE will extinguish.
11. Now Open the VCB, lower the pantograph.
12. Put BL from 'C' to 'Off' and 'off' to 'D' and energise loco & resume traction.

Note:

1. If LSCE lamp does not extinguish after 15/20 mins, keep BL key in Driving Mode and try. If TE/BE handle responds, ignore LSCE and work further.
2. During Cooling Mode observe UBA meter frequently. If battery voltage drops to 92V, stop cooling mode and energise the loco in driving mode to charge the batteries (CHBA will not work in cooling mode).
3. During cooling mode ,if VCB trips ensure no OCR action.
4. Operation Of Reverser :

Reverser has following 3 positions.

Position 'F' : Forward

Position 'O' : Neutral

Position 'R' : Reverse

Throttle and reverser are interlocked mechanically.

Driving:

1. After creating MR pressure above 6.4 kg/cm2 and ensure node No. 570.
2. Move the reverser into desired position.
3. Release the parking brake if applied.
4. Put A9 to 'RUN' position & ensure BP 5 kg/cm2
5. Check AFI is not deviating.
6. Set the TE/BE throttle to desired position.
7. Put SA9 handle to 'Release' position.
8. In order to increase adhesion and to avoid wheel slipping use sanders.
9. Bogies 1 & 2 meters will show in TE side and loco starts moving.

Braking:

1. Set the TE/BE throttle to - '0' or move towards braking side as per requirement.
2. 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.
3. Regenerative Braking is possible up to '0' KMPH.
4. When train stops, apply SA9.
5. Maximum brake force is 260 KN in WAG-9/WAP-7 & 160 KN in WAP-5.

Note:

Train brakes can be applied with Regenerating brakes but Loco brake cannot be applied simultaneously with Regenerating brakes.

5. Operation Of Throttle:

TE/BE Throttle

The TE/BE throttle controls traction and the electric braking effort of the locomotive with an angle transmitter and auxiliary contacts.

The TE/BE throttle has the following three positions:

For Traction

Position 1/3 : 33% Tractive effort

Position 2/3 : 66% Tractive effort

Position TE max : 100% Tractive effort

Position "0" : no tractive / no braking effort

For Regenerative Braking effort

Position 1/3 : 33% braking effort

Position 2/3 : 66% braking effort

Position TE max : 100% braking effort

Note:

1. If TE doesn't increase beyond 300 KN in WAG 9, then check ZTEL (Panel 'A'), which should be in 'OFF' position.
2. The % of tractive/braking effort is indicated in the two TE/BE meters on the panel A.

Failure Mode Operation

This mode allows the locomotive to operate even if the angle transmitter of the throttle is failed. In this mode, driving and electrical braking are controlled by the auxiliary contacts on the throttle.

Driving in failure mode:

Driving in failure mode becomes necessary if the difference between auxiliary contacts and the absolute value of the angle transmitter is greater than 25% of the full range because of a defective master controller.

following steps are initiated with a time delay of 2 sec:

1. Traction is set to 0 by the MCE.
2. A priority 1-fault message (F1703P1/F1803P1) is displayed.
3. The Loco pilot must keep the TE/BE throttle into position "0".
4. The Loco pilot must now move the rotary switch "152-Failure Mode Operation" in the (SB1) into position '1'.

This deactivates the angle transmitter.

Position '0' : Fine control throughout the range by angle transmitter.

Position '1': Fine control in steps through auxiliary contacts.

5. The Loco pilot must acknowledge the fault message.
6. Now the TE/BE handle will respond in three position only ie., 33%, 66% and 100%.

6. Loco Brake Testing:

1. Apply loco brakes by SA-9.
2. Ensure that brake cylinders showing 3.5 kg / cm2.
3. Physically ensure the brake blocks are touching to the wheels and no person/loco is in front.

4. Set the screen in simulation mode.
5. Release parking brakes, release A-9 and remove wooden wedges if any.
6. Ensure no person, points, signals in front of loco.
7. Whistle freely.
8. Operate reverser to forward.
9. Keep throttle in TE side and loco should not move up to 150 KN in WAG-9 & WAP-7 locos and 100 KN in WAP- 5 locos.
10. After conducting loco brake power test ensure TE/BE handle in neutral position.

7. Procedure of Cab Changing:

Single Unit

1. Stop the train/loco.
2. Apply direct brake and ensure loco BC gauge is showing 3.5kgs/cm2.
3. Build up maximum MR pressure (BLCP in 'MAN' position).
4. Open 'VCB' and ensure LSDJ is glowing.
5. Lower the pantograph. Physically ensure it and 'U' meter should show '0'.
6. Move automatic brake (A-9) handle to Emergency and ensure BP dropped.
7. Move automatic brake (A-9) handle to 'Neutral' position.
8. Remove the automatic brake (A-9) handle form 'Neutral' position.
9. Operate BL key from 'D' to 'OFF' and remove it.

a. CE will remain ON for 10mins.

b. Parking brakes will apply.

10. Release the direct brake handle.
11. Close the doors and window shutters.
12. Go to the other cab.
13. Apply direct brake.
14. Insert the automatic brake (A-9) handle and keep in 'Run' position.
15. Operate BL key from 'OFF' to 'D'.
16. Raise pantograph and close VCB as per procedure.
17. Conduct loco brake power test.

Note:

After moving the key switch 'BL' to position 'OFF', the MCE remains active for 10 minutes. The cab changing should be done during this time.

8. 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 be operate in banking mode.

Procedure:

1. Build up MR pressure up to 10.0 Kg/cm2 and BP up to 5.0Kg/cm2.
2. Couple the banking loco to the formation (CBC).
3. Couple the BP Hose Pipes (Do not open BP Angle Cocks).

4. Open the DJ of the loco being coupled as Banker.
5. Put Switch "ZBAN" to ON position.
6. Observe and ensure BP pressure drops to ZERO and message "LOCO IN BANKING OPERATION" appears on DDS screen.
7. Put 70 Cock handle to vertical (close) position.
8. Now open BP angle cocks between banking loco and formation. Ensure BP builds up to 5.0Kg/cm2 in Banking Loco.
9. Close DJ in the Banking Loco and ensure that no message appears on the DDS screen.
10. With loco brakes applied check in simulation screen that TE demand is coming. Now the loco is fit for Banking Operation.

9. 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 illuminated push button 'BPCS'.

The control electronics and GTO controls the constant speed by giving tractive or braking effort to the TM as per requirement irrespective of position of throttle (ATDC-Angle transmission Loco pilot Controller) i.e. TE/BE .

CSC is activated only when

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

The actions of CSC are cancelled in following conditions.

1. Pressing 'BPCS' while CSC is active, lamp will extinguish.
2. Moving of throttle by 3%.
3. Drop in 'BP' by 0.25 kg/cm2 and above.
4. BC pressure more that 0.6 kg/cm2.

Precautions For Using of CSC:

1. To minimize oscillation, the CSC should be set during a slow acceleration phase.
2. CSC will maintain the speed only up to max TE / BE. Speed may vary if required TE / BE is more than loco capacity. The speed may vary +/- 10 kmph to preset value, depends up on the gradient.
3. If CSC is used in very frequent up / down graded region, 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.
4. In undulating area BPCS should not use.
5. Also in some areas where special driving technique is required, CSC may stall the train. So, in such areas, instead of using CSC, Loco pilot should use his best driving technique by operation of throttle.
6. While nullifying CSC ensure that needle position of TE/BE meter and throttle are not just opposite. If so, first bring the throttle as per needle.
7. While using CSC in yards, loop lines observe TE/BE meters for any abnormal fluctuations.

10. Emergency Stop Push Button

One red coloured push button is provided on panel 'A' in such a place that Loco pilot as well as Asst. Loco pilot can operate it. In normal condition it remains projected out. In case of an emergency if Loco pilots/Asst. Loco pilot presses 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 applied.
5. LSFI & BPFA glow with message (F1008P1).
6. "Emergency shutdown on the loco" appears on screen and train will stop with emergency brakes.

Resetting:

1. Bring TE/BE throttle to '0'.
2. Press "emergency stop push button" slightly and rotate it clockwise as per arrow indication on it, the button will comes out from pressed condition.
3. Press BPFA and acknowledge the fault and node information will appear.
4. Energise the loco and work the train as per procedure.

11. Automatic Vigilance Control System:

VCD is meant for keeping the Loco crew alert. It is a safety device. A foot switch of VCD is provided below Loco pilot's desk in each cab and also push button 'BPVG' is provided on Loco pilots' desk panel 'D'.

Loco pilot/Asst. Loco pilot is expected to activate VCD within every 60 seconds interval by anyone of the following ways.

1. Press VCD " Foot switch".
2. Press BPVG.
3. Operate throttle in TE/BE with difference of more than 3%.
4. 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 seconds, then buzzer will sound and 'LSVW' will glow for next 8 seconds ie., from 61 to 68 secs.

Within these 8 seconds VCD should be acknowledged. If not acknowledged, VCD will apply penalty brakes ie., TE/BE will come to '0' & BP pressure drops 2.5 to 3.0 kg/cm2 and P1 Message F1003P1 will be displayed on the screen.

Note:

VCD comes into service when the speed of train is more than 1.5 KMPH.

Dead Mans Mode:

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

Resetting Of VCD Penalty Brakes:

1. Bring throttle to '0'.
2. Apply auto brakes to Full Service to avoid MR pressure dropping and after stopping the train Apply Direct brake
3. Wait for 160 seconds in WAG-9/WAP-7 and 120 seconds in WAP 5 loco.
4. Press "BPVR" to reset VCD, LSVW will extinguish and buzzer will stop.
5. Press and release VCD "Foot switch".
6. Press 'BPFA' for acknowledging fault message.
7. Release auto brakes.
8. MR/BP pressure would come back to normal.
9. Resume normal traction.
10. Inform to TLC and write remarks in loco log book.

Isolation Of VCD:

If Loco pilot is acknowledging VCD correctly as per procedure, but till VCD penalty is applying, it is assumed that VC is malfunctioning. In such cases stop the train, take safety measures. VCD can be bypassed by keeping switch No

237.1 (SB 1) on '0' position. Remark should be given in log book, TLC is to be informed & proceed carefully.

12. PASSING NEUTRAL SECTION (SU) Before approaching neutral section:

1. Ensure that MR pressure is between 8.0 to 10 kg/cm2.
2. Bring TE / BE throttle to '0" gradually before 250M board.
3. At DJ open board, open DJ by BLDJ, LSDJ will glow, Aux. sound will stop, but U meter will show OHE supply.
4. At actual neutral section location, OHE meter will comes down to "0" and will shoot up when neutral sectio over.
5. In PTFE type neutral section, at higher speed, needle will just fluctuate.
6. At DJ close board close VCB (DJ), and resume normal traction.

In case MU operation

1. The command from the master locomotive to switch the main circuit breaker "ON", "OFF" also controls the mai circuit breaker on the slave loco.
2. The VCB of the slave loco is switched on after a delay of 0.5 seconds following the switch on of the master loco When switching off, there is no delay.
3. While passing neutral section follow the procedure mentioned for SU, but DJ should be closed after passing on mast after DJ close board.

13. LOCO GROUNDING:

Loco should be grounded only while climbing loco roof to attend any trouble on loco body like removin foreign body, securing damaged pantograph etc.

Procedure:

1. Stop the train at convenient place and secure the train.

2. Open VCB and lower pantograph.
3. Rotate IG-38 in anti-clockwise direction and extract key.
4. Insert the key in empty socket of HOM box and rotate in clock wise direction.
5. Operate HOM handle by 180 degrees by taking it out from latch.
6. Rotate yellow KABA key in clock wise direction and extract the key and keep in personal custody.
7. Now attend the trouble.

14. Resetting of MCB:

Sometimes MCB trips momentarily without any equipment failure. Loco pilots should try to reset MCB once. While resetting ABB make MCB, resetting screw below the respective circuit breaker turns to horizontal position from initial vertical position. This screw should be turned to vertical position first and then, MCB should be reset by lifting it's handle.

For resetting MG make MCB, handle should be pulled first downward towards offside and then in upward direction towards on to reset the MCB, otherwise the MCB will not hold.

For resetting Schneider red and green knobs MCBs, if MCB trips green knob will project out, for resetting press green knob, then red knob will project out, indicated MCB reset.

If it is needed to trip any MCB, trip it with proper procedure i.e. by rotating screw or by pressing tripper knob provided on MCB. Don't trip any MCB directly and in VCB closed condition.

Note:

To reset MCBs in HB-1/HB-2 panel, VCB has to be tripped and in SB-1/SB-2 Panel (except 310.1/1 head light, 310.7/1 marker lights and 127.92 SPM), CE has to be switched OFF.

15. Pantograph:

Two pantographs are provided on either end of loco. Design of pantograph is same as other AC locos. For raising and lowering of pantograph one switch 'ZPT' is provided on panel 'A' having 2 positions, UP and DOWN.

When we press switch down ward (i.e position UP) and release - panto will raise. When we press switch upward (i.e position DOWN) and release - panto will lower. Note: The rear panto will rise automatically.

Selection Of Panto:-

Panto selector switch is provided on Pneumatic Panel in machine Room-1

Position:

Auto : Normal position (only rear panto will raise)

I : Panto of Cab 1 will raise (2 will isolate electrically)

II : Panto of Cab 2 will raise (1 will isolate electrically)

For isolation of both pantos pneumatically, two COCS are provided on Pneumatic Panel PAN-1 & PAN-2. Normally these COC should be opened (Horizontal). For isolating particular panto keep that COC on closed position (i.e Vertical)

One circuit breaker (127.12 Circuit breaker Pantograph, VCB Control) is provided for panto circuit in SB-1 cubicle. Key IG-38 is provided on pneumatic panel to control the air pressure to Pantographs. For air passage to pantographs this key should be kept ON.

16. Auxiliary Compressor (MCPA) :

The auxiliary compressor is used to raise the pantograph. While the control circuit is switched 'ON, the auxiliary compressor controlled by Pn switch start automatically (independent of MCE) till the pressure reaches to 6 kg/cm2 (MCPA will work in DRIVING and COOLING mode. (works between 5.2 kg/cm2 to 6 kg/cm2)

Auxiliary compressor has one drain COC on pneumatic panel. Normally this COC should be horizontal to pipe line (i.e. closed).

17. Main Reservoir:

For storage of compressed air pressure MRs are provided on this loco. In WAP-7 & WAG-9 loco, two MRs and one AR is provided in machine Room in vertical manner. Capacity of MR is 450 liters. Drain COC is provided below each MR, which can be operated from machine room. In WAP-5 MRs are located in under truck and each MR having capacity of 240 liters.

In dead loco AR is charged by BP pressure of Live loco provided that COC 47 should be in open condition. This AR pressure is utilized for conjunction loco braking and Parking brakes.

18. Sanding:

Sanding is done automatically on leading wheels when

1. PSA is pressed.
2. Anti spin device activated.

Note: Don't press PSA continuously, but press and release it. Continuous sanding is not possible, If PSA is pressed continuously for 1 minute, then dead man's penalty brakes will apply. 10-12 sec pause is required between two operations of PSA.

19. Active functions with deactivated Loco pilot's cab:

While the cab deactivated, the following functions remain operative.

1. MEMOTEL functions
2. Emergency brake Cock on assistant Loco pilot's side
3. Cab and desk lighting
4. Windshield wipers
5. Fault display screen
6. Marker lights switches
7. Cab venting and heating
8. Crew fans
9. Hand lamp socket.
10. U- meter.
11. Gauges.

20.INCHING MODE

For making engine on train, INCHING MODE feature is newly provided in the three phase loco. By this, loco will move at a speed of 0.5 to 1.5 kmph.

edure 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. / Software / Inching"
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)
7. Now release Direct brake, keep MPJ forward and close ZTEL. Loco will start moving with set speed.
8. To stop the train open ZTEL and apply direct brake.

Note:

i. Throttle need not be operated for inching mode.
ii. After attaching the loco if ZTEL is not opened, train will work only with 1.5 kmph.
iii. While moving the loco with 1.5 kmph, if ZTEL is opened due to any reason, set speed will come back to preset ie., 0.8 kmph.
iv. VCD need not acknowledge during inching mode.

21. PROTECTIVE MEASURES

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.

Catenary voltage out of range:

When catenary voltage drops down below 17.5 KV and raise above 30.5 KV ,VCB will open automatically.

Temperature protection: When temp of Transformer exceeds beyond 840 C, for more than 10 sec, VCB will trip.

22. 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.

If OCR-78 relay is acted, before resetting the target, inspect the machine room for any oil spillage. Check the oil level in both the expansion tanks of transformer in machine room located near Oil Cooling Unit and the expansion tanks of both the converters. It should be in between the Max. & Min. marks. If there is any abnormality like splashing of oil inside the machine room or from the transformer/converter, sign of overheating/sparking of connection, don't reset the relay target and ask for relief loco. If there is no any abnormality, then the target can be reset once.

If OCR-78 relay is acted for second time, with or without any abnormality, don't reset the target and ask for relief loco. (In modified locos CE off automatically).

If VCB trips during 'C' mode then check oil level of transformer and converter and check relay-78. If anything is abnormal, fail the loco.

23. Train Parting:

Airflow measuring valve is provided in loco. Whenever train gets parted, or air flow increases and AFMV gets activated, resulting in glowing of LSAF and sounding of buzzer. Also message of ALARM CHAIN PULLING will appear on screen.

As due to uncoupling / parting, the BP pressure start expelling at very fast rate, resulting in sudden drop in MR pressure which leads to Priority -1 message on screen "Low Pressure Main reservoir"

So, after parting/uncoupling, the Loco pilot will get message of low MR pressure.

So, whenever AFI shoot up with sudden drop in BP pressure, your first duty is to act as in case load parting / accident (like switching ON of flasher light, protection of adjacent track, Securing of load / loco, etc.), After asserting that trailing load is OK, then think about the loco / message.

24. Fire Alarm:

In loco fire detention unit is provided in SB2. There are two smoke detectors provided to detect the smoke in FDU.

When one detector detects the smoke –

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

When both detectors detect the smoke –

1. Priority-1 message will appear on the screen - Inspect Machine room
2. Throttle T/E, B/E becomes '0'
3. Buzzer will sound.

Do the necessary arrangement to extinguish the fire by using suitable fire extinguisher provided in Cab1/2 and Machine Room 1/2 (Total 4 Nos.)

Action to be taken by Loco pilot

1. Trip DJ, lower Panto, stop and secure the train, switch off battery, Inspect the Machine room and take necessary action. In case of fire on loco, use big fire extinguisher provided in the rack behind asst. Loco pilot in cab. To operate this fire extinguisher, open the cut out COC after releasing lock and release the gas by rotating adjusting knob, gas will expel and extinguish the fire at appropriate places in machine room behind it. In addition to this two numbers of portable fire extinguishers are provided on the loco which should be used accordingly as per requirement.
2. To reset the FDU, press 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.

25. Alarm Chain Pulling:

When airflow increases without initiation of Loco pilot or CE i.e. in case of ACP/Guards brake applied/ leakage in train etc. Following indications appear.

1. Air Flow Indicator needle will deviate.
2. LSAF will glow.
3. Buzzer will sound.
4. BPFA will illuminate with P-2 message.
5. Auto flasher will start.

26. ACP Indication:

1. Reset the ACP or arrest the leakage.
2. Buzzer will sound continuously until the leakage/ACP is arrested. To stop sounding, press BPFA. If ACP/leakage is not arrested buzzer will start again.
3. When ACP leakages are reset, all indications will disappear, but for BPFA indication press it once.

27. Multiple Unit Operation Pantograph

In multiple operation, both the most distant pantographs are raised if "pantograph selector switch" in both the locomotives are in position "AUTO". The train bus connections define the free end of each locomotive. The command from the master locomotive to raise/lower the pantographs also controls the pantographs on the slave locomotive.

Note:

If it is required to work with rear pantos of both the locos (as conventional locos), panto selector switch of the master loco to be changed as per cab leading.

Main circuit breaker

The command from the master locomotive to switch the main circuit breaker "ON/OFF" also control the main circuit breaker on the slave locomotive. The VCB on the slave locomotives is switched on after a delay of 0.5 seconds following the switch on of the VCB on the master locomotive. When switching off, there is no delay.

Note :

If the VCB on the slave locomotive cannot be closed due to a fault, an appropriate fault message appears on the master loco screen.

Constant Speed Control (CSC)

During multiple operation, 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. The master loco performs speed controlling function, demanding TE/BE on master and slave loco.

Compressor control

The compressors are able to operate in three different operating modes.

These modes can be selected with the spring-loaded switch "BLCP", (Panel A).

Emergency Brake:

An emergency brake on the slave locomotive can only be initiated in the following manner:

1. By actuating the brake handle of the automatic train brake to "Emergency" position.
2. By actuating the emergency brake Cock on the assistant Loco pilot's side. If the pressure switch 269.1 on the master or slave locomotive registers actuation of the emergency brake, the ensuing command for emergency braking applies to both locomotives.

3. The master for all other emergency braking commands is the master for all other emergency braking commands is the master locomotive in the double (multiple unit) Other Brake functions

Coupling

1. Both locomotive must be deactivated. The BL key switch must be in position “0”.
2. Couple both locomotives mechanically, pneumatically and connect the UIC cable.
3. Close the isolating Cock on the brake supply line of the slave locomotive.
4. Move the key switch on the slave locomotive into position “D” and, as soon as the light test starts, turn back to position “0”. The MCE on the slave locomotive is now in self-hold mode.
5. During the self-hold mode of the slave locomotive, move key switch into Pos. “D” on the master locomotive.

The control electronics starts to configure the train bus.

6. After the configuration procedure, screen on the display shows the serial numbers of the master and slave locomotives.

Example :

Train configuration Loco 31001

Loco 31002

Note :

1. If configuration proves impossible, (or if no locomotive is available) locomotive number 00000 appears.

Uncoupling

Starting position:

Master and slave locomotives are available and both are ready.

1. Shut down both locomotives in accordance with regulations (VCB switched off, pantograph lowered).
2. Remove the UIC cable and disconnect the locomotives pneumatically and mechanically.
3. Both the locomotives are now ready for setting up as a single locomotive.

Note:

If for any reason the train bus link is interrupted, or if both locomotives are set up or in motion, the system protection initiates a monitored shut down of the slave locomotive.

Reaction:

The pantograph of the slave locomotive is lowered and a corresponding fault message appears on the screen of the master locomotive.

Sanding:

Sanding on both locos can be initiated by the Loco pilot by pressing the sanding foot switch on the master loco.

Fire alarm:

A fire detection 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.

Trailing mode

Trailing mode means that on the master locomotive in a multiple unit no tractive effort is available, if both bogies are electrically isolated. The Loco pilot's cab of the master locomotive still controls the slave locomotive.

The status of the master locomotive is as follows :

1. VCB switched off.
2. Pantograph is lowered.
3. Train bus is working correctly.
4. Pneumatic brake system is working correctly.
5. Brakes are controlled from the master locomotive.
6. The TE/BE meters show the values for the slave locomotive.
7. Battery charger of master loco will not work.

Note: All equipment's on the master locomotive are supplied by the battery and are functional for a maximum of 5 hours, if battery is fully charged.

COC's Position in Pneumatic panel

COC	74	70	136	47
LIVE -SU	Open Horizontal	Open Horizontal	Open	Close Horizontal
DEAD (Towed)	Close Vertical	Close Vertical	Close	Open Vertical
As Banker	Open Horizontal	Close Vertical	Close	Close Horizontal
MU leading loco	Open Horizontal	Open Horizontal	Open	Close Horizontal
MU trailing loco	Open Horizontal	Open Horizontal	Close	Close Horizontal
MU trail dead	Close Horizontal	Close Horizontal	Close	Close Horizontal

28. Computerized control brake (CCB) system (Knorr make) in 3-phase locomotive

In some WAG 9 locos KNORR type brake system is provided which is different from conventional brake system of wag 9 locos. In conventional loco, loco get failed in case of brake electronics failure. But in this loco, block section can be cleared by 10 kmph in case of failure of brake electronics.

Changes in Auto brakes & Direct Brakes:

In case of conventional system, automatic train brake and direct brake handles has to be operated from left to right, but in this system handle has to be operated forward and backward like throttle. both valves are provided on left side of loco pilot on control stand.

A. Direct Brake:

It has two positions: Apply and Release. One spring loaded clip called "bail ring" is provided below the handle. If this ring is pressed and released, synchronized brakes get released very fast whereas brakes get released gradually if PVEF is pressed.

B. Auto brake:

Automatic train brake handle can be locked or unlocked in FS (full service) position by a key provided in each cab. Non driving cab auto train brake handle to be is kept on FS 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 locked condition. This handle has following 5 positions.

1. REL (Release):

In this position BP pressure is over charged to 5.5 kg/cm2 and drop down automatically after some time with restricted flow to 5.0 kg/cm2. This position is used for quick charging of BP.

2. RUN:

This is the normal position on which BP is charged to 5.0 kg/cm2. At the time of recharging, BP is overcharged by 0.2 kg/cm2 at this position for short time.

3. Minimum Reduction: BP pressure remains 4.5 kg/cm2.
4. FS (Full Service): BP pressure drops to 3.0 kg/cm2. The handle can be locked or unlocked in this position.
5. Emergency: BP drops to 0 kg/cm2 on this position.

C. Mode switch:

One rotating switch called mode switch is provided in each cab below direct brake valve. This spring loaded switch can be operated by pressing downward. This switch has following 4 positions.

1. HLPR(HELP): While using loco as banker, this switch should be kept at HLPR position on this mode in addition to ZBAN at ON.
2. TRL (TRAIL): In non working cab (SU / MU), this switch should be kept on TRL position.
3. LEAD: In working cab (SU / MU), this switch should be kept on LEAD position and then BP will be charged 5.0 kg/cm2.
4. TEST: In this position BP leakage test is done. When this switch is kept on TEST position, Loco brakes get applied. This switch should be kept on lead position immediately after testing.

D. PTDC (Pneumatic Time Dependent Control):

In this loco automatic train brake and direct brakes are governed by Brake Electronics. In case of failure of brake electronics train can be worked by maximum of 10 kmph by PTDC. This is provided in each cab near brake handles and has 2 positions: release and apply. PTDC is having one coc, which should be in open condition always.

CHANGES IN UNDER TRUCK:

BC 1 & BC 2 COCs are not provided in under truck. These COCs are black in color and provided at the bottom of brake manifold in machine room. Normally these COC should be vertical (open).

Changes in pneumatic panel:

Pneumatic panel is divided into two parts.

a. Air Brake Manifold.
b. Auxiliary manifold.

1. Parts in Air Brake Manifold:

a. PB-BUS (Parking Brake Back Up Switch): This is a black colored switch. Normally this switch should be in horizontal condition. But in case of PTDC mode or clearing loco as dead, this switch should be kept closed (Vertical) to release the parking brakes.

b. PER-COS (Pneumatic Equalizing Reservoir Cut Off Switch): This is a black colored switch. Normally this switch should be in horizontal condition. But in case of PTDC mode, this switch should be kept vertical.
c. PBR-COS (Parking Brake Reservoir Cut Off Switch): This is a black colored switch. Normally this switch should be in horizontal condition. Maintenance staff uses this switch.
d. PB-PDS (Parking Brake Pneumatic Disable switch): This is a black colored switch. Normally this switch should be in horizontal condition. In case of parking brakes malfunctioning maintenance staff uses this switch and to be kept vertical along with PBR-COS.
e. SIFA-74 (Vigilance exhaust COC): This is yellow colored COC. Normally this COC should be kept down ward but while clearing loco as dead this COC should be kept upward.
f. BC- & BC-2 COCs: These are bogie isolating COCs.
g. DV: Distributor valve

2. Auxiliary Manifold:

Following COCs are provided on this manifold.

a. WFL: Pressure switch for wheel flange lubrication.
b. TC1&TC2: Pressure switch for traction converter 1&2
c. KABA KEY: Loco grounding key.
d. FC: Harmonic filter contactor pressure switch.
e. PAN 1 & 2: Pressure switch for Panto 1 & Panto 2.
f. VCB: Pressure switch for VCB.
g. VESA 1 & 2: Pressure switches for sanders (Vertical).
h. 136: Pressure COC for Feed Pipe.
i. 47: Cock for dead loco (Normally closed- parallel to the pipe)
j. Panto selector switch: for selection of Panto

PROCEDURE OF CAB CHANGING:

1. Keep Automatic train brake handle in FS and lock it and remove the key out side,.
2. Keep the Direct brake handle in release.
3. Keep MODE switch in trail position.
4. Open the VCB, lower the panto and move BL key from ‘D’ to ‘OFF’. Remove the BL key and go in other cab.
5. In other cab, Unlock Automatic train brake handle and keep it on RUN position. Operate Mode switch from TRAIL to LEAD.
6. Energise the loco as per the procedure.
7. To charge BP, release parking brake and ensure charging of BP pressure.

ENERGIZING OF LOCO:

Loco should be energized as conventional 3 phase loco, but ensure following:

1. Automatic train brake handle of working cab should be at RUN and non-working cab should be at FS in locked condition.
2. Mode switch should be kept at LEAD in working cab and at TRAIL in non-working cab.
3. Energise the loco as per normal position.
4. For charging BP move Automatic train brake handle to FS for 10 seconds and then keep it to RUN position. BP will be charged by 3.0 kg/cm2.

5. Ensure that parking brakes are released.
6. Keep Automatic train brake handle from RUN to FS. Wait for 10 seconds, then again keep it to RUN and ensure that BP is charged to 5.0 kg/cm2 and BC is '0' kg/cm2.
7. Every time after recharging, BP will overcharge to 5.5 kg/cm2 at RUN position and then after some time become normal to 5.0 kg/cm2.
8. For overcharging BP to 5.4 kg/cm2, keep Automatic train brake handle to REL position, if necessary.
9. For releasing synchronised loco brakes use Ball Ring for quick release or use PVEF for normal release.

PARKING BRAKE:

Whenever parking brakes are applied by CE or manually, every time penalty auto brakes will be applied along with parking brakes in which BP will drop to 3 kg/cm2 and loco brakes up to 2.5 kg/cm2 with Priority -1 message on screen.

For recharging BP pressure, first release parking brakes and keep Automatic train brake handle to FS position for 10 seconds, again keep it in RUN position and ensure that BP is recharged to 5.0 kg/cm2. Acknowledge the fault and work further.

For applying parking brake manually, rotate switch PB-BUS from horizontal to vertical and for releasing vertical to horizontal.

VIGILANCE PENALTY BRAKES:

In this loco BP pressure is dropped by 3.0 kg/cm2 (in gauge 2.0 kg/cm2) on application of vigilance parking brakes. Do the following for resetting vigilance penalty brakes:

1. Keep throttle in '0'
2. Wait for at least 2-3 minutes.
3. Keep Automatic train brake handle to FS, press BPVR for acknowledging fault message.
4. Keep Automatic train brake handle at RUN and ensure that BP is charged to 5.0 kg/cm2 and loco brakes are released.
5. Acknowledge the fault by BPFA and proceed further after ensuring pressure.

EMERGENCY BRAKE – ACTIONS

Emergency penalty brakes applied when, emergency push button is pressed or due to over speeding or due to emergency application by / ALP Emergency valve, in which BP pressure drops to '0'. For releasing this penalty brake, keep Automatic train brake to Emergency (EMER) for 10 seconds and again keep to RUN position, BP will charge to 5.0 kg/cm2 then acknowledge the fault message and work further.

SERVICE PENALTY BRAKES:

Service penalty brakes apply automatically in following condition in which, BP is dropped to 3.0 kg/cm^2.

1. If BC 1 & BC 2 are isolated in locos 'LEAD' mode.
2. If any one COC of PB-PDS, PB-BUS, PB-R-COS is isolated and BPPB is pressed then also penalty brakes will apply.
3. To release service penalty brakes, normalize the above switches, keep Automatic train brake handle to FS for 10 seconds then again keep to RUN position and ensure BP to charge at 5.0 kg/cm2.

PROCEDURE OF CLEARING BLOCK SECTION BY USING PTDC:

1. Bring throttle to '0'
2. Open the DJ, Lower the panto and switch OFF CE.
3. Trip the MCB 127.7 (SB 2) and ensure that MCB 127.15 (SB 2) is in ON position.
4. On Pneumatic panel, Close PB-BUS COC & PER-COS from horizontal to vertical position.
5. Keep automatic train brake handle of working cab on RUN.
6. Switch ON CE, raise Panto and close VCB as per procedure
7. Acknowledge the fault by pressing BPFA
8. Keep PTDC on release position and ensure that BP is 5.0 kg/cm2 and BC is '0' kg/cm2.
9. If BC pressure does not come to '0' then release by distributor valve.
10. To apply / release auto brakes keep PTDC handle to apply or release as per requirement and clear the block section by 10 KMPH.

CLEARING LOCO AS DEAD

1. Keep the throttle at '0', Open VCB, lower the panto, and remove BL key by switching OFF of CE.
2. Keep the Automatic train brake handle of both cab in FS and remove the key after locking it.
3. Keep both Direct brake handle at release and keep MODE switch at TRAIL.
4. Open 47 COC (perpendicular to the pipe) and close 136 COC (FP) provided on auxiliary manifold.
5. Keep PAN 1 & 2 COCs (Auxiliary manifold) on vertical position.
6. Close 74 SIFA COC (Vigilance) provided on pneumatic manifold by keeping upward.
7. Switch OFF MCB 112.1 (in SB 2). Drain out MR & AR.
8. Couple the energised loco with dead loco and couple BP/FP pipes and open their angle Cocks.
9. BC pressure should be '0' and if not then release the distributor valve.
10. For application and releasing of parking brakes in dead locomotive rotate PB-BUS (air brake manifold) from horizontal to vertical. Ensure 5 kg/cm2 pressure in parking brake gauge.

Note:

No. 70 COC of BP and Solenoid valve No. 30 are not provided in this loco.

Before clearing loco as dead ensure that parking brakes are released fully and parking brake gauge is showing 5 kg/cm2. Also ensure the same on run.

KNORR'S CCB-2 BRAKE SYSTEM ON 3-PHASE LOCO

In 3-phase Locos, some of locos 31393 onwards provided with KNORR CCB-2 brake system, with minor modifications in equipment and working system with existing KNORR brake system.

1. Auto brake (A-9): Automatic train brake handle can be locked or unlocked in FS (full service) position by a locking spindle provided in both cabs and coupled with a chain. 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 following 5 positions.
2. REL (Release):In this position BP pressure is over charged to 5.5 kg/cm2 for pre-set time, for quick charging of BP.
3. 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 pre-set time.

4. Minimum Reduction: BP pressure drops to 4.5 kg/cm2.
5. FS (Full Service): BP pressure drops to 3.0 kg/cm2. The handle can be locked or unlocked in this position.
6. 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 ring" is provided below the handle for 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 pedal switch.

Mode switch: One rotating switch called Mode switch is provided in each cab below direct brake valve. This spring loaded switch can be operated by pressing downward. This switch has following 4 positions.

1. HLPR: While using loco as banker, this switch should be kept at Help position on this mode in addition to ZBAN at ON.
2. TRL (TRAIL): In non-working cab (SU/MU), this switch should be kept on TRL position.
3. LEAD: In working cab (SU / MU), this switch should be kept on LEAD position then only BP will charge.
4. 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.

LCD DISPLAY : It will show messages like

1. "Okay to Run" : Auto handle to RUN from FS position, BP will charge to 5 kg/cm2 and BC will reduce to zero.
2. "Safety Penalty – Keep Handle in FS" :To recover this penalty brake, move Auto/A9 handle to FS and then back to run.
3. "Train-line Emergency – Keep Handle in EMER" :To recover Emergency penalty, Auto/A9 handle should be moved to Emergency and then back to FS and then to RUN.

PTDC Switch :

It is having 3 positions (STABLED POSITIONS) Used when train clearing in PTDC mode, when brake electrons failed.

1. Apply
2. Neutral
3. Release

PARTS IN PNEMATIC PANEL:

1. Solenoid for parking brake: with application spindle (left side) and Release spindle (right side) in red colour for application & releasing of parking brakes.
2. COC NO 74: working position open (vertical) , while moving dead loco Close (horizontal).
3. C3W/DV handle: Normal position vertical, Isolation Position horizontal.
4. GOODS/PASSEGER MODE switch: As per the train working (goods/chg) in addition the passenger/ goods handle position.
5. Panto selector switch: with 3 positions AUTO, I, II positions. Auto : Rear panto will raise.

I position : Pant I will raise. II position : Panto II will raise.

6. COC-136 (Feed pipe cock): Normal position open (horizontal), while moving dead loco close (vertical).
7. COC- 47 : Normal position close, in dead loco open.
8. PER-COC: Normal position horizontal, while moving loco in PTDC mode vertical.
9. 20TP & 16 TP POINTS: If loco brakes not release, remove the safety caps, press and release test points.
10. SANDER 1&2 COCs: Normal position working (vertical), sanders to be isolated keep in horizontal position.
11. UNLOADER-COC: Normal position open (horizontal) , in case of air leaking from auto drain valve or un-loader valves, we can close this COC (to vertical).
12. VCB COC: Normal position open (horizontal) for closing of VCB , for VCB isolation close (vertical).
13. IG-38 key: Normal position open (vertical) for raising of pantos, for grounding keep it in horizontal.
14. PAN-1 COC: Normal position open (horizontal), in case of panto-1 isolation close this cock (vertical).
15. PAN-2 COC: Normal position open (horizontal), in case of panto-2 isolation close this cock (vertical).
16. SR-1, SR-2 COCs: Normal position open, for closing electro pneumatic contactor of SR-1 & SR-2 (in GTO locos). For IGBT locos close (for IGBT locos electromagnetic contactors are used for SR-1 & SR-2).
17. Harmonic filter contact cock: Normal position open, for closing electro pneumatic contactor of harmonic filter.

UTO/A9 Operation:

To charge the BP, energize the Loco as normal 3 phase loco, Keep Auto/A9 handle in FS, wait to see the massage on LCD display of Controller as “Okay to Run”. Move the Auto handle to RUN from FS position, BP will charge to 5 kg/cm2 and BC will reduce to zero.

To overcharge the BP to 5.50 Kg/cm2, 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 Kg/cm2.

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.

CAB CHANGING PROCEDURE :

In currently operating cab: Apply SA-9, Put A9 Handle in Full Service position & Lock it using Locking Pin (fixed), Change the position of Mode selection switch from LEAD to TRAIL & Switch the BL Key to Self-Hold Mode as usually done with E-70 Brake system , release SA-9 handle.

Go to another cab: Apply SA-9, Change the position of Mode selection switch from TRAIL to LEAD, Switch ON Loco Electronics &Un-lock the A9 Handle, Bring A9 Handle from FULL Service position to RUN position after LCD display OK- TO RUN, Résumé traction after conducting loco brake power test.

Recovery of penalty service brake:

Penalty service brake would result into dropping of BP to 3 Kg/cm2& 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/cm2.

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 massage 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 :

1. Parking brakes can apply in three ways by BPPB, solenoid valve left spindle (red colour) and by moving BL key D to OFF.
2. Parking brakes can release in three ways by BPPB, solenoid valve right spindle (red colour) and by manual releasing.

PTDC (Pneumatic Time Dependent Controller) set up &operation :

This feature has been provided in case of brake electrons failure (CCB System), by keeping brake system in this mode, locomotive / train can move at a restricted speed of Max. 10 Kmph to clear the block section.

Procedure of clearing block section by using PTDC:

1. Bring throttle to '0'
2. Open the VCB, Lower the panto and switch off CE.
3. Trip the MCB 127.7 (SB 2) and ensure that MCB 127.15 (SB 2) is in ON position.
4. On Pneumatic panel, keep PER-COS (Pneumatic Equalizing Reservoir Cut out Switch) in active position from horizontal to vertical position.
5. Keep automatic train brake handle of working cab on RUN, non-working cab FS and locked with pin.
6. Switch ON CE, raise Panto and close VCB as per procedure Acknowledge the fault by pressing BPFA (the message of "Brake electronics failed" will not come).
7. Keep PTDC on release position and ensure that BP is 5.0 kg/cm2 and BC is '0' kg/cm2.
8. If BC is not reducing to zero then give brief pulls to quick release lever provided at bottom of distributor valve. Ensure BC reduces to zero. (Note: If Loco Brake remains applied, press 20TP/16TP (Test Point nipple) of 20CP & 16CP on Pneumatic Panel to Release BC to Zero.
9. Release parking brake BPPB, take traction.
10. To apply / release auto brakes keep PTDC handle to apply or release as per requirement for sufficient time by observing the BP pressure gauge and clear the block section by 10 KMPH.

While working in PTDC mode ensure rear cab PTDC handle is in neutral position for proper BP charging.

Dead locomotive operation:

1. Keep the throttle at '0', Open VCB, lower the panto, and remove BL key by switching OFF of CE.
2. Keep the Automatic train brake handle of both cabs in FS, Insert Pin to lock the A-9 Handles.
3. Keep both Direct brakes handle at release and keep both cabs MODE switches in TRAIL.
4. Close 74(SIFA cock) on Auxiliary panel (keep in horizontal to close).
5. Keep 47 COC in Dead loco position by rotating in anti-clock wise and close 136 COC (FP) to vertical position.
6. Keep PAN 1 & 2 COCs on vertical position.
7. Switch OFF MCBs 112.1, 110 & 310.4 (in SB 2).
8. Couple the energised loco with dead loco and couple BP/FP pipes and open their angle Cocks, after charging of BP pressure to normal level, ensure Brakes are fully released and BC pressure is zero in the gauge. If BC is not reducing to zero then give brief pulls to quick release lever at bottom of distributor valve. Ensure BC reduces to zero. (Note: If loco Brake remains applied, press 20 TP (Test point) of 20 CP on Pneumatic Panel to Release BC to Zero.
9. Ensure parking brake released condition, (apply parking brake by application spindle, it will latch automatically and Release Parking Brake by Pulling Manual Release Pins of Parking Brake Cylinders).
10. After moving, stop the train at a distance of 500 mtrs, ensure no brake binding.
11. At stopping, ensure there is no brake binding.
12. At destination, before detaching dead loco, apply parking brakes and put wooden wedges.

Trouble shooting for BP not charging in loco:

1. Ensure MR pressure 8 to 10 kg/cm2.
2. Ensure both side angle COCs in closed position.
3. Ensure both side additional BP COCs open.
4. Ensure lead cab A-9 in run position, rear cab A-9 in FS and locked by pin.
5. Ensure both side RS COCs closed position.
6. Ensure MODE switch in leading cab LEAD position, in trailing cab in TRAIL position.
7. Ensure Z-BAN switches in off position in both cabs.
8. Ensure both side PTDC handles in neutral position.
9. Initially To charge the BP, energize the Loco as normal 3 phase loco, Keep Auto/A9 handle in FS, wait to see the massage on LCD display of Controller 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.
10. Ensure there is VCD action.
11. If message will appear as "Safety Penalty – Keep Handle in FS" and BP not charging more than 3 kg/cm2, To recover this penalty brake, move Auto/A9 handle to FS and then back to RUN (Follow massage on LCD of Brake Controller), BP would charge to 5.0 Kg/cm2.
12. If message will appear as "Train-line Emergency – Keep Handle in EMER. To recover Emergency penalty, Auto/A9 handle should be moved to EMER & then back to FS and then to RUN (Follow crew message on Display of Brake Controller). BP would charge to 5.0 Kg/cm2.
13. If still BP is not charging switch of CE and switch on CE and try.

14. Still BP is not changing contact TLC.

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 & then back to FS and then to RUN (Follow crew message on Display of Brake Controller). BP would charge to 5.0 Kg/cm2.

29. Trouble shooting of different make 2x500KVA, IGBT based Hotel Load Converter of WAP-7 locomotive- Ref: Technical Circular No. RDSO/2017/EL/TC/0141 (Rev'0') dt: 30.10.2017

30. DO's and DON'Ts for Loco Pilots in 3 phase locos DO's

1. Acknowledge VCD always within every 60 sec.
2. Do maximum use of regenerative braking, it not only control the train but participate in generating the power.
3. In case of any trouble, as a last step, switch OFF the CE and switch ON.
4. In case of heavy airflow, instead of attending the screen, do the protection of train and adjacent track.
5. In case of emergency use emergency stop push button.
6. While de-activating the CSC, check the position of throttle, it should not be opposite to the force.
7. Use throttle gradually.
8. Before regenerative braking, bunch the load.
9. While working dead loco, ensure conjunction working of brakes in dead loco.
10. While working dead loco ensure releasing of parking brakes and pneumatic brakes in dead loco. 11.First note down the fault message and then acknowledge the fault.
12. During failure mode operation, use throttle carefully. 13.Keep the SA-9 handle of rear cab at release. 14.Apply parking brakes when stationary.
15. Instead of continuous operation of sanders, use frequently.

DON'Ts

1. Don't operate BL when loco is in motion.
2. Don't believe on U-meter, ensure the panto physically.
3. Don't press PSA continuously.
4. Don't allow any unauthorized person in rear cab, as some functions are remains active in rear cab.
5. Don't declare the loco FAIL, without switching OFF and ON the control electronics.
6. Don't lower the panto for more than 10 minutes otherwise CE will switch off.
7. Don't forget to acknowledge the fault message.
8. Don't use CSC in undulating area.
9. Don't isolate VCD unnecessarily.
10. Don't switch off CE in running train.
11. Don't smoke in the loco.
12. Don't use quick release position of A-9 frequently and unnecessarily.
13. Don't operate MPJ, If MR pressure is less than 6.4 kg/cm2.
14. Don't open rear cab corridor door.

30606 Checks by Loco pilot/Assistant Loco pilot on Taking Over

For Checks by Loco pilot/Assistant Loco pilot on Taking Over guidelines apper in Para 30604/30605 to this chapter.

30607 Cleanliness of Loco

Responsibility for the cleanliness of the driving desk, cab, look-out glasses and glass windows during preparation before departure by the maintenance staff The maintenance staff who also carry out the scheduled inspections are responsible for the cleanliness of HT room, cubicles and corridors. The washing gang at the home shed is responsible for the cleanliness of the roof and body sides during every washing schedule. In particular care should be taken to keep the interior of the loco quite clean. Oil drippings should be cleaned out and leaky valves attended to at the earliest possible opportunity to eliminate fire hazards. Where no maintenance staff available Assistant Loco Pilot is responsible for the cleanliness of the driving desk, cab look-out glasses and glass windows during preparation before departure, changing of crew.

30608 Unauthorized Persons in the Loco

No person shall be permitted to enter any locomotive or to handle any apparatus contained therein unless he has been authorized to do so by the Sr. DEE/DEE/(OP).

Only Loco Pilorts certified for electric locos must be allowed to drive the locomotives. The Loco Pilot must not allow anyone to enter any of the driving compartments, other than those who are authorized to do so under the rules or hold a permit issued by Sr DEE/DEE/(OP).

Normally not more than three persons other than running staff will be permitted to travel in the cab.

A Loco Pilot / Asstt. Loco Pilot who is off duty is not permitted to enter or travel in any of the driving compartment unless authorized by TLC / LPC / Jr CC and that too for travel towards headquarters after being relieved en-route. This will be permitted only in the non driving cab/cabs.

30609 Interference with Equipment

Loco Pilots and Assistant Loco Pilots will not tamper with the measuring instruments, speed recorder and protective relays.

Relays or other sealed equipment should not be opened or wedged except as authorized in the trouble shooting manual. If a Loco Pilot opens a relay or breaks the seal of any equipment, full particulars should be noted in the loco log book. Particular care is also necessary while putting back metallic covers of relays to avoid inadvertent shorting of live terminals.

30610 Check on the Run by Loco pilot/Assistant Loco pilot

For Check on the Run by Loco pilot/Assistant Loco pilot guidelines apper in Para 30604/30605 to this chapter.

30611 Change of Locomotive Crew at Stations

Crew to check log book for any defects, interact with incoming crew, if train is waiting for line clear then the crew to check under frame, drain the main reservoir and feel by hand axle boxes and motor bearings to make sure they are not hot. The relieving crew shall note and initial the entries in the log book.

30612 Service Troubles on Line

Loco Pilot is expected to be fully trained on every locomotive to deal with troubles which may be experienced while a locomotive is on the run. Drivers should keep themselves fully conversant with fault finding procedures so that they are able to identify the fault, isolate it, give first aid attention to the equipment to keep the locomotive functioning, until it arrives at the next station. The Driver may refer the Operating Manual for the type of loco where necessary to refresh his memory.

Loco Pilot before locomotive to fail completely on being unable to start it on his own, should seek the help and guidance of the TLC/LPC by CUG phone or plugging the portable telephone set to the nearest emergency telephone socket within 20 minutes.

30613 Entering Equipment Compartment

If the Loco Pilot or Assistant Loco Pilot has to enter the equipment compartment of a loco, He/She should take care to see that the cab doors and drop windows on both sides are closed before opening the corridor door, to prevent dusty air being drawn into the equipment compartment.

30614 Loco Pilot's Duty when Stabling a Loco

Stabling of locomotive

1. Apply SA-9/Independent/direct brakes and ensure 3.5/5.0 kg/cm2 brake cylinder (BCP) pressure is built up in loco and physically confirm that loco brakes are applied.
2. Apply parking brakes, if available.
3. Apply hand brakes of loco and check the brake cylinder piston is in applied condition and also physically ensure that the tight contact of brake block with wheel tread.
4. Apply SA-9 to maximum in double headed trailing loco/banker loco also, if any.
5. Apply hand brakes of double headed trailing loco/banker loco also, if any.
6. Keep Iron skids/Wooden wedges at wheels of locomotive against falling gradient.
7. Entry should be made in loco log book about the placement of wedges and application o hand brake and also mention the same in the stabling register available with Dy.SS office as per G&SR 5.23.1.
8. Loco Pilot while on duty should not leave the loco unmanned. In case, he is required to leave the locomotive unmanned, he should do so only after receiving written authority from the Station Master/Yard Master and ensuring the above aspects.

30615 Knowledge of Road (Learning Road)

1. Every Loco Pilot (as well as Assistant Loco Pilot, and Loco Pilot Shunter) shall have a good knowledge of the section before he is allowed to work a train in the section. He shall be fully conversant with the maximum permissible speeds, gradients and land marks on the section, the block and non-block stations on the section, type and location of each individual signal and the line referred to by each signal, the speed restrictions to be observed and neutral sections. For learning road as mentioned above, he should be allowed a period of training at the end of which he shall be orally tested by the Chief Loco Inspector. He should also sign a declaration stating that he is fully conversant with the road. The declaration should be witnessed and countersigned by the Chief Loco Inspector and scrutinized by the officer concerned before issue of the Certificate of Competence.
2. When a Loco Pilot, Assistant Loco Pilot or Loco Pilot Shunter has been absent from duty for a continuous period of six months, he shall not be permitted to work a train until he has again learnt the road and his Certificate of Competency revalidated after oral examination by the Chief Loco Inspector and a fresh declaration. The period of six months prescribed above may be reduced,

if necessary, by local instructions issued by Sr DEE(OP) /DEE(OP). These instructions shall be equally valid if the driver did not have the opportunity to work on the section whatsoever be the reason. However, in extreme emergency such a Loco Pilo can be permitted to work the train with a Loco pilot who is conversant with the road.

3. Road Knowledge Registers shall be maintained for all sections on which running staff headquartered at a particular shed are required to work trains. Separate registers should be opened for each individual section and each category of staff. The register should be in the following proforma:

ROAD KNOWLEDGE REGISTER

(Section ... to)					
Sl. No.	Name of Driver/ Asstt. Driver (or Motorman)	Signature of token of possessing necessary road knowedge on section concerned	Date of signature	Signature of the Chief Loco Inspector	Signat
1	2	3	4	5	

Procedure to be followed while giving Learning Road (LR) to Crew

Crew:

a. LP/ALP taking LR should sign 'ON/OFF' in CMS only at originating/destination station.

b. LP/ALP should undertake two LR trips during day time & one trip during night time.

c. New Loco Pilots should undertake two trips during day time & two trips during night time.

d. LP/ALP should record the details of signals in the LR book properly i.e. signal name with station name, km no., location of signal etc.

e. LP/ALP shall make themselves conversant about signals at Right hand side, signals which may get confused with other signals, Calling out signals, Automatic/Semi automatic, Repeater signals, Trap indicators, Shunting signals, Gate signals, IB signals, Routing signals etc.

f. LP/ALP shall make themselves conversant with Catch sidings, Slip sidings, Gradients & curves, Station yard layouts, Loop lengths, Fouling marks, LC gates locations, Coasting and Warning boards, Engine stop boards etc.

g. LP/ALP at night time shall make themselves caution enough to locate correct signals in bright back ground of lightings of platform/ other lights, in back ground of coach indicators etc. He/She shall be in position to correctly identify the signals.

h. LP/ALP shall make themselves aware of signals of other Branch/Main lines/siding lines joining/ taking out the main lines, signals to go for Branch/Main line/Siding lines etc.

i. LP/ALP should go in all sidings and make themselves conversant about working in the section. The sidings also may be taken as part of main line.

j. Self declaration by LP/ALP should be given to CCC that he has taken requisite trips of LR and is conversant with the signals and topography of the section.

CCC/Lobby incharge:

a. Should specify LR should be taken by Freight or Coaching trains as per the category.

b. Should ensure that LP/ALP is signing 'ON/OFF' in CMS.

c. LP/ALP has under taken requisite number of trips.

d. Should ensure that while booking LP for first trip after LR, one LI is deputed to monitor him for one round trip.

Chief Loco Inspectors:

a. Whether LP/ALP has physically undertaken the journey.

b. Whether the LP/ALP has noted down the signal location properly i.e. signal name with station name, km no. etc.

c. Whether the LP/ALP has noted down the special character of signals like Gantry type, located on right side of the track, etc.

d. Knowledge of LP/ALP of the section to be tested by conducting viva-voce and same should be certified in LR form.

e. Should monitor his nominated LP for one round trip after completion of LR.

Power Officer:

a. Concerned Power Officer incharge of crew shall issue LR template in the sections. LP/ALP may be booked as per template such that, he/she covers requisite trips prescribed without missing any portion.

b. Concerned Power Officer incharge of crew shall interview LP/ALP about above aspects and if it is ascertained that LP/ALP has not learned LR properly then repeat LR may be ordered.

As per G&SR:

2.1. Every Loco Pilot should be given three trips including one night trip from 20.00 hours to 06.00 hours road learning for familiarizing himself with the section(s) on which he is rostered for duty.

2.2. If a Loco Pilot has not operated on a section for over 3 months, he should be given road learning trips as per the schedule given below.

Duration of absence	Number of trips
3 to 6 months	1
6 months to 2 years	2
Over 2 years	3 (as for new entrants)

Any additional trip/s considered necessary should be provided with the approval of the controlling branch officers of the Division.

2.3. The scale of trips provided at para 2.1 above would apply to all systems of working.

2.4. On Hill and Ghat sections, the Loco Pilot shall operate minimum of 6 (six) trips including two night trips from 20.00 hours to 06.00 hours for learning road purposes.

2.5. Additional trips for road learning may be prescribed for special conditions of working like Automatic block territory, important junctions/stations etc., by DRM if considered necessary.

30616 Speed Restrictions

1. Loco Pilo and Assistant Loco Pilo must be fully conversant with permanent as well as temporary speed restrictions. Permanent speed restrictions are indicated in the working time table.

2. Temporary speed restrictions will be made known to the running staff at their booking office as under:
   a. Every Loco Pilo should study "Temporary Speed Restrictions" bulletin issued by the Division and sign the prescribed register in acknowledgment of having read and understood the same.
   b. Temporary speed restrictions imposed by the Engineering, Signal and Electrical Departments are communicated to the running office through messages and are displayed' on the notice boards at the booking points.
   c. Caution orders as prescribed in the General and Subsidiary Rules will be issued for all temporary speed restrictions.

30617 Loco Pilot's Personal Equipment

While working a loco every Driver must have with him the following personal equipment -

1. Loco Pilot's personal log book.
2. Trouble Shooting Directory
3. General and Subsidiary Rules Book
4. Working Time Table.
5. Watch in good working order
6. Screw driver 150 mm one
7. Adjustable wrench 150 mm one
8. Torch with Red and Green slide or Torch with Red, Green & White color facility
9. Red and green flags*
10. Detonators* 12 Nos.
11. Washers - 5 Nos.
12. MU Washers - 2 Nos.
13. Teflon tape -2 m.
14. Any other items prescribed under local instructions.
15. Portable Emergency telephone
16. Chisel
17. Hammer

30618 Personal Equipments to be Carried by Assistant Loco Pilot

While working a loco, the Assistant Loco Pilo shall carry the following personal tools and equipment :-

1. Red and Green flag - one each
2. A rough journal book
3. A watch in good working order
4. Working Time Table
5. A duster -
6. A torch with Red and Green slide or Torch with Red, Green & White color facility
7. Asstt Loco Pilot's log book

30619 Tools and Equipment in Locos

1. Tools

Each electric loco when on line shall carry the following tools in a locked tool box or tool locker to be issued to the Driver -

i)	Wooden blocks	4
ii)	Air hose pipe	1
iii)	Screw Coupling	1
iv)	Spare fuses of different size	2 nos. of each size
v)	DCP fire extinguisher	2 of 4 kg each or 4 of 1.25 kg each.

2. Equipment

30620 Loco Log book

1. A separate log book is required to be maintained for each individual loco.
2. For each trip the Loco Pilot should enter the following particulars in the log book available in the loco cab-

i. Date
ii. Train Number
iii. From ... To...
iv. Load of train (in terms of vehicles)
v. Loco Pilot and Asstt. Loco Pilot 's name
vi. Brief description of unusual occurrence and failures, if any.
vii. Kilometre reading at the end of trip.
viii. Energy meter reading to be recorded if meters are provided. (Start journey & Comlete journey)
ix. Regeneration reading (Start journey & Comlete journey)

3. The details of repair carried out should be entered to by the PPIO of the shed before the loco leaves the shed.
4. Running and Shed supervisors will also enter in the log book particulars of any item to be specially watched by the Loco Pilot.
5. Every time a loco is taken for the scheduled inspection, the type of inspection and the date on which it is done should be entered in the log book by the PPO. PPO will similarly enter details of unscheduled withdrawals of the loco for repairs, as well as particulars of modifications carried out.
6. Completed loco log books should be serially numbered for each loco and preserved in the Planning and Progress Office for a period of one year.
7. Officers and supervisors of the Rolling Stock section, during their cab inspections, will also record their observations regarding performance of the loco in the log book.

30621 Loco Pilots competency and counseling book

Every Loco Pilot and Assistant Loco Pilot shall be provided with competency and counseling book to be carried by him while on duty to enable Inspectors and Officers to record their observations regarding his working as noticed by them during their cab inspections. This book should have machine numbered pages. All entries should be in ink. Erasers or alteration of the entries made or tearing off of pages will be viewed as serious misconduct by the crew.

30622 Detailed Preparation of Locomotives

For Detailed Preparation of Locomotives by Loco pilot/Assistant Loco pilot guidelines apper in Para 30604/30605 to this chapter.

30623 Check of Vacuum before starting (deleted)

30624 Minimum Brake Power

The running staff shall abide by all rules regarding the minimum brake power on the goods and passenger trains, issued by the Railways. For the purpose of working out the percentage of brake power, the "piped" vehicle should be deemed to have inoperative cylinder/cylinders. An operative cylinder is one in which the / destroyed by control from the engine and which moreover satisfy the stipulation that its piston should remain up for not less than 20 minutes after the / pressure is destroyed.

Procedure for Brake Feel Test & Brake Power Test by LPs

A. Brake Feel Test

1. To be done immediately after start at the station where the crew have taken over charge.
2. On attaining the speed of about 15 kmph, LP shall drop the BP pressure by 0.5kg/cm2 through A-9 and release.
3. LP should feel the application of brake & speed should drop to about 10 kmph.

B. Brake Power Test

1. To be done in the first Block section (or first opportunity)
2. Speed of the train should reach 60 to 70 kmph in case of coaching train & 40 to 50 kmph in case of Goods train.
3. LP shall drop BP pressure by 1kg/cm2 in Coaching train and loaded Goods train and 0.5kg/cm2 in case of Empty Goods train through A-9 and release after a small pause.
4. The speed of the train should drop 30 to 35 kmph in coaching train & 20 to 25 kmph in Goods train by the time BP pressure comes back to 5.0kg/cm2.
5. The LP shall observe the effectiveness of Brake & Brake power of the train.
6. As the AFI needle comes to '0' or previous reading, normal traction shall be resumed.

C. Duty of ALP during Brake feel & Brake power test:

1. ALP shall keep a watch & ensure that both the tests are done by LP and will remind him for the same, if required.
2. He will equally participate (carefully watch) in Brake Feel Test & Brake Power Test to assess the effectiveness of the braking system of the train, and confirm the same to LP.

Note:

1. Crew shall obey the signal aspects while performing the brake feel & Brake Power Tests.
2. In case of up gradient in the first block section, suitable guidelines will be issued by the division as per site condition to avoid stalling.

30625 Operation of Air Braked Stock

For operation of air braked stock guidelines apper in Annexure 6.01 to this chapter.

30626 Master Controller

1. The progression or regression from one traction notch to another (and similar progression or regression during braking In the case of locos with regenerative or rheostatic braking) is controlled by the Master Controller from each driving cab. The Master Controller has two 'stable' and two 'unstable' positions for traction notches as under:

O(zero) ..... Stable position -
-(minus) ..... Unstable position
N (neutral) ..... Stable position
+ (Plus) ..... Unstable position

First release the mechanical locking of the Master Controller by moving the Reverser Controller to Forward or Reverse position. Then move the Master Controller to Neutral position. By moving the controller momentarily to (+) and back to N, the tap changer would be notched by one step. Notch-by-notch progression is effected by repeating this operation. In a similar manner notch-by- notch regression is possible by moving the Master Controller to (-) and back to N.

2. A blue Indicating lamp or the corresponding LED glows in the driving cab when the tap changer is at "0". The position of the tap changer at any instant is indicated to the Driver by a Notch Indicator. It takes a few seconds (the exact time interval varying for different types of locos) for the tap changer to return from full 'on' to full 'off position when the Master Controller is switched off. The blue lamp re-lights when the tap changer has returned to '0'.

30627 Use of Pantographs

1. The rear pantograph of the loco (in the direction of motion) should normally be used by the Loco Pilot The leading pantograph may be used only if the rear pantograph is defective or damaged or specially instructed.
2. Loco should not be worked with both the pantographs raised.
3. For normal lowering of pantographs the Master Controller should be switched off and the circuit breaker tripped before the panto-selector is moved to position "0. In an emergency when the locomotive is in motion, the pantograph may be lowered by using the panto-selector switch, even without tripping the circuit breaker but after bringing Master controller to '0' position.

30628 Regenerative and Rheostat Braking

1. The regenerative / rheostat braking is also controlled by the Master Controller. For braking, the Master Controller Is moved in the opposite direction. The Master Controller positions corresponding to such dynamic braking are -

a. Stable positions

0 Common for traction and braking

P Preparation for braking.

N Neutral

b. Unstable positions

+ (Plus) Notch-by-notch progression during braking.

- (Minus) Notch-by-notch regression during braking.

Notch-by-notch or continuous progression and regression are effected during braking, in the same manner as during traction, but using the above mentioned positions of the Master Controller.

30629 Starting of Train

For Starting of Train guidelines apper in Para 30604/30605 to this chapter.

30630 Starting on an Up-gradient

For Starting on an Up-gradient guidelines apper in Para 30604/30605 to this chapter.

30631 Speed control by field weakening

After the maximum voltage has been reached, speed control can also be effected by using the field shunting controller.

Field Weakening Switch, after the maximum voltage for the motor has been attained, field weakening may be effected if it is necessary to raise the speed further. This is done by operating the 'Shunting Lever'. Care must be taken to see that sufficient time is allowed for train to accelerate before going to the next step. The current ratings prescribed for each type of loco should not be exceeded. Too fast a rate of field weakening could cause a flashover of traction motors and should not, therefore, be attempted. It should be avoided on steep up gradients.

30632 Operation of the Reverser for Braking

Operation of the reverser to stop a train when the loco is in motion is strictly forbidden

30633 Manual Control of the Tap Changer

1. Provision exists in all the locomotives for manual operation of the tap changer, in case of failure of operation by Master Controller. In some locomotives, manual control is possible from the driving cab itself. In some others manual operation has to be done by the Assistant Loco Pilot in the corridor in response to signals from the Loco Pilot. In some types of locos, in addition to manual control through the Master Controller, separate electrical push-button control is also provided.
2. The manual control located in the corridor should be used only to clear the block section and if directed by TLC/LPC, the driver can go to the nearest loco changing point. The loco should be withdrawn from service at the earliest opportunity.

In addition, as per TSD

1. Manual operation of GR should be done, when MP and EEC failed in both cabs.
1. Place MP on position N for closing of line contactors.
2. Turn ZSMGR handle anti-clockwise from 6O clock to 3O clock position and remove the handle.
3. Ensure SMGR drum is on '0', Ensure pacco switch in pressed condition.
4. Insert ZSMGR handle on GR shaft at 6O clock position, rotate ZSMGR handle in clock wise direction within 0.6 seconds from 6O clock to 6O clock position for one notch Progression.
5. Turn ZSMGR handle in anti-clockwise direction within 0.6 seconds from 6O clock to 6O' clock position for one notch regression.
6. Watch RGR for any overheating during progression and regression.
7. Progress and regress by exchanging signals (normally use corridor lights for indication) or any communication.
8. Speed of the train shall not exceed 30 kmph.
9. In case of emergency, Loco Pilot shall open DJ and apply brakes.
10. Whenever DJ is tripped GR should be brought to '0' manually and MP should be placed on '0' for closing DJ.
11. While regressing, ensure that GR is not over travelled beyond '0' by observing notch indicator

of SMGR drum and lamp LSGR.

12. Assistant Loco pilot is responsible for manual operation of GR. 13.After clearing the block section, contact TLC for advice.

Working the train by energising the loco from rear cab:

Follow the instructions given for the method of driving the loco from rear cab:

I. LP in leading cab, ALP in trailing cab:

A. In rear cab:

1. Place ZPT on position '2' and raise the panto.
2. Close DJ, switch on BLCP and BLVMT. Keep A9 in release position and do not change I/L and O/L COCs position.
3. SA9 supply and apply cut out cocks should be in closed position.

B. In leading cab:

1. Keep A9 handle in running position and do not change supply and apply cut out cocks (open position).
2. Do not change SA9 supply and apply cut out cocks to apply loco brakes when required (open position).
3. The loco shall be operated by the Assistant Loco Pilot from rear cab as per GR 21. The Loco Pilot will remain in leading cab control the train as and when required.
4. If necessary, the Loco Pilot can operate A9 to emergency position to regress GR to '0'.
5. The loco shall be operated by exchange of signals between the Loco Pilot and Assistant Loco Pilot.
6. At neutral section, the Assistant Loco Pilot shall open DJ and lower panto if necessary.
7. The speed of the train shall not exceed 40 kmph if the Loco Pilot is in leading cab.

II. LP in trailing cab, ALP in leading cab :

1. If the Loco Pilot is in trailing cab and Assistant Loco Pilot is in leading cab, the speed is restricted to 15 kmph.
2. LP will energise, drive and control the train from trailing cab.
3. ALP will exchange signals with LP, proper using of horns, in case of emergency operating of ALP emergency brake valve to stop the train.
4. Inform TLC/LPC, Enter in the loco logbook stating the place from where TLC has been informed.

30634 Slow down and Stopping

For Slow down and Stopping guidelines apper in Para 30604/30605 to this chapter.

306035 Locos in Multiple Operation

For Locos in Multiple Operation guidelines apper in Para 30604/30605 to this chapter.

30636 Double Heading Operation

1. Operation of a train with two locos in front, both coupled together and to the train, but operated independently by separate crew is known as double-heading. The two locos can be of different types.
2. Subject to compliance with all speed restrictions, the maximum speed of a double headed train shall not exceed the lower of the maximum speeds of the two locos individually.
3. Each loco must be manned by a Loco Pilot and Assistant Loco Pilot who are qualified to work the type of loco and have learned the road over which the train is working. The Loco Pilot of the

leading loco, known as the "Train Loco Pilot " must be qualified to work the class of train and will be responsible for working the train in accordance with rule

4. While starting, tractive efforts may be applied by both locos as per requirement. The leading Loco Pilot who is in charge of the train will notch up until the train moves. The rear Loco Pilot will assist as required.
5. While running, tractive effort may be applied as often as necessary but gradually by the rear Loco Pilot.
6. The rear Loco Pilot may switch off as per operational requirement. The rear Loco Pilot must frequently observe the application of train brake applied by leading Loco Pilot and be prepared to switch off power.
7. It is the duty of the train Loco Pilot to ascertain that the second Loco Pilot is acquainted with the contents of all caution orders and special instructions etc. which he may receive while working the train.
8. Instructions issued by local Railways regarding coordination amongst the two crews should be followed.
9. All rules in regard to switching off power at neutral section, lowering of pantograph in the event of emergency feeding etc. shall be observed. The Loco Pilot of the rear locomotive will be signalled by the Loco Pilot in the leading locomotive to carry out these operations, as required, by means of code whistles. The code to be used for such occasions shall be laid down under local instructions.

30637 Banking

1. On a gradient sections, sometimes banking locos are used in the rear of the train to assist the leading loco/ locos to negotiate the gradient. The banking locomotive, must be coupled to the train.

The air brake pipes of the banking loco should be coupled to the last vehicle, but on no account should the banking loco be charge BP of the train. In the event of banking air braked trains, MU28 valve of banking loco shall be kept in trail position. The Loco Pilot of the banking loco will keep a watch on the BP pressure gauge and take necessary action to assist the leading Loco Pilot when brakes are applied.

2. All rules in regard to switching off power at neutral section, lowering of pantograph in the event of emergency feeding etc. shall be observed. The Loco Pilot of the rear locomotive will be signalled by the Loco Pilot in the leading locomotive to carry out these operations, as required, by means of code whistles. The code to be used for such occasions shall be laid down under local instructions.
3. When working a train up a gradient with the assistance of an electric banking loco, the following procedure should be followed.
   a. When the signal is lowered the leading Loco Pilot will give the prescribed code whistle. The banking Loco Pilot will acknowledge the whistle and notch up quickly so as to obtain the maximum permissible starting current, simultaneously releasing the loco brakes. The sanders should be used to avoid wheel slipping.
   b. The leading Loco Pilot should take 2 to 3 notches, releasing the loco brakes simultaneously and using the sanders as required.
   c.) The leading and banking Loco Pilot should keep a watch on their respective ammeters and maintain the current at the continuous rating.
   d. If a "Stop" signal is encountered in the gradient section by the leading Loco Pilot, he should switch off the Master Controller and bring the train to a stop applying the brakes to the extent required. He will also use code whistle for the banking Loco Pilot. This will increase current in the banking loco. The banking Loco Pilot should regress the Master Controller so as to maintain

the current at the continuous rated value till the train stops. On stopping, both the leading and banking Loco Pilot should apply independent air brakes to avoid rolling down. Apart from this Ghat operating manual of the division if any to be followed

e. When re-starting after a stop signal, the same procedure as in (a), (b) and (c) should be followed.

f. At the point where the rising gradient ends, the Banking Loco Pilot should switch 'off the Master Controller and stop pushing. A board is provided to indicate this point.

30637A Distributed Power Wireless Control System (DPWCS):

Grouping Process

The Grouping screen is as shown below: In this screen, pilot has to press "Initiate Grouping", then the lead loco starts grouping sequence.

In this grouping sequence, the lead loco checks for BP continuity with remote loco. For this purpose the pilot has to do a small exercise.

When pilot presses the "Initiate Grouping" button the display shows as "Release Brake for BP Continuity Check" if the brake pipe pressure in lead and remote loco is less than 4.5 kg/cm2. Then pilot has to release the formation brake to build the BP level to 4.5 kg/cm2.

When the BP in Lead and remote loco is greater than 4.5kg/cm2 the system will display as "Apply Brake for Full Service for BP Continuity Check" message to the pilot to apply the formation brake to reduce the BP to less than 3.2 kg/cm2.

Now the pilot has to apply the formation brake to reduce the BP in lead and remote locos to less than 3.2 kg/cm2.When the BP pressure in the lead and remote loco is less than 3.2 kg/cm2, the system will show as "Release Brake for BP Continuity Check". Now the pilot has to release the formation brake to build the BP.to 4.5 kg/cm2. The following figure shows the Release Brake Screen.

When the BP in lead and remote locos are greater than 4.5 kg/cm2 then the system will display as "BP Continuity Ok and Grouping Successful" and the system will display the operational screen.

Operational Screen

In the Operational screen the pilot can see the parameters of both self and remote loco like BP, BC, MR, FP, Battery voltage, Loco number, Notch Position, DB position, Sanding and Lamp Signals etc..

Normally the lead and remote tabs are changing for every five seconds. If the pilot does not want this tab changing the pilot can press this "Auto off" button and stop this auto changing. He can press the Self tab to see the information of self loco and he can press the Locol tab to see the information of the remote loco.

Ungrouping Process

If Pilot wants to ungroup the locomotives, he has to open the Lead locomotive DJ, Drop the BLSN switch and then press the ungroup button in the Loco 1 tab on the Driver Interface Unit. When the Pilot presses this "Ungroup" button then it will ask for confirmation. The pilot has to press OK button fro Ungroup.

After giving the confirmation it will ask to enter the password. If pilot enters wrong password it will show the display as wrong password. Then pilot has to press "Cancel Entry" button and re-enter the correct password and press "OK". Then the display shows as "Ungrouping in Progress". Lead sends an ungrouping command to the remote loco to ungroup.

After ungrouping is completed the DIU displays the login screen in, both lead and remote locos. Now the pilot is allowed to do fresh configuration and grouping.

Diagnostic Screen

When the pilot presses the diagnostic button, the following screen will be displayed. Otherwise, in case any failure is found in self loco or in lead loco the system will give the . audio visual warning and the diagnostic screen will come up automatically and show the error in orange colour. The buzzer will switch when' the loco pilot press the acknowledgement button or after one minute

In this screen pilot is able to see the status of BCD coupler inputs and the status of the system hardware like CPU1, CPU2, Power supply-1, Power supply-2, Speedometer input, GPS receiver, Battery voltage and Radio modem of the self and remote loco. If any error occurs the color of the input will become orange color otherwise it will be in green color.

Configuration of Remote Loco

Login Process

The login process in remote loco is same as the process in lead Ioco.

Configuration Process

There are three steps to configure the remote loco. They are

1. Selecting Remote button
2. Selecting the operating Cab
3. Enter the Lead Loco Number

If the pilot enters any invalid data and presses confirm button, then a pop up window will come up and display as "Error in Data Entry".

After entering the entire parameters pilot has to press "Confirm" button. Then the configuration screen disappears and grouping screen will display

Grouping Process

After completing this configuration process the system will show the grouping screen. In this the pilot has to press "Initiate Grouping" button to start grouping.

After pressing Initiate grouping button the display shows Congregating formation and the system waits for the lead commands.

When the lead gives the registration successful command then the display shows Grouping Successful and the operational screen will appear.

Operational Screen

In the Operational screen the parameters like BP, BC, MR, FP, Battery voltage, Notch Position, DB position, Sanding and Lamp Signals etc. will be displayed.

Automatic Neutral Section Negotiation

The automatic neutral section negotiation is one of the excellent features of the Wireless MU coupler System. For this automatic neutral section negotiation the pilot has to press a push button switch when the lead locomotive approaches the 500 meter warning board. Apart from this pressing of switch the lead locomotive pilot has to do his normal neutral section exercise. In the remote locomotive, the

neutral section negotiation will be done by the system automatically.

In the Neutral sections the Looc pilot has to press the Neutral Section push button switch placed on the Driver Interface Unit, when lead loco approaches the 500 meter warning board. After pressing this push button switch the system will display as Neutral section Negotiation in Progress".

When the remote locos enters into Neutral section 500 meters warning zone the system will display the message in the DIU as "Crossed 500 mark".

The remote loco will automatically open his DJ whenever it approaches the DJ open board. The system will display the message in DIU as "DJ Opened".

The remote loco DJ will be closed when the locomotive crosses the DJ closed board. The system will display the message in DIU as "DJ Closed and Neutral Section Negotiation Successful".

After pressing the Neutral Section push button switch, If Pilot wants to cancel the automatic neutral section negotiation, Cancel button is provided on the Screen. By pressing this cancel button the Automatic neutral section negotiation which was initiated by the pilot will be cancelled.

If Both Speed inputs (GPS and Speedometer) fail in the remote locomotive, the automatic neutral section negotiation is not possible. The system will display the message in the DIU as "Speed inputs failed. Automate Neutral Section Negotiation Off". Then the pilot has to take care of Neutral section negotiation of remote locomotive.

Manual traction Control

Manual traction control is one of the finest features of the Wireless MU system. By using this manual traction control the lead loco pilot can control the remote locomotives individually. The manual traction button is available only in the remote loco tab in the operational screen.

In the manual traction control the following commands can be given to operate the remote loco from lead.

1. Notch Up/Down
2. Dynamic brake,Up/Down
3. DJ Open/Close
4. Pantograph Raise/lower
5. Energies the Locomotive
6. Shutdown the Locomotive
    a. Notch up/Down

Pilot can give the Notch up/down command by clicking on Traction up/down buttons displayed on the manual traction screen. Then the remote locomotive will execute the notch up/down command irrespective of the lead notch position. Once the loco pilot comes out of this manual traction the remote locomotive notch position will synchronize with the lead locomotive notch position automatically. The notch up and notch down button will be displayed only when the pantograph in raised and DJ is in closed condition.

    b. Dynamic Brake Up/Down

Pilot can give the Dynamic Brake up/down command by clicking on up/down buttons displayed on the manual traction screen. Then the remote loco will execute the Dynamic Brake up/down command irrespective of the lead Dynamic Brake position. Once the loco pilot comes out of this manual traction the remote locomotive Dynamic Brake position will synchronize with the lead locomotive Dynamic Brake position automatically.

c. DJ Open/Close

Pilot can give the command to open the BLDJ by clicking on the "Open BLDJ" button/ then in the remote locomotive execute the command and send the acknowledgement to the lead. If the command is, executed successfully then the display will show as the Open BLDJ Figure and the Button shows as "Close BLDJ".

Same way the closing of BLDJ will be executed.

d. Pantograph Raise/Lower

If the pilot gives the command to lower the pantograph by clicking on the "Lower Panto" button, remote locomotive will lower its pantograph and send the acknowledgement to the lead. If the command is executed successfully, then the display will show as the Open Panto Figure and the Button shows as "Raise Panto".

If the Pilot presses the Raise Panto button, one pop up window will come up and ask the pilot to select the Pantol or Panto2. According to the selection of pantograph the remote locomotive execute the command.

e. Shutdown Sequence

Pilot can shutdown the remote loco by giving the command through the Driver Interface Unit. When pilot presses the "Shutdown Sequence" button then a pop up window will come up and asks for confirmation. If the pilot clicks on "OK" button then, the lead locomotive transmits a command to the remote for initiating shutdown sequence.

In the shutdown sequence the remote locomotive brings down the notches to zero, open the DJ and lower its pantograph.

f. Energising Sequence

Pilot can energize the remote loco by giving the command through the Driver

Interface Unit. When pilot presses the "Energising Sequence" button then a pop up window will come up and asks for confirmation. If the pilot clicks on "OK" button then the lead transmits a command to the remote for initiating energising sequence

If pantograph of the remote loco is not raised or the BLDJ is not closed the system gives a warning to the loco pilot to raise the pantograph and close the BLDJ before initiating the Energising Sequence. In the display a pop up window will come up and display the warning as "Raise the Pantograph and close the DJ Before Energising".

g. Remote Loco Isolation

If Pilot founds that the system in the remote locomotive was malfunctioning or found any problem in the remote locomotive itself the pilot can isolate the system by switching on the Isolation switch placed on the Driver Interface Unit. When the pilot operates this switch, the remote locomotive DJ will be opened and pantograph will be lowered. The Emergency indication will be displayed in the Driver Interface Unit as "Emergency Activated".

Troubleshooting

If Loco Pilot finds any problem using, the WMUCS please follow these instructions to rectify the same.

1. RF Failure

If Pilot finds there is no communication from the Lead to remote please follow the instructions given below to diagnose the problem.

1. Check the RSSI value available on the Right most corner on the Driver Interface Unit. It should be less than -115dbm.
2. Check the RF cable connections to the RF connectors on the side panel of the CCU.
3. Check the RF cable connection to the Antenna.

After following the above steps, if the problem persists please contact support.

GPS Failure

If Loco Pilot observes the GPS failure in the diagnostic screen of the Driver Interface unit, please follow the instructions to diagnose the problem.

4. Check the cable connection at GPS connector on the side panel of the Control and Communication Unit.
5. Check the cable connection to the Antenna.

After following the above steps, if the problem persists please contact support.

Speedometer Failure

If Pilot observes the speedometer failure in the diagnostic screen of Driver Interface unit, follow the steps to diagnose the problem.

6. Check if locomotive Speedometer is in operation or not.
7. Check the cable connections at junction box of Speedometer.
8. Check the cable connections at allied connector on the Side panel of the Control and Communication unit.

   System may show speedometer failure if notches are more than 2 and Train/Loco is not in Movement due to any reason After following the above steps, if the problem persists please contact support.

9. DIU Offline or Unable to Login

If Pilot found that the loco parameters like BP, BC, MR, FP, Notch Position etc, are not updating in the Driver Interface Unit and Displaying DIU Offline or unable to login, then follow the instructions to diagnose the problem.

   a. Check the Ethernet Cable connection on the side panel of the Driver Interface Unit.
   b. Check the Ethernet Cable connection on the side panel of the Control and Communication Unit.

After following the above steps, if the problem persists please contact support.

10. I/O Failure

If Pilot observed that I/O status is not updating in the diagnostic screen, please follow the steps to diagnose the problem.

1. Check the cable between the BD board and the corresponding connector on CCU.
2. Remove the corresponding connector and check the voltage at particular pin with respect to ground.

After following the above steps, if the problem persists please contact support.

11. Power Failure

If Pilot observed that system is not switching ON, please follow the instructions to diagnose the problem.

1. Check the Power led on the side panel of the CCU is on or not.
2. Switch off the MCB and check the voltage at the input of the MCB is greater than 75 or not.

After following the above steps, if the problem persists, don't switch on the MCB further and please contact support.

30638 Inability to Haul Goods Trains - Stalling

The most common causes for inability of electric locos to haul goods trains are as under :-

1. Inclement weather can result in poor adhesion. Some sections on Indian Railways during autumn season In forest areas are subject to track being covered by semi-dry leaves which turn into a wet paste by movement of wheels and is a serious cause for failure of adhesion.
2. Passage of salt laden trains with leaking wagons can also affect the adhesion.
3. The total trailing load exceeds the permissible load for the type of loco, either due to increased number of wagons or due to the cumulative effect of excess loading of a number of individual wagons.
4. The drag caused by brake-binding on rakes equipped with vacuum brakes

30639 Heavy Haul Trains

Such are the trains which cannot be accommodated in the existing loops of the section. Railways operating such trains will issue special Instructions and the driving crews should be made familiar with various problems anticipated to be countered with such operation. Some of these trains may have locomotive/locomotives sandwiched in between. Their operation too will call for special set of instructions.

30640 Neutarl Section

For Neutral Section guidelines apper in Para 30604/30605 to this chapter.

30641 Lowering Pantographs Under Emergency Feed

When power supply from one substation is interrupted and feed is extended from the adjacent substations, it will be necessary for the Loco Pilot to lower the pantograph at least 2 or 3 spans before arriving at the overlap span opposite the substation which is out of operation. Such an eventuality may also arise when some portion of OHE is defective. When any of such contingencies arise the Loco Pilot are advised by a "Caution Order" either at the starting point or through Station Masters enroute. Where this restriction is to be observed emergency "lower pantograph" and "raise pantograph" boards may be provided (Chapter II - Vol. I).

30642 Unwired Tracks

1. In station and goods yards only certain tracks are equipped with OHE. Special sign-boards are exhibited at points where unwired tracks take off from wired tracks. Loco Pilot /Motormen should keep a careful lookout for unwired tracks when entering or running through stations and goods yards.- Should per chance an electric train be signaled erroneously to enter an unwired track, the Loco Pilot should stop short of the turn-out and draw the attention of the cabin. Loco Pilot should also report such cases with details to the TLC /LPC immediately.
2. If in case a Loco Pilot notices that he is going on an unwired track and cannot stop, he should lower the pantographs immediately. This will minimize damage to the pantographs.

30643 Coasting Down-gradients

1. Loco Pilot are expected to be well conversant with the road and to make the best use of down-gradients to effect maximum possible saving in energy consumption.

2. In level sections and particularly in suburban sections, coasting should be resorted to as much as possible and brakes applied only when essential to control the speed or to stop the train. To help Loco Pilot "coasting boards" are fixed in some sections.
3. In undulating country, speed may be allowed to drop down when going up a short up- gradient. After passing over the crest, the train will automatically pick up speed with power off on the other side when going down-hill, so that it attains maximum permissible speed, on the section when it arrives at the foot of the next-up-gradient. This feature should receive special emphasis during learning the road period.
4. When going down a long, steep gradient, brake shoes are liable to get very hot and in these circumstances, brake power will be reduced. With the reduction of brake power, speed may rise to dangerous levels. To prevent this possibility, Loco Pilot are required to maintain the speed within the limits prescribed and sometimes even to halt a train at certain points to prevent the possibility of a run away speed and consequent serious accidents. Loco Pilot are required to adhere strictly to standing instructions issued by local authorities in this regard.

30644 Loco Running Light (Light Engine movement)

Before starting a light loco .the Loco Pilot should personally verify that the loco brake isolating valves are closed in rear and open in the driving cab. When a loco is run light; the free ends of the hose pipe shall be secured firmly to the dummy.. The Loco Pilot should, however, satisfy himself that the airbrakes on the loco are effective. He should normally stop the loco during light run by independent air-brake valve, but the Assistant Loco Pilot may apply the brakes by operating emergency brake valve, if the situation warrants.

30645 Wheel Skidding

Wheel skidding in locomotive takes place whenever braking force exceeds the limit of adhesion. The braking force could be higher due to incorrect setting of automatic brake valve, independent brake valve and pressure limiting valve or due to malfunctioning of proportionate valve, distributor valve and C2 relay valve. This can also however happen if the pressure gauges are not calibrated properly.

Wheel skidding is also noticed under adverse adhesion conditions caused by oil and grease on rail table, wet rails and falling of tree leaves and salt on the tracks. Poor brake power of the train can also result in wheel skidding of the locomotive, in certain condition.

To avoid wheel skidding, it is necessary to maintain the brake equipment in perfect working order and ensure setting of equipment's at designed value. Locomotive brake should be applied judiciously. In case the poor broke power of the train is observed, the loco pilot should advise control for joint checking and corrective action as laid down in Operating Manual and ensure pressing of PVEF switch while applying train brakes

General Guidelines ON " FLAT TYRE

There have been several instances where Flat-tyre has caused extensive damage to track by causing rail fractures and weld failures resulting into serious accidents. In order to prevent recurring of such incidences, following guidelines are to be followed:

A. PREVENTIVE MEASURES:

1. The TXR staff in Depots / Sicklines must check the flatness of wheel tread with the help of tyre-defect gauge during examination when the train is stationary. The permissible flat on wheel tread is limited to 60mm for Goods Stock and 50mm for Coaching Stock / Locomotive. All train

examination staff shall adhere to the provisions of Rule 2.8.4, 3.2.2 and 'S' 4.21.1 "Tyre Defects" of Part IV IRCA Conference Rules for Coaching Stock and Para 4.18.1 of Part 111 of IRC A Conference Rules for Freight Stock.

2. The train crew and Shunting staff should release brakes whenever DV Isolating Cock is operated by them.
3. The empty / load device should be kept in the relevant position to avoid skidding of wheels, resulting into flatness of tyre during run by the GLP at the time of clearing empties from the Sidings.

B. DETECTION OF FLAT TYRE:

1. The Loco-Pilot and Guard should be vigilant in detection of unusual / hammering sound in the formation.
3. TXR staff during 'rolling-in' examination at all major train examination points to detect flat face on wheel tyre in train while in motion. Such a wagon in a motion train can be located by them as per procedure given below;
4. Station Operating Staff while exchanging 'all-right' signals shall be vigilant and attentive to hear any unusual / hammering sound in the running train and make efforts to stop and examine the train. If they hear such sound, they should start counting the location of such a wagon (counting it as one) till the BV. It will demarcate location of such a wagon in moving train and communicate it to control and next station.
5. Traffic & Engineering Gatemen shall also be vigilant in detecting any unusual / hammering sound on a running train and they should be in readiness to exhibit STOP hand signal and stop the train; or intimate the SM if they failed to stop train. Such a wagon in moving train can be located by them as per procedure given above;
6. Engineering Staff and Supervisors while at worksites or while doing trolley inspection or footplate inspection should also be advised to be vigilant towards detection of flat- tyre on the passing train/s and take suitable action for stopping the train or informing the train Crew / SM by the quickest means of communication available. Such a wagon in moving train can be located by them as per procedure given above;
7. On-board staff like TTEs, Coach Attendants, AC Mechanics and other Supervisor / Officers travelling by the train can also detect any unusual/hammering sound in the coach/train.

C. ROLE OF STAFF AFTER DETECTION OF A 'FLAT TYRE

1.0 Loco Pilot & Guard of the train:

i. On detecting / getting information about the hammering sound on the formation in the block section, the train crew shall observe a speed restriction of 30 KMPH for clearing the section up to next station. After clearing the block section, the LP and Guard of the train shall ask for the TXR staff for examining the concerned coach / wagon.

ii. If no TXR staff is posted to work at that station, and it is likely to take more time for TXR staff to come, the LP, Guard and ASM shall decide in consultation with the SCOR to detach the coach / wagon at the same station. If the coach / wagon are detached at that station, the detached coach / wagon shall be moved by another train / loco as planned by the SCOR up to the next TXR examination point with a restricted speed of 30 KMPH.

iii. If TXR staff is available at that station or they can come quickly from other station, the flat tyre shall be examined by them and they will certify whether the flatness is within the permissible limits or beyond. If the flatness is within the permissible limit, they can certify for running the train further at normal speed and if flatness is beyond the permissible limit, the wagon has to be detached at the same station.

2.0 Mechanical (C&W) Staff:

Mechanical staff /TXR staff working at the station shall inspect the wagon / coach which were reported with flat tyre and take action as per the above mentioned guidelines in Para 1.0 above.

3.0 Operating Staff:

Once report about hammering sound is reported in the train from the SM in rear or by any Gateman from the rear block section, the SM shall definitely stop the train.

Arrange to issue a memo to the TXR staff if available; to measure the length of flatness and allow the train further only if the measured flat is within the permissible limits. If no TXR staff is posted to work at that station, the SM shall take action to detach the coach/wagon in consultation with Control and allow the remaining train to proceed with normal speed. Under no circumstances, ASM shall allow the train to run with a suspected flat tyre, once the information is received.

4.0 Functions of Control Office:

The SCOR after getting information from the SM, shall top the train at the next immediate station duly taking the advice seriously as reported by stations and advice Deputy Controller and Chief Controller. He shall take action as stated in Para 1.0 & Para 3.0 in consultations with LP, Guard & ASM. Deputy Controller shall co-ordinate with Engineering Control and depute the SSE (P. Way) / JE/P. Way / P. Way Supervisor of Engineering Department to inspect the rear block section either by travelling in a light engine / Tower Car with a restricted speed of 30 KMPH or by proceeding on a motor / push trolley if Loco/Tower car is not readily available or arranging the same is likely to take more time.

5.0 Engineering Staff:

On getting the advice from the Control (Engineering or Traffic) they shall be in readiness to proceed for inspection and certification of track in the rear affected block section duly taking protective action for any failure noticed during such inspection.

6.0 Engineering Control:

Engineering control shall co-ordinate with Traffic Control in alerting SSE/JE/P.Way Supervisor of Engineering department and getting the section inspected by Engineering official as laid down in Para 4.0 and 5.0 above. Thereafter, Engineering control in consultation with SSE/JE-P.Way Supervisor who has inspected the section shall impose SR of 50 KMPH for Passenger trains as well as for empty Goods trains in the affected section till USFD in the affected section (point of detection of unusual sound to next station) is completed and protective action thereafter is taken. No loaded goods train shall be allowed to run unless USFD testing is completed. Adequate number of Ultrasonic teams for checking the affected section shall be arranged, if required by pooling them from other Divisions so as to complete testing within the earliest possible time. On completion of USFD testing, speed of passenger trains and that of empty goods trains shall be raised to 75 KMPH and after observing for 24 hours, normal sectional speed shall be restored for these trains. Loaded goods shall be permitted at 50 KMPH on completion of USFD and after observing for 24 hours, normal speed shall be restored for such trains.

Annexure 6.01

OPERATION OF AIR BRAKED STOCK

Air- Brake Trouble shooting

I. BP pressure is not building up on air brake train:

1. Close the BP angle cock of the loco between the loco and first vehicle of the train. Ensure BP pressure is 5.0 kg/cm2 in case if the BP pressure is less in the loco. If BP is not charged, attend as per instructions given in 6.3.
2. If the loco is in good condition, check the train for any leakage of the pipe lines and at the angle cocks and arrest the same if necessary.
3. Check for any BP air hose washers are missing. If missing, replace the same.
4. Ensure in front of the loco BP angle cock is closed and there is no air leakage. Similarly ensure BP angle cock in rear of the brake van/SLR is closed and there is no air leakage.
5. In case of air leakage is noticed on any distributor valve try to arrest the leakage. If not possible to arrest the leakage, isolate that particular distributor valve and release the brakes of that vehicle.
6. Ensure all auxiliary reservoirs drain cocks are closed.
7. Check for any leakages in BP iron pipe, attend if any, if not possible detach the defective wagon.
8. Ensure emergency valve in BV/SLR in closed position.
9. If loco air flow indicator pointer is shooting up above the previous level maintained, arrest the leakage till it drops to the previous level.

II. Brake pipe pressure dropping on run:

1. Ensure A9 and RS are in proper position in both cabs.
2. Check and ensure that all the angle cocks of the train are opened fully and there is no leakage at the angle cocks and palm ends (missing rubber washers).
3. Ensure BP angle cock in front of the loco and rear of the brake van or last vehicle is closed properly.
4. Check and rectify the leakage of BP pipes if any.
5. In case of coaching train, check for any Alarm chain pull is operated. If so, reset the same.
6. Ensure that there is no leakage at Guard's brake valve.
7. In case of any leakage noticed at the distributor valve and if it could not be arrested, close the isolation cock of the distributor valve and release the brakes of that vehicle

III. FP pressure dropping on run:

1. Ensure that the FP feed valve COC is opened fully on the loco.
2. Ensure that FP angle cock in front of the loco and in the rear of the brake van or last vehicle of the train is closed.
3. Check and ensure all the FP angle cocks on the train are opened fully
4. Check and rectify the leakage on the FP pipe line if any.
5. If the leakage on FP pipe line could not be arrested or could not be traced or any FP hose is damaged, work onwards with single pipe system duly closing FP angle cocks of the loco and first vehicle of the formation.

Note:

1. In case of DURANTO rake, if FP isolated, Maximum speed of the train is restricted to 60kmph.
2. If loco with C2N type valve feed valve is moved as dead , concern inlet and out let cocs to be closed for C2N.

IV. Brakes binding:

For goods trains with conventional bogie:

Ensure BP pressure 5 kg/cm^2, ensure no leakage in pipelines, DV, palm ends and ensure load /empty handle in proper position.

A. Piston showing outside:

1. Ensure Hand brake is released.
2. Operate QRV of DV, if not successful
3. Isolate DV and operate QRV.
4. If still not release slacken the vent plug of brake cylinder carefully.

B. Piston showing inside:

1. Slacken the SAB and try.
2. Disconnect the brake pull rod pin of brake rigging.
3. Ensure no part is hanging. If required secure the hanging part with rope/wire.

1. For goods train with BMBC (Basic Mounted Brake Cylinder) bogies:

1. Identify the wagon on which brake binding occurred.
2. Release QRV by pulling if not successful.
3. Isolate the DV by lifting the DV handle to horizontal Position, Pull the manual release valve of DV.
4. Ensure that piston stroke indicator has fully gone in side of cylinder and brake blocks are loose.
5. If still not success, Isolate the isolating cocks provided between APM and both the brake cylinders and work the train.

Note:

If mechanically brakes not releasing (piston stroke indicator inside) shake the brake rigging assembly slightly to get release of mechanical

2. FOR COACHING TRAINS WITH BMBC BOGIE:

Ensure BP pressure 5 kg/cm^2, ensure no leakage at Pipelines, DV, palm ends etc.

1. Release QRV by pulling, if not success.
2. Isolate FP, BP branch pipe lines and drain out AR isolate DV handle, again pull QRV.
3. In case of crimped flexible pipe, straighten the flexible pipe to allow brake cylinder pressure to exhaust. If still not success,
4. Close the bogie isolation cocks and work further.
5. If still not success (Mechanical brake binding), pull the latch of BC of effected wheel and rotate resetting plate in clockwise direction to release brakes. Ensure brakes are released by shaking brake block.
6. If still not successful, remove the truss bar pin, secure truss bar and work further.

3. FOR LHB COACHES /DOUBLE DECKER:

In case of brake binding/brake applied condition the brake indicator of each bogie brake cylinders will show red colour.

1. Pull quick release handle of distributor valve. If not released…
2. Turn isolation cock/cocks of effected in anti clock Wise direction from horizontal position to vertical position (900), which is provided on brake panel. But in KNORR panel normal position of cocks are vertical). If released, red indicators of each Bogie brake cylinder will change from red colour to green. Ensure brake release by shaking brake caliper.
3. If not released, open flexible pipe of effected trolley having brake binding and ensure brakes are released.
4. If not released, loosen the hexagonal nut brake calliper with suitable spanner 27x30. Check brake release by Shaking brake caliper.

V. Isolation of LHB bogie: (In case DV is defective or malfunctioning, both bogie COCs closed)

1. Isolate distributor valve by lifting handle up wards.
2. Isolate FP connection to AR, by isolating cock fitted on brake module panel by rotating 900 in anti clockwise direction.
3. Drain out AR fully.
4. Pull QRV of DV.
5. Physically ensure the release of brake pads of all wheels by shaking and brake indicator on green position.

VI. BP iron pipe is broken of a vehicle (in goods train):

1. Since MR pressure gets discharged through BP pipe line, Keep A9 handle in 'emergency position'
2. Check the train and close the rear BP angle cock of the Vehicle before the defective vehicle.
3. Release the brakes of the remaining vehicle up to the brake van or last vehicle including the defective vehicle.
4. Inform the Guard and exchange signals with the Guard frequently and clear the section with necessary precautions, if the section is favorable.
5. After clearing the section inform CHC/CTLC and detach the defective vehicle.
6. If the section is not favorable to work with partial brake system clear the block section in two portions duly taking the precautions.

In Coaching Train:

1. Collect BP-FP BYPASS Coupling kept in Pantry Car/AC II tier/SLR.
2. Close the FP-BP cut off angle cock of adjacent to affected coach at locomotive end.
3. Wait till both air hose pressure releases from rear-end.
4. Uncouple BP-FP air hoses.
5. Couple BP-FP BYPASS coupling as shown.
6. Similarly uncouple BP-FP air hoses of rear end Of affected coach and couple FP-BP BY PASS coupling.
7. Close FP angle cock of adjacent to affected coach at rear end.
8. Put spare hanging air hoses on hooks.
9. Open BP angle cock of adjacent to affected Coach at locomotive end
10. Manually release and Isolate the affected coach.
11. Close rear FP angle cock of locomotive to work the train with single pipe.
12. Conduct air pressure Continuity test and work further.

Breakage of main pipe line of BP in Duronto rakes:

1. Bring the flexible coupling pipe of coach length, kept in guard compartment.
2. Lay across the flexible coupling pipe from one end to other end through vestibule of the affected coach.
3. Couple palm ends of flexible pipe to the BP air hose of adjacent to affected coach.
4. Manually release and isolate the affected coach.
5. Conduct air pressure continuity test and work the train with prescribed speed.

VII. BP air hose is damaged:

1. Keep A9 in 'emergency' position.
2. Close the BP angle cock before the air hose damaged.
3. Renew the air hose, if spare hose is available or with the hose in the rear of the last vehicle or with the Hose in front of the loco and resume traction duly Opening the closed angle cock.
4. If no spare hose is available or could not be replaced, Close the BP angle cock of the vehicle before defective air hose and act as per the procedure.

LHB coach BP or F P pipe / angle cock failure:

1. Angle cocks of one BP/FP air hose are kept in working Position and spare BP/FP hoses are in closed position.
2. In case of BP or FP air hose failure, close the angle cockof affected air hose and also close the angle cock opposite to the affected hose coupled to it.
3. Open the angle cocks of spare air hose.
4. Conduct air pressure continuity test, work the train.

VIII. BP angle cock towards loco end in between the vehicles is closed by unknown person when train is stopped due to any reason:

The BP pressure of the loco will not drop and air flow indicator white needle will go below red needle.

1. When a Loco Pilot tries to start a train he will experience hard pulling due to train brakes being applied in rear of the vehicle where the angle cock is closed.
2. Check the train and open the angle cock, which is closed and ensure continuity of BP pressure and last vehicle before starting the train.
3. Attend brake binding if any.

IX. ACP pulled on the air brake train:

(Air flow indicator shoots up suddenly. If ACP/AFL circuit is available and is in service, buzzer sounds with LSPAR/LSAF lamp glowing in the cab)

Whenever ACP is pulled, the train brakes also get applied. Isolate the Buzzer & FL by pressing BIS /SW switch on the loco. Stop the train, Apply SA9 and depute the Assistant Loco Pilot to check the train.

Simultaneously Guard of the train also should come from the SLR. If phone facility is available on the train, Loco Pilot should inform the Guard and the train Superintendent to check the ACP along with the C & W staff if available on the train for this purpose. After identifying the ACP pulled bogie, reason to be ascertained by the Guard or train Superintendent for pulling of ACP. Later ACP clappet valve to be reset with the help of pulling ACP resetting rope/ ACP resetting key which is available with C & W staff or Guard of the train.

Once ACP is reset, the air flow indicator while needle drops back to the red needle level and lamp LSPAR gets extinguished. The train should be restarted as per the rules.

Note:

Whenever Clappet valve could not be reset or clappet valve leaking or any leakage on ACP pipe line, close the ACP COC duly informing the Guard. Message should be given to arrange C & W staff to attend at the next TXR point.

PASSENGER EMERGENCY ALARM SIGNAL

DEVICE (PEASD): (in LHB coaches /Double Decker)

1. There is no mechanical linkage like chain.
2. To stop the train, the PEASD handle is pulled and this directly operates the PEASD.
3. Valve for venting the brake pipe pressure through 19mm choke.
4. During ACP, the red light provided outside at the end of the coach and a red light provided near PEASD inside the cabin will glow.
5. For re-setting the PEASD, the resetting key is to be inserted on the projection available near the PEASD and the key is to be rotated in the clock wise direction.
6. If the air leakage does not stop, then isolate the PEASD isolation cock provided under the coach

X. Air spring failure in hybrid coaches

1. In case of punctured / defect, air bellows levelling valve lever will be in inclined position.
2. Close isolation cock of air supply pipe of air spring provided for each bogie air spring.
3. In case of air pipe on main reservoir broken/air leaking, close main isolation cock provided for it.
4. Work the train with restricted speed of 60 kmph up to destination/attention.

Note: In case of DOUBLE DECKEER rakes air bellows puncture will be indicated through FIBA system, close concern COC for air suspension, FIBA BP COC, reset FIBA indicator, build up pressure work with 60kmph.

30646 Push Pull Train Operation

Railway Board vide letter No. 2007/Elect (TRS)/440/15 Pt dt 11/11/2019, 9/5/2019, 19/02/2019 and Pull Push train operation scheme given in RDSO Generic Pull-Push Speed certificate MC/LHB/Coach/ Pull-Push-Gen dt 12/07/2019 provides for Pull Push train operation.



Pull Push train operation in widely prevalent globally in prestigious trains such as TGV (France), Talgo (Spain), ICE1 (Germany), Eurostar, Diesel Push Pull (in Sri Lanka), China, etc.



Key advantages of Pull Push Train

A. Improved safety

1. Safer mode of operation vis-à-vis hazardous NON-SYCHRONISED banking operation in Ghat section, all over Indian Railways.
2. Pull-Push mode offers same safety level as Train-Set.

B. Most economic option for higher speed train operation

1. Existing rolling stock & locomotives can be used.
2. Cost of modification of coaches/locomotive is negligible:
   Cost of modification is much less compared to train-set.

C. Operational advantages

1. Faster operation of dense traffic at longer distance
2. No need of engine reversal where train direction reverses such as in NGP, DD, etc
3. Hub & spoke train operation – Slip coaches can be moved promptly with rear loco. (Eg Chalisgaon -Dhule coaches of train 11057)
4. Stoppage time can be significantly reduced
5. Suitable for platform return trains-quicker return (especially in dead end terminu station)
6. Higher acceleration & faster braking leads to increased sectional capacity.
7. Higher and flexible transport capability to cater for the higher traffic volume
8. Flexibility to vary train-length due to seasonal variations in traffic volume.
9. No chance of section blocking
10. Higher reliability due to the use of proven and mature technologies

The ‘push & pull’ technique involves placing of two locomotives, one in front of the train and one at the back, essentially providing more stability to the train.

Generally, there are two power cars in a train set, which take care of the hotel load requirement. The two locomotives attached to a train will take care of the hotel load requirement, doing away with the need of power cars. We will replace the power cars with coaches increasing capacity and revenue

For enhancing the average speed of coaching trains, The first Pull-Push passenger train over Indian Railway i.e CSMT-NZM Rajdhani express run successfully on 13.2.2019 between CSMT and NZM.

With this Push Pull arrangement operation, need for attaching /detaching of banker locomotive on Ghat section has been eliminated. With Push Pull operation, journey time has been reduced by 95 minutes between CSMT-NZM.

Operation of WAP-7 locomotive in Push Pull mode.

Vide letter no. EL/3.1.35/4 dated 11.12.2018, RDSO has issued scheme for modification to be carried out in WAP-7 locos for operation in Push Pull mode. The scheme is implemented in 5 WAP-7 loco pairs of ELS/Ajni. Locomotive details are as below.

1. 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 'D' panel in each cab of both master and slave loco.

'D' Panel



2. ZTEL switch provided on 'A' panel is renamed as ZNN switch and is used for negotiating of neutral section.

'A' Panel



3. The WAP-7 locos are provided with four couplers on each cab side.

a. IVC coupler- 2 Nos. for power connection of Hotel load. ON command pins of hotel load converter are provided in IVC coupler only.

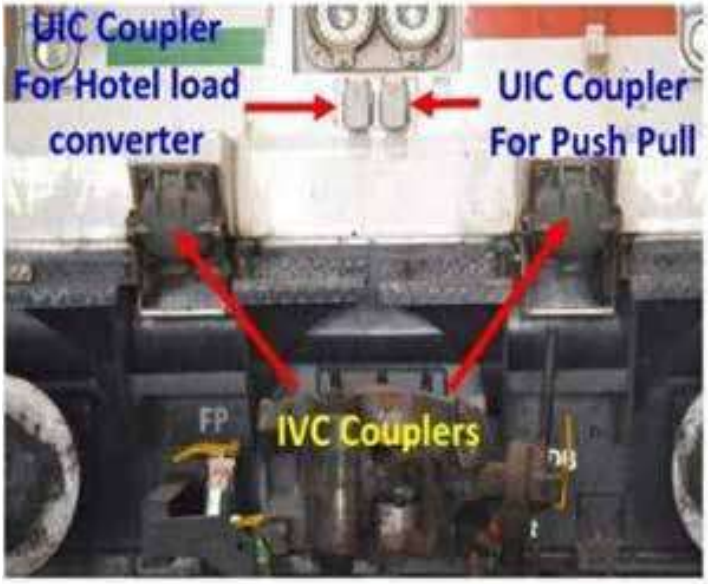
   i. LP side for Hotel load converter-2.

   ii. ALP side for Hotel load converter-1.

b. **UIC couplers** – 2 Nos.

   i. LP side for Push Pull operation & (additional coupler on ALP side for MU provided in 30579 & 30580)

   ii. ALP side for Hotel load converter





4. UIC couplers, provided on locomotive cab for hotel load converter and Push Pull operation, are female sockets and IVC couplers, provided on locomotive cab for hotel load converter power connections, are male coupler.

5. 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.

Dedicated IEC 61375 Compliant Communication Train Line using Modular Connectors for Pull-Push Mode Train Operation








6. 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 crossed 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.
7. (One additional straight and one cross coupler is required for 30579 & 30580. Further this modification will be extended in all locos)

   Once master and slave locos are attached with the rake and flexible jumpers for push pull operation are connected then procedure for energisation of loco is as below.

1. Cock and switch position of master and slave loco is as below.

S.N.	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

* In Master loco panto selector switch 85 to be manually selected so that rear panto is raised.

2. Connect BP and FP pipe of both locos with BP & FP pipe with train rake and open angle cocks.

3. In slave loco ensure:

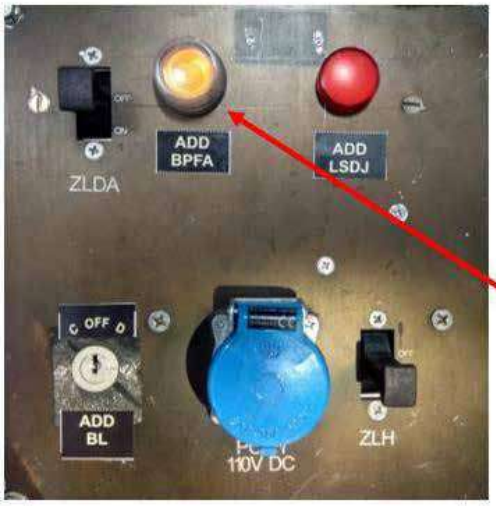
a. Keep SA-9 in released position in both cabs and observe '0' pressure in BC gauge.
b. Move A-9 /DBC to emergency position and brakes will be applied in loco and rake.
c. Move A-9 / DBC to neutral position and take out the handle.

4. In master loco:

a. Insert BL key in additional BL switch provided on 'D' panel and move it from OFF to D mode. This will result in glowing of additional LSDJ. (This amounts to activating slave loco)



b. After around 35-40 seconds slave loco will be on 504 node and additional BPFA provided on D panel in master loco will glow. (This amounts to VCU boot up in slave loco)



Glowing of Additional BPFA in master loco

c. Move additional BL key from D to OFF and take it out. This will display 612 node for slave loco in DDU of slave loco. (This amounts to slave loco in "self hold mode active".

d. 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.

e. Now energise the 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.





f. If ZNN switch is on OFF position, then VCBs of both master and slave loco will open or close simultaneously by BLDJ switch.

g. Node information displayed on DDU of master loco is for both Master and Slave loco. The status of slave loco is known from the node information displayed on DDU of master loco in column of slave loco.



5. Instructions for neutral section:

a. At 500 m board by following signal aspects and section speed restrictions, attain maximum speed.

b. At 250 m board bring throttle to Zero and switch ON ZNN.

c. At DJ open board, switch OFF BLDJ and ensure LSDJ is glowing.

d. At DJ close board, switch on BLDJ and ensure extinguishing of LSDJ.

e. Additional BLDJ provided on 'D' panel of master loco will remain in extinguished condition continuously.

f. The logic used for negotiating of neutral section in push pull operation is as

i. After DJ OFF of master loco, DJ of slave loco opens after 330 meters. (Considering minimum rake length)

ii. After DJ ON of master loco DJ of slave loco closes after 750 meters. (Considering maximum rake length)

- Opening and closing of VCB in slave loco can be checked from Node information screen in Master loco.
- In Push Pull operation no fault messages will be pop up on DDU of slave loco. However, fault messages will be recorded in slave loco and can be seen in DDS. (Diagnostic Data Set)
- In Push Pull operation fault messages will be pop up on DDU of master loco with LSFI glowing but along with loco No. From loco no. LP 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 take place automatically.

iii. VCB tripping in master loco

iv. VCB tripping and lowering of Panto in slave loco.



Fault message of "Communication Disturbance" is displayed in DDU of Master Loco

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30700 Duties of Motorman

1. Rules 30604, 30606, 30608 to 30616 and 30620 for Drivers in connection with operation of locos will be equally applicable to Motormen. (Revised rule no. 30605,30606,30607,30609,30610,30612.30613,30617)
2. Motorman will also be responsible for cleanliness of the EMU cabs.

30701 Motorman's Personal Equipment

Motormen of suburban trains should carry the following equipment while working trains:

1. Special keys for operation switch etc. — 1 set of the Master Controller, reverser, control
2. LED based flashing tri-colour hand signal — 1
3. 2 red and 1 green flags mounted on sticks — 1 set
4. Working Time Table (WTT), Detail book & Drivers memo Book — 1 Set
5. A watch in good working order — 1
6. Detonators (10 in a box) — 10
7. General and Subsidiary Rules (Updated) — 1 copy each each, AC Traction Manual and Operating (Updated)

   Manual for the type of EMU, and Pocket trouble shooting book for EMU rakes
8. A pair of spectacles (if prescribed by Doctor)
9. Motorman Competency certificate & Health card.
10. Any other items in accordance with local instructions.

30702 Checks to be done by Motorman.

1. While taking the charge –off a EMV train (as per (a)&b below)shall carry out check as detailed in para 30703 and 30704 in addition to the checks as detailed by concerned Zonal Railways -
   a. a train is taken over from an EMU shed or stabling line after maintenance or inspection;
   b. a train is taken over for its first trip of the day or after stabling at a station siding for more than one hour
2. The duties prescribed in the paras 30703 and 30704 above for the Motorman will devolve on the Shunters or Engine Turners when the train is worked by a Shunter or Engine Turner from the shed or stabling line to the station platform and the Motorman takes over the train on the platform. The Brake continuity test (BCT) prescribed in para 30708 shall, however, be carried out only by the Motorman who works the first trip.
3. Instructions given in this section are of a general nature applicable to all types of EMUs and should be treated as complementary / supplementary to detailed instructions issued by respective Railways for each class of EMUs.

30703 Preliminary Checks

The Motorman shall - .

a. Check that the entire train is on a wired track so that by inadvertent raising of the pantograph on an unwired track, is eliminated.

b. Ensure possession possession of the correct set of keys for operation of the reverser, control switch, pantograph selector switch and doors and

c. Go through the defects register to acquaint himself with the defects noted earlier and the action taken by the maintenance staff to set right such defects.

30704 Checks Before Starting Trains

1. In the entire train the Motorman shall check the following:-
   a. Correct position of the pneumatic pipes and electrical couplers in the dummy sockets and dummy hooks respectively;
   b. Working of the headlights, auxiliary headlight, flasher light, blinker light, tail lights, head-codes and tail boards.
   c. Hand-brakes/parking brakes are released;
   d. Availability of fire extinguishers and alarm resetting rods.
2. In the leading driving cab i.e. the driving cab to be used for the first
   a. all fuses are in position and fuse free breakers are “ON”;
   b. the dead man’s device is functioning normally;
   c. wiper, hooter, headlight (including emergency headlight), head code light and taillight (including emergency tail light) are functioning correctly;
   d. the main reservoir and brake pipe pressures are normal;
   e. AWS must be in working condition & all indicating instruments are normal.
3. In addition, motorman will conduct checks for each type of EMU as required in the respective Operating Manuals.

30705 Familiarity with automatic brake application

In EMUs provided with electro-pneumatic and automatic brakes, normally the braking system made use of by the Motorman for service stops is the electro-pneumatic system. Though primarily meant for use in emergency and for automatic application in the event of train parting, the automatic air brakes are capable of graduated application for service stopping of EMU trains. This graduated application of automatic brakes, however, requires some practice on the part of motormen. Once during every trip they should, therefore, control the Train and bring it to a stop making use of the automatic brakes. In the event of failures of electro-pneumatic brakes it will be quite safe to keep the units in service using the automatic brake system till the train can be conveniently withdrawn from service.(Stopping with auto brake is allowed in AC Retro unit, in Siemens & Bombardier rake auto brake application is only for testing.

30706 Dead Man’s Handle

1. Since an Electrical Multiple Unit train is operated by a motorman alone, it is necessary to provide means of applying the brakes and bringing the train to a stop in the event of the motorman setting incapacitated in any manner. This is arranged by means of a dead man’s device associated with the master controller. With the reversing key in the ‘forward’ or ‘reverse’ position, the handle of the master controller has to be kept continuously depressed by the motorman. If the pressure on

the handle is released on account of the motorman fainting or getting incapacitated in any manner, power for the traction motors is cut off and the brakes are automatically applied.

2. Dead man's device should be tested before commencement of every trip. An EMU- train should not be considered fit for service if the dead man's device in any of the end driving cabs of a train formation is inoperative. In the event of the dead man's device becoming defective when a rake is in service, it should be either promptly withdrawn from service or a Guard, Train Examiner or some other person conversant with the operation of the brakes in an emergency should travel with the motorman.
3. The dead man's device will be operative when the train is in motion only if the reversing key is in 'forward' or 'reverse' position. If the reversing key is returned to the off position when the train is in motion, the dead man's device is rendered inoperative with consequent serious danger of accident in the event of the Driver fainting or getting incapacitated in any other manner Motormen are, therefore, forbidden from moving the reversing key to the off position when the train is in motion.
4. It is essential to impress upon Motormen (during their initial training and whenever they attend refresher course), the importance of this rule. Frequent checks are also essential to ensure that the rule is being strictly observed by motormen during their working. This is one of the primary responsibilities of the Chief Loco Inspectors. Officers and other senior supervisory staff should also, during their cab, inspections, specially check on the Motormen's observance of the rule. Any disregard of the rule should be dealt with severely and promptly.

30707 Auxiliary Warning System (AWS)

This system ensures extra vigilance on part of the motorman and in case of motorman becomes momentarily Inattentive it gives a warning bell and then applies the emergency brakes automatically. Power is cut out and brake operation also take place, in case motorman crosses a stop signal at danger. The driving crew operating with the system should be made fully conversant with the same before being put on loco /EMU, while working trains operating on sections fitted with such system.

30708 Joint Testing of Brakes Continuity by Guard and Motorman

1. Before an EMU train is brought on to a running line after inspection or maintenance in an EMU shed or stabling line, the brakes of the train shall be jointly tested by the Motorman and the Guard to ensure that the electro-pneumatic, automatic brakes are functioning normally and the brake pipe is continuous throughout the train.
2. This joint brake continuity test shall be conducted in accordance with detailed local instructions laid down for the purpose in the Operating Manual for the particular type of EMU.
3. As far as possible this joint test should be carried out before the EMU train leaves the shed or stabling line. However, if specially authorized jointly by CEE and COM, the brake test may be taken on the platform before commencement of the first trip from stabling sidings, platform stabling & carsheds.

30709 Duties of Guards of EMU Trains

In addition to the normal duties prescribed for them in General and Subsidiary Rules and other instructions, Guards of EMU trains shall be responsible for the following :

1. Joint brake continuity test with the Motorman as detailed in Para 30708.
2. Switching on the lights, fans & ventilation in train for passengers when required and making a general check at the commencement of the trip that lights and fans are in good working order in the train.

3. Conveying information to the TLC, maintenance staff regarding failures and defects of lights and fans in the compartments.

30710 Defects in EMU Trains

1. Motormen are expected to be fully trained to rectify minor defects and in the method of isolation of faulty equipment. Detailed instructions on the method of trouble-shooting and rectification of minor defects are contained in the Operating Manual of the respective type of EMU. Motormen are expected to keep themselves fully acquainted with details of these instructions and to rectify such defects themselves.
2. Defects such as failure of fans or lights, leakages in air pipes etc. will be attended to on arrival of the units in the Car shed or Stabling Depots.

30711 Defects Noticed During Run with Special Reference to EMUs

1. In the event of defects which affect the punctual and safe running of trains and require early attention by the maintenance staff, the Motorman will convey a message indicating the exact nature of defect to the Traction Loco Controller through the Station Master of the nearest station and will abide by the instructions given by the TLC. Depending upon the nature of defects, the TLC will decide whether the units are fit to be retained on line or should be withdrawn from service.
2. In the event of isolation of faulty traction motors, failure of auxiliaries etc., the maximum speed and other restrictions subject to which the train may be worked are detailed in the Operating Manual for each type of EMU.
3. Brake power percentage of EMU rake ex carshed should be 100%, Ex Sidings brake power percentage not allowed less than 90%, If brake power is less than 90% due to isolation speed restriction is 75 kmph .

The Motorman should abide by these instructions strictly.

30712 Turn-round Time at Terminal Stations

At terminal stations a minimum turn-round time of 9 minutes for 12 car rake & 15 minutes 15 car rake should normally be allowed. This is necessary since normally the brake pipe pressure should be reduced to zero at the end of the trip and normal pressure built up again when the train starts in the opposite direction. In exceptional circumstances, justified by local requirements, the PCEE and PCOM jointly may permit a shorter turn-round time in which case it will only be possible for a partial reduction in brake pipe pressure to be effected at the end of the trip.

30713 Stabling of EMU Trains

1. When stabling an EMU train in the Car Shed or on a stabling line, the Motorman or Engine Turner who has taken over the rake will carry out the following essential operations:
   a. ensure fouling mark is clear in rear or both side the line on which rake is planned for stabling.
   b. Switch off the lights and fans of his driving cab,
   c. Destroy the brake pipe pressure to zero isolate the brake controller and return brake controller to the “release” position. Check BP gauge is showing zero pressure & brake cylinder gauge is showing 1.2 kg/cm2.
   d. apply the hand brakes/parking brakes fully in the driving cabs at both the ends.
   e. if any defects noticed it should be noted in defect log book with out fail.
   f. apply wooden wedges on wheels against falling gradients.
   g. shutter of driving cab should be close .
   h. Lock the equipment compartments and driving cabs.-

i. Any other operations prescribed under local instructions.

2. When a rake is to be stabled, the Motorman should invariably be at the leading driving cab. Backing an EMU rake to a siding with the motorman at the rear cab is strictly forbidden,
3. After stabling an EMU train or handing over to the Engine Turner, the Motorman before going off duty should convey to the supervisor-in-charge of the Car Shed or stabling line (or to the TLQ any defects or abnormalities noticed during the previous trips inquiring immediate attention. -

30714 Coasting with Special Reference to EMU Operation

In order to keep down the energy consumption for operation of EMU trains, it is necessary to resort to coasting to the maximum extent feasible. The running time between stations given in the Time Table is after allowing for sufficient coasting. For guidance of Motorman, Coasting Board indicating the point at which power may be cut off normally are fixed on the OHE masts facing the direction of the train movement. When the distance between a pair of stations is long, sometimes power may have to be applied in two spells. In such cases additional boards indicating at what point power has to be switched on a second time and the point at which power may be switched off again are also provided.

It is an important duty of a Motorman to observe the Coasting Boards to the maximum extent feasible when the train is running on time. To make up time when a train is running late, the Coasting Board may be disregarded and power kept on for a longer time, taking care not to exceed the permissible speed of the section.

It must be remembered that if the "switch-off" Coasting Board is not observed when the train is running to schedule, apart from waste of electrical energy, there will be greater wear and tear of brake block. The location of the Coasting Board on each line should be decided by Sr. DEE / DEE (RS) after taking actual trials. A register should be maintained in the Office of Sr. DEE / DEE (RS) as well as TFR showing the locations of the Coasting Boards provided. These locations should also be advised to the ATFO (OHE) of the section who should ensure that the Coasting Boards are not shifted for any reason by OHE staff. A periodic check that the boards are located correctly in accordance with the register should also be carried out by the Driving Inspectors.

30715 Operation with Traction Motor(s) Cut Out /Isolation

1. Normally an EMU should be operated with all the traction motors in position.
2. In case it is important to operate an EMU with motor(s) cutout/Isolation as a long term measure, the EMU should be operated at a restricted speed and coasting restricted and a revised time table should be issued, if necessary.
3. For temporary cut out/Isolation operation, motorman should inform the TLC and operate the train as directed i.e. to clear the section or to haul to destination or to complete the link till the EMU touches the maintenance shed. No EMU should normally leave the shed with any motor cut out/ Isolation.

30716 Working of Trains when Tracks are Flooded

1. The speed at which an EMU train may be worked with various heights of water from rail level shall be laid down for each type of EMUs under local instructions and incorporated in the respective Operating Manual.
2. It must also be ensured that in areas liable to flooding, special gauges (as laid down in Para 716 of Indian Railways Permanent Way Manual) are provided to indicate when different types of EMU stock and electric locos have to be stopped.

30717 Push pull Operation

Some of the suburban trains are equipped with a locomotive in the centre not at each end. The operation of such train is similar to EMU operation and the maintenance of the locomotive should be carried out in a loco shed and the various schedules as laid down should be followed.

30718 Long EMUs

1. At times it may be necessary to haul long EMU train say two or more of 9 coach or 12/15 coach trains as one unit. In such an event Railways will Issue local instructions in the matter.
2. It will be necessary to ensure that controls on each 12/15 coach trains are fed from the battery of the leading motor coach of the same train.
3. CRS sanction may be required for such an operation.

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CHAPTER-8
COMMISSIONING OF NEW ELECTRIC LOCOMOTIVES AND EMUs

30800 Sanction of CRS

Sanction is required from the CRS in respect of -

1. Introduction of electric traction on any Railway or section of a Railway(as per policy circular no.6 issued by Rly Board vide letter no. 2018/CEDO/SR/PC-6/0 dated, 31/10/2018.).
2. Bringing into use any new type of electric locomotive or EMU or to operate any in service at speeds higher than those already sanctioned. The term "New Type" include **(Ref.: 6-Rs 945(E) issued by Railway Board on 1/102018. Gazette of India Part II, Section 3, Sub Station (i):**
   a. Any alteration made in the existing rolling stock which will have an effect on the riding characteristics of the rolling stock, generally, the points to be considered are Speed control method, axle load, unsprung mass, primary and secondary suspension systems and load transfer arrangements between body and bogies and bogies and wheel sets.
   b. Any alteration in the traction electrical system, which is likely to interfere with signalling system.

30801 Commissioning of New type of Rolling Stock

When any new prototype Locomotive/EMU are received for the first time from a manufacturer, the following are required to be ensured for inducting the rolling stock into services safely: -

First Stage: One time movement of the Rolling Stock

The new prototype needs to be certified fit for movement, based on an application made to the PCOM of the Railway over which the loco is to be moved. The application is supported by -

1. Certificate from RDSO regarding its overall dimensions, axle loads, curve radius etc. for fitness to move on IR tracks.
2. Certificate from manufacturer of the locomotive from site of unloading/ interface with the zonal Railway that the vehicle is fit to be moved.
3. A note on origin, destination, route and special conditions of speed, escort, etc under which the loco is to be moved.

The COM of the zonal Railway issues a movement order authorizing the movement of the locomotive, based on the application, and any other conditions which he may find essential to stipulate.

Second Stage: Provisional running

1. RDSO at the first instance shall furnish Provisional Speed Certificate for the particular type of loco. In this certificate RDSO will indicate the maximum provisional speed of the rolling stock permitted to run on a particular type of track, nature of curvature, type of bridges, axle load, length of the rolling stock, ODC dimensions if any and type of traction installations. RDSO will also furnish the infringements for which the loco is over dimensional and Board's condonation for the same is required to be obtained.

2. On receipt of the Provisional Speed Certificate, an application is made by the Chief Engineer of the concerned Railway to the concerned CRS for obtaining sanction. This is accompanied by Safety Certificate by PCEE, PCE, PCSTE,PCME and PCOM. This certificate will contain detailed restriction imposed and precautions to be observed for the movement of the locomotive. CRS, in turn will then forward the same to the Secretary (Works), Railway Board along with his recommendations. Engineering Directorate at the Railway Board will finally communicate the sanction based on the safety certificate issued by PCEE, PCE, PCSTE, PCME and PCOM and comments of the concerned CRS for the provisional running of the rolling stock.

Third Stage: Instrumented trials

RDSO will furnish the details of test and trials to be carried out on the rolling stock, generally, consisting of the following:

1. Oscillation trials: The trials are carried out for assessing the speed potential, the riding quality and stability at different speeds on straight and curved tracks of concerned sections. The parameters which are generally measured on the oscillograph car are lateral forces, lateral and vertical accelerations, dynamic augment, bogie rotation and other parameters are derived. These trials are repeated for leading and trailing bogies with new and worn out wheel diameters.
2. Braking Distance Trials: RDSO will conduct the braking distance trials with the locomotive hauling prescribed loads at different speeds.
3. Tests regarding Interference with Signalling Circuits: The tests also will include measurements to determine the interference to signal and telecommunication circuits.
4. Performance trials: RDSO will conduct the trials to assess the performance ratings of the locomotives as per the extant instructions laid down.
5. Bridge fitness with Axle load.

Fourth Stage

Based upon the results of trials RDSO will issue a Final Speed Certificate indicating the maximum speed for which the new stock is considered fit, mentioning therein special precautions to be observed if any. Based upon this certificate, the user Railway will issue a speed certificate signed by PCE, PCEE, PCME, PCOM and PCSTE and send the same to concerned Commissioner of Railway Safety (CRS).

Final Stage:

Sanction of the Railway Board for commercial exploitation of the rolling stock is accorded.

30802 Trial Runs on Open line

Subject to the condition that operation of the particular new type of locomotive has already received the sanction of the CRS, trial runs on the open line may be undertaken with all the usual precautions. The Driver should be a senior and experienced person who has acquired the "feel" of the type of locomotive in question, as he would be in a better position to give his reactions as to the performance of the locomotive. Initially the locomotive should be run for short lengths at low speeds subject to various equipment continuing to operate satisfactorily, the length of run and the speed may be progressively raised over a period of time. Test in particular, how the brakes function under the normal and emergency conditions. At the conclusion of each trip, a detailed examination should be made of the equipment, particular attention being paid to the temperature rise, lubrication, protective devices etc. Every new rolling stock after initial run for a period of 15 to 20 days will be called back to the home shed and will be given a thorough inspection of all under-gear equipment with special attention to loosening of bolts. These bolts will be re-tightened and secured before the rolling stock is put back into the system.

30803 Commissioning of New Electric Rolling Stock

1. Locomotives and EMUs do undergo detailed tests and trials at manufacturing units before dispatch, detailed tests and trials at manufacturing units which include tests prescribed by RDSO. Nevertheless, it is necessary for officers and staff of open line to check up the equipment thoroughly before they are put into commercial operation.

   Hence, an inspection programme (IC0) broadly based on IC schedule is generally carried out at home shed during commissioning of rolling stock. During the schedule(IC0), Sr. DEE/ DEE(RS) and the staff should make a detailed inspection of all parts of the rolling stock, one equipment after another, keeping a full record of defects observed during its run from manufacturing/production unit and necessary action will be taken to rectify them. Homing shed should also ensure during commissioning of rolling stock whether all the modifications recommended by RDSO is being carried out by production unit. If not, the same will be carried out during commissioning at home shed. In any case, a report should be forwarded for every loco/or EMU tested to manufacturing unit and RDSO for improvement in design. if required, revise the testing procedure and tighten up final inspection. Such checks should also be normally carried out before commissioning a loco / EMU after an IOH/ POH by the shed / workshops.
2. Test certificates bound in book/Digital form issued by the Manufacturers / Production Units should be available in duplicate. These should contain details of purchase order, name & address of supplier/OEM, data of supply received at CLW/other production units, Warranty/Guarantee clause etc. of each major equipment, results of actual tests and measurements carried out on the different components and duly countersigned by the Inspecting Officers. One copy should be kept preserved for reference in the loco shed and one copy in PCEE's office.
3. The manufacturer is also required to submit guarantee / warranty of the loco components / sub-assemblies wherever applicable. Whenever a new type of equipment / sub-assembly is inducted into the locomotive, its operation and maintenance instructions shall be furnished by the manufacturer in advance, before dispatch of the locomotive.

30804 Electric Multiple Units

The contents of paras 30801 to 30803 apply equally to every electric multiple unit, except that, in addition to the electrical equipment of the driving unit, the interconnecting pneumatic pipe connections and the brake equipment in each coach should be subjected to detailed examination for detection of leakage and proper operation. Similarly the control cable connections between coaches should be checked for proper sealing at the ends to make them weather-proof. The running gear and brake equipment in all motor and trailer coaches should also be tested.

Insulation resistance of the through wiring in the coaches, and internal wiring for lights and fans within the coaches should also be checked and recorded. Verify that the different circuits are provided with individual fuses and the fuses are of the correct rating. All tests and trials should be conducted with the EMU without any passengers, except for the officials in-charge for testing and loading of the train may be done by sand box, etc.

30805 Additional Precautions before Commencement of Commercial Operation

1. During trial runs, very close watch should be kept on the performance of new loco or EMU before putting into normal service. For the first few runs, the Driving Inspector, together with a few key personnel, should accompany the loco or EMU, and examine the equipment at frequent intervals and arrange for rectification any defects that may show up. A separate History Sheet should be maintained for every electric locomotive or EMU.

2. The “trouble-shooting directory” should be got ready well in advance of introduction of a new type of loco/ EMU and the running staff adequately trained in the trouble- shooting methods and operation of the type of loco/ EMU.

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CHAPTER-9
SAFETY, BREAKDOWNS AND DISASTER MANAGEMENT

30900 General

The safety precautions to be taken have been dealt with great length in various parts of the Manual particularly from chapter 2 to 7 dealing with Operation and Maintenance of Rolling Stock. The compliance of these rules should be ensured.

Various instructions given in this Chapter are in addition and over and above to the ones already mentioned elsewhere in this manual and other relevant manuals issued by the Railway.

Loco Pilots / Motormen should be fully trained to protect not only their train but also the trains running on other tracks in case of any infringement suspected as laid down in General and Subsidiary rules.

30901 Knowledge of Rules

All officers and supervisors of the Rolling-Stock section should be fully conversant with the "Rules for Reporting Accidents" as given in the Accident Manual and other instructions in force for dealing with accidents and breakdowns. The instructions given in the following paragraphs are to be treated as supplementary instructions. They should not be taken as nullifying or contradicting the instructions contained in other official manuals.

30902 Emergency Stores and Break Down Equipment

At electric loco sheds and EMU sheds and at selected stations in the electrical sections, tools and equipment such as special lifting jacks, traversing jacks, etc. for dealing with accidents to electric rolling stock shall be maintained. 'Sr. DEE / DEE in charge of sheds will be responsible for proper upkeep of such equipment. They should inspect the same periodically and ensure that the same are kept in working order and maintained properly. The list of tools and equipment to be maintained specially for dealing with breakdowns of electric rolling stock in use on the Railways will be issued by PCEE.

30903 Use of Hydraulic Re-railing Equipment of Electrified Track (Deleted)

30904 Break Down Gangs

It is essential that adequate number of selected, experienced staff of all categories should be housed in Railway quarters closed to loco sheds / EMU sheds, outstation depots and EMU stabling lines etc. so that their services can be utilized for dealing with breakdowns and accidents whenever required.

30905 Record of Staff Movements

Senior Supervisors of the Rolling Stock section should keep Traction Loco Controller advised of their movements to enable him to contact them in the event of an emergency due to breakdown involving electric rolling stock.

30906 Summoning of Emergency Staff

Addresses and telephone numbers of officers and staff of the Rolling Stock Section should be available with TLC. Station Masters should also keep the residential addresses of staff residing nearby especially those who have no residential telephones, so that they can be summoned when required. Where special sirens are installed in Railway colonies to summon emergency staff in the event of breakdowns or accidents, a special code signal may be employed for such summoning. The adequacy and proper observance of these instructions should be checked at least once in every six months by sounding the alarm and recording the time taken for the key staff to turn up.

30907 Expeditious Clearing of Track

In the event of a failure of locomotive or EMU, the primary objective should be to clear the line as quickly as possible so that the repercussions on traffic are minimal. The Loco Pilot should follow the detailed instructions given in the respective trouble-shooting manuals. He should seek guidance from TLC wherever necessary.

In such cases it may be necessary to disconnect / disengage and even cut out the drive due to wheel sets getting jammed. For expeditious clearing of the track, the locomotive may have to be driven at a reduced speed to be decided in consultation with the engineering staff.

If the Loco Pilot is unable to move the locomotive or EMU on its own power, he should ask for a relief engine or assisting train as the case may be.

30908 Emergency Telephone.

The Loco Pilot of every locomotive shall carry a portable emergency telephone set, so that in the event of a serious breakdown enroute in mid-section, He/She could contact the TPC/TLC from the nearest emergency telephone circuit. To help the Loco Pilot arrow marks are painted on the faces of OHE masts indicating the direction in which the nearest emergency telephone socket lies. Every Loco Pilot shall be fully conversant with the method of plugging the portable telephone to its socket and establishing communication with TPC/TLC.

In case telephone is not working the Loco Pilot will arrange to communicate the incident to the nearest Railway station either himself or through Guard or Asstt Loco Pilot. In busy suburban sections, motormen of disabled EMU trains can send messages to the nearest station through the Motorman or Guard of trains on adjacent track, which may be stopped by him for this purpose by showing hand signals. In case telephone is not working the Loco Pilot will arrange to communicate the incident to the nearest Railway Station either himself or through Guard or Asstt. Loco Pilot

30909 Flasher Lights

These lights are provided on all locomotives and EMUs. As soon as BP pressure drops due to any reason not initiated by the crew Auto flasher light will glow, the Loco Pilot should assume that some portion of his train has derailed and should put on the flasher light manually also to warn the driving crews of the oncoming trains on the opposite track. The operation of the flasher lights may be suspended only after the crew have verified physically that the neighbouring track is not infringing. Similarly the crew observing the flasher light should take immediate action to stop the train even with emergency application. of brakes if necessary and should only restart after the physical verification of the infringement.

30910 Access to the Roof of Electric Locos and EMUs

On Line

1. Access to the roof of electric locos and EMUs is authorized only under the conditions that the OHE has been made dead and earthed on both sides of the loco /EMU by the OHE staff in accordance with procedure laid down. The power block will be' taken by the OHE staff.
2. On locomotives a ladder is provided for gaining access to the roof. The ladder is normally kept locked. To remove the ladder from its locked position the Loco Pilot should operate the main isolating switch and take out the key for unlocking the ladder. When the operations on the roof of the locomotive are over the Loco Pilot should put back the ladder in its proper place. After locking the ladder he can release the key for operating the main isolating switch.
3. When required, for climbing from rail level, portable ladders are provided in each EMU. These ladders are fixed at a height at the ends of motor coaches. Though no special interlocking is provided to prevent the ladders being used, the Motorman must ensure that the condition of para (a) above is satisfied before going on to the roof.
4. After the Loco Pilot /Motorman has completed his work, he shall ensure that everything is in order and advise the OHE staff to energize the line.

In Sheds

The supervisor in charge of maintenance gang shall ensure that OHE supply is switched OFF and earthed before any staff is authorized to go on the roof of a locomotive/EMU. For this purpose, the OHE shall be made dead and earthed by opening the controlling isolator(s) fitted with earthing heels. He will ensure physical contacts of earthing wheel and provision of padlock in this condition. Where the isolators are not provided with earthing heel, the line shall be earthed an both the ends of the locomotive with the help of discharge rod. Having ensured this, he will allow the staff access to the roof who in turn will follow the following procedure :

1. Each of the staff will collect padlock(s) with key(s) and will sign in a register maintained for this purpose.
2. Handle(s) of the controlling isolator(s) already opened by the supervisor in charge will be further secured by providing individual lock(s) by the staff. Keys of the locks will be retained by the staff till such time the work is completed.
3. After completion of the work and when the last staff has removed his padlock(s) from the isolator(s) and signed the register again; the concerned supervisor, after satisfying himself that all staff, tools etc. and the earths provided have been removed, may re-energize the OHE.

30911 Precautions to be Followed While Despatching Locomotives as Vehicle

Electric locomotives should not be worked as dead vehicles unless an authorised Railway employees has taken all the measures detailed in the respective Operating Manuals. Essentially these measures are lowering and isolating the pantographs, making all electrical equipment of the loco dead, releasing the brakes of the loco and closing the corridor and cab doors. In such cases, the loco must be attached as the first vehicle of the train next to the engine. Para 30912 may also be referred in this regard.

30912 Hauling a Damaged Locomotive

1. If a damaged electric locomotive which is stabled on the open line or at a station is to be hauled as a dead vehicle, it must be certified by the Loco Pilot or EXR and must be accompanied by competent staff. In case of damage to the traction motor or transmission gear, the locomotive must be examined by an engine examiner and certified as fit for movement. The speed at which the

damaged locomotive may be hauled in such cases should be as specified by the engine examiner.

2. On dead locomotive all the circuit breakers and battery knife switch shall be off and such other steps to ensure that the dead locomotive cannot be started inadvertently.
3. Care shall be taken to ensure that traction motor reversers are physically placed and locked in the neutral position. For long distance movement of dead electric locomotives, the traction motor brushes shall be lifted and secured before the loco is dispatched.
4. The locomotive brakes shall be fully released. The brake pipe and main reservoir pressure shall be fully discharged or the vacuum fully destroyed. The MU2B valve, if fitted, shall be lifted and properly secured.
5. The dead locomotive shall be accompanied by a competent person not lower than an Asstt Loco Pilot when attached to a passenger train and also when attached to the rear of a goods train. When attached to the rear of a goods train, it will be the duty and responsibility of this person to apply the hand brakes judiciously in case of run-away occurring on a graded section.
6. The train Loco Pilot shall be informed that he should work the train carefully as the dead locomotive will have no brake power at any time. If the dead loco is to be hauled by a light engine, the speed may be required to be limited on account of limited brake power available on the light loco. This will be laid down by the PCEE of the Railway.
7. The Assistant Loco Pilot of a train to which a dead electric locomotive has been coupled should keep frequently looking back to watch for any signal from the staff accompanying the dead locomotive.

30913 Haulage of a Disabled EMU Train

1. Instructions contained in Para 30912 for haulage of damaged loco shall apply mutatis-mutandis for movement of a disabled EMU as well.
2. An EMU train which cannot move on its own power but is otherwise fit to be moved, may be hauled by another EMU train or a steam, electric or a diesel locomotive till it can be conveniently side-tracked into a siding. Special adopters are provided to enable such emergency haulage of EMU trains fitted with automatic couplers by means of locomotives. Loco Pilots must be familiar with the procedure for fitting such adopters. The speed at which a disabled EMU train may be hauled under such conditions will be as laid down in local instructions.
3. The relevant General and Subsidiary Rules for moving disabled EMU trains should be rigidly observed.

30914 Movement of Electric Trains under Conditions of Flooded Tracks

When the tracks are flooded, the restrictions regarding movement of electric locomotive and EMU trains shall be in accordance with local instructions (see also para 30716).The traction motor and associated parts including gear case, etc., are designed to permit propulsion of rolling stock at 10 km/h through water upto a level of 200mm above rail level. Further, the traction motors are made completely water-proof to a standing water depth of 760mm above rail level.

30915 Accidents involving Electric Rolling Stock

The Traction Loco Controller should immediately inform the Officer-in-charge of operation of Electric Rolling Stock in the event of any accidents involving Electric Rolling Stock. An Officer or Senior Supervisor of the Electric Rolling Stock section should be invariably associated with restoration work when derailment or other accidents to Electric hauled trains are involved. Before restoration commences the shed supervisor shall make measurements/ checks jointly with the engineering staff to help investigation into the cause of accident later. For this purpose proforma prescribed in the Accident Manual or issued under the local orders

of the Railway should be used. Action shall be taken to preserve the evidence as far as possible. The restoration work of locomotive and train shall only be started after the TrD gives clearance.

The checks to be carried out are detailed in the Annexure 9.01.

30916 Look out for OHE Defects

The engine crew of all trains shall keep a sharp look out and report any defects in OHE noticed by them to the TPC from the nearest station. Such defects need not be confined to the line on which train is moving but in the entire vicinity. They should give as detailed information as possible on the nature of the breakdown, its location whether the masts have been uprooted, whether both lines in a double track section have been affected etc. The OHE defects as observed by the Loco Pilot may be of any one of the following classification:

1. Uprooting of or damage to OHE masts on account of cyclone, derailments etc.
2. Entanglement of pantographs with the OHE.
3. Snapping of OHE conductors.
4. Flash-over or other damage to insulators.
5. Faults on account of stray wires etc.
6. Theft of OHE conductors,
7. Foreign material on OHE

30917 Pantograph Entanglement

The officer or supervisor of the Electrical Department arriving first at site of a breakdown, particularly those involving entanglement of pantographs with the OHE, should make a very careful note of all relevant details pertaining to the break-down and also prepare a sketch indicating the particulars. He will also arrange for preservation of such evidence as may be useful subsequently for investigating the cause of the breakdown.

Items to be checked on the pantograph and OHE are indicated in the Annexures 9.02 and 9.03.

Maintenance Staff, after ensuring that OHE is dead, and earthed in association with OHE staff will climb on the roof of the locomotive. They will remove the HPT links of the damaged pantograph and earth it pantograph will be secured with wire rope from the base frame of the pantograph in such a manner that it does not come in contact with OHE during the run.

30918 Protection of Train in Case of Loco Failure and / or OHE Supply Failure

1. When overhead supply fails, the Loco Pilot shall use the momentum of the train and see whether he can reach the next station otherwise he will stop the locomotive close to a emergency socket. To help the Loco Pilot, arrow marks are painted on the faces of OHE masts indicating the direction in which the nearest emergency socket lies. If power supply is not restored within 5 minute after stopping the train, he should make use of his portable telephone to ascertain from the TPC through the emergency telephone socket the time when the supply is expected to be restored. If it is likely to be more than 15 minutes then the Loco Pilot should apply air and hand-brakes on the loco Hand brakes to be applied as per G&SR No.

   If the Loco Pilot is unable to stop the train close to the emergency telephone socket, and is likely to take more than 15 minute to ascertain the time of restoration of the overhead power supply from TPC he must first protect the train against rolling as indicated above and then contact the TPC.

   The same instructions shall be observed in case of electric loco failure when it becomes necessary to make the loco dead and call for assistance.

2. In addition, the precautions prescribed in General and Subsidiary Rules for protection of trains when stopping out of course should be observed.
3. If after power, is restored, the Loco Pilot experiences tripping again, he shall not energize the locomotive until he has personally satisfied himself that there is no abnormality on his locomotive.
4. The locomotive will not be left unmanned in such an eventuality.

30919 Parting of Trains

1. Failure of inter-vehicle couplers can cause train partings. This can be due to sudden acceleration or braking causing jerky motion of vehicles. Such jerks cause waves of alternate compression and tension in inter-vehicle couplers passing down the train length and the weakest coupler is liable to break.
2. Loco Pilot shall observe following precautions to avoid parting of trains:
   a. When starting a train, tractive effort shall be applied gradually to ensure that all the couplings are fully tight.
   b. Pick up speed notch by notch and start train smoothly.
   c. Do not use loco independent air brakes to stop trains (except Light Engines)
   d. Ensure engine coupling is properly tightened / locked before starting a train.
3. When a parting occurs the Loco Pilot (in the front portion) should not endeavour to stop the front portion of the train, but should allow the portion to move forward to the extent possible to prevent the possibility of the rear portion colliding with the front portion. The automatic brakes applied on parting may not be effective equally on both the halves of the parted train.

30920 Fire fighting Appliances for Electric Rolling Stock

1. Every electric locomotive should be provided with 4 number of 5kg capacity DCP or CO2 two in each cab. The fire extinguishers shall be fixed on brackets at approved points in the cabs and corridors. The SSE/PPO on duty will be responsible for ensuring that the locos leave with the full complement of fire extinguishers. Sufficient number of spare fire extinguishers should be available with the SSE/PPO to replace defective and damaged fire extinguishers.

   In exceptional circumstances PCEE may authorize change in complement and / or type of the fire extinguishers.
2. On EMU, 2 number of 2.5 kg. capacity Halon type fire extinguisher should be provided in each of the cabins occupied by motorman and Guard and also one number of Halon type extinguisher of the same capacity should be provided in each motor-coach of EMU. As in the case of other passenger trains, the Operating Department will be responsible for custody of the fire extinguishers and their issue to the Guard at the originating station of each EMU rake.
3. All the staff of electrical department connected with the running and operation of trains should be duly trained for fire fighting and use of fire extinguishers within the locos and EMUs.
4. The staff should be trained in taking necessary precautions as enumerated in para 30921.

3-Phase locomotives:

Fire Detection unit is provided in SB2. There are two smoke detectors provided to detect the smoke in FDU.

When one detector detects the smoke –

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

When both detectors detect the smoke –

1. Priority-1 message will appear on the screen - Inspect Machine room
2. Throttle T/E, B/E becomes '0'
3. Buzzer will sound.

Action to be taken by Loco pilot

1. Trip DJ, lower panto, stop and secure, switch off battery, Inspect the Machine room and take necessary action.
2. In case of fire on loco, use big fire extinguisher provided in the rack behind asst. Loco pilot in cab. To operate this fire extinguisher, open the cut out COC after releasing lock and release the gas by rotating adjusting knob, gas will expel and extinguish the fire at appropriate places in machine room behind it. In addition to this two numbers of portable fire extinguishers are provided on the loco which should be used accordingly as per requirement.
3. To reset the FDU, press the white knob provided on it. To acknowledge the fault press BPFA. Resume normal traction. 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.

30921 Fires in Electric Rolling Stock

Preventive Maintenance and Inspection

1. The presence of a large quantity of oil in the transformers and tap-changers of electric locos and EMUs makes it possible for even minor fires to spread and assume serious proportion. Leakage of oil from compressors results in accumulation of oil on the loco flooring causing spread of fires. An essential step in prevention of fires in locos is, therefore, to control the leakage of oil from exhausters, compressors and pipe lines and to arrange periodic cleaning of the locos to remove accumulated oil. Always use funnel of proper shape for tapping of oil to prevent spillage.
2. The arcing horns should be properly attended to during inspections. The arc-chute should be properly secured and the securing arrangement periodically checked. The arc-chute should also be cleaned during inspections.
3. In addition to periodic cleaning of the bogies and underframe to remove oily dust, it is also important that rheostatic and regenerative braking, where provided, is kept in working order and Loco Pilot trained to make use of these on graded sections, obviating the need for heavy mechanical braking as far as possible thus preventing sparks from brake blocks.
4. Rating of the fuses particularly of low voltage dc circuits are to be checked periodically to eliminate the possibility of fires due to short circuits / overloads etc. Always ensure that the proper sizes and types of fuses are used for replacement. Check calibration of MCBs during POH. Use MCBs and fuses of only approved suppliers as laid down by RDSO.
5. Ensure that all the protective relays are in good working order and are properly calibrated. Do not bypass any protection on the rolling stock.
6. A loose connection is a potential source of fire. Proper tightness of all the connections is, therefore, to be ensured and this point is to be given particular attention during inspections. Coaches commissioned after POH or new coaches after commissioning should be thoroughly checked up for loose connection as during the first few days, loose connections will show up. Ensure that all the connections secured with a nut and bolt are provided with a set of plain and spring washers.
7. Insulation failures may result from surface flash overs due to presence of dirt and dust. It is, therefore, essential that proper cleaning of terminal connections, bus bars, insulators and equipment is done during schedules as laid down to remove oil and dust.

8. Fires in control equipment cubicles are a problem and usually lead to considerable damage. Fire detection always remains a challenge and normally it is noticed when its intensity becomes more. Ensure that proper maintenance of the equipment inside the cubicles is done and the equipment are carefully looked at during inspection for any developing faults.
9. Batteries may lead to fire or explosion when they are being given a heavy charge. Heavy charging can be either due to malfunction of the charging equipment or carelessness when charging from the shop floor rectifier. It is therefore important to check that the ventilation provided in the battery box is not choked. The staff should, therefore, be made aware of the danger of overcharging.
10. Use only approved quality of cables and furnishing material for repairs. Proper care should be taken while laying down the new cables so that no damage to the insulation is caused.
11. In order to monitor healthy condition of insulation of wiring and equipment, insulation resistance should be measured periodically in sheds and during POH in shops, and records kept.
12. In the event of fire it is essential that the main circuit breaker is tripped and the battery fuses of locomotives and EMUs are immediately removed to eliminate the continued feeding of the fault by the battery.

30922 Technical Investigation into Fires

Every case of fire minor or major fire incidences at all locations, Irrespective of the location, whether In power, auxiliary or control circuits, should be investigated very carefully, even though an inquiry in accordance with the Accident Rules may not be called for. The causes as established by the investigation should be analyzed by the Sr DEE / DEE personally to identify areas requiring further investigation and to tighten up preventive measures. A report on each case of fire should also be furnished to PCEE. The general guidelines to check up the items in locomotive in the event of fire, is given Annexure 9.04.

30923 Fire Accidents

1. Fires in trains, whether carrying passengers or not, resulting in loss of human life or injury to any person or loss of or damage to Railway property to the extent of or more than the value prescribed are required to be treated as “accidents” and have to be inquired into in accordance with the “Rules for Reporting and inquiring into Accidents”. Fires in other Railway premises resulting in damage to Railway property of the prescribed value or over are also to be treated as “accidents”. Fire accidents involving loss of human life or injury to persons or damage to Railway property estimated to cost equal to or over a prescribed value have also to be reported as soon as possible on telephone to the Railway Board by the General Manager through Operating (Safety) Branch. Procedure laid down in the Finance Manual should be followed.
2. When electrical installations or electric rolling stock are involved or when there is possibility that the fire was caused by electrical short circuit or due to defect or malfunctioning of electrical equipment, a representative of the Electrical Department should invariably be a member of the inquiry committee. Rules also require that a representative of the Security Department should be associated with all inquiries into fire accidents. On arrival at the site of fire they will collect necessary evidence and make out a joint report in consultation with the representative of the security department.
3. The composition of the inquiry committees and the method of disposal of the report of the inquiry committee will be as laid down in the “Rules for Reporting and Inquiring into Accidents” issued by the Zonal Railways.

30924 Electrical Safety

Procedure for reporting of electrical accidents and action to be taken have also been laid down in Vol. I of this manual. The various authorities to be informed in case of injury / death due to accidental contact with live installations have also been indicated.

Following guidelines are specifically meant for Electrical Rolling Stock. These are to be observed and in no way nullify or counter any of the instructions laid down elsewhere by the PCEE in his capacity as Electrical Inspector to the Government of India.

1. All Loco / EMUs sheds shall ensure that the various interlocks provided on the high tension compartments are effective and it is not possible to open HT compartment until the pantograph is in lowered position and is fully earthed.
2. Loco Pilots / Motormen shall not not enter the HT compartment unless the pantograph has been lowered and fully earthed.
3. Loco Pilot / Motormen should be fully trained in operations necessary to ensure electrical safety.

30925 Rehabilitation of Fire/Accident Damaged Rolling Stock

The items need to be checked up before the electric rolling stock is taken for rehabilitation for its suitability is given is Annexure 9.05.

Annexure – 9.01

Proforma for Motive Power/ Locomotive (Diesel & Electric)

Proforma to be filled in case of accident /derailment when loco is involved in accident.

1. Basic information:

a. Date of Accident:

b. Train No. :

c. Loco Class:

d. Loco Number:

e. Loco manufacture year and place:

f. Base Shed of Loco :

g. Date & Place last POH :

h. Kilometres earned after last POH :

i. Date & place of last major inspection:

j. Date & place of last schedule inspection:

k. Whether any schedule is overdue? :

2. Give brief particulars of the safety items not provided or provided but missing/not working

Whether Loco is provided with:

Safety fittings	Provided	Working
Headlight		
Speedometer		
Speed Recorder		
Flasher light '		
Horn		
Brake System		
VCD		

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3. Check & record the observations as follows:

(a) Position of control handles, cutout cocks etc after the accident.

(b) Functioning of brake synchronizing valve-whether working or not.

(c) Position of brake blocks after the accident- whether applied or not.

(d) Condition of cattle guard.

(e) Any sign of seizure of roller bearing in Axle box including condition of its components

(f) Condition of Pivot and Side Bearer arrangementof bogie including obstruction to Bogie rotation.

(g) Condition of Friction Damper components/ Hydraulic Dampers

(h) Condition of Traction Rod/ Guide Rod including its connection.

(i) Condition of Traction Link including its connection.

(j) Condition of Lateral Stop components between Bogie and Loco body underframe

(k) Any other observation in respect to mechanical defect of the locomotive, which might have any bearing on safe running of loco.

Note: Defective or broken material should be sent to CMT for testing, if necessary.

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4. **Measurement for Wheels for All Classes of Locomotives with wheel gauge (04 locations applicable for Bo-Bo Locos)**

S.No.	Description	Observed Value (in mm)			Remarks
1.	Particulars-of axle (ID No.)	1			
		2			
		3			
		4			
		5			
		6			
2.	Diameter of wheel at tread		LH	RH	
		1			
		2			
		3			
		4			
		5			
		6			
3.	Wheel Flange thickness		LH	RH	
		1			
		2			
		3			
		4			
		5			
		6			
4.	Wheel Root wear		LH	RH	
		1			
		2			
		3			
		4			
		5			
		6			
5.	Tread wear		LH	RH	Tread wear should be measured from tread at 63.5mm from wheel gauge face (from the back face of flange) in BG and at 57mm from wheel gauge face (from the back face of the flange) in MG.
		1			
		2			
		3			
		4			
		5			
		6			
6.	UST of axle: Give the date of last UST test done	Axle	Observation		Information is relevant in case of axle breakage
		1			
		2			
		3			
		4			
		5			
		6			

Measurement for Wheels for All Classes of Locomotives with wheel gauge (04 locations applicable for Bo-BoLocos) (Continued)

Notes:

1. Wheel number one is the outer end axle of truck under the short hood and wheel count increases towards the Long hood on diesel loco, whereas for Electric Loco, wheel number one is the outer end axle under Cab-1(Cab- 1 is that side of the loco which has the compressors and Cab-2 is that side of the *loco* which has the ARNO convertor) and wheel count increases towards the Cab-2.

2. The measurements of wheels are to be done using *wheel* gauges to ROSO drawing No.SKDL-3592 for all BG locomotives except WAP5 locos. For WAP5 locos RDSO's drawing No. SKOL-4446 and SKDL-4447 may be followed.

3. All measurements are to be taken on a level, un-canted trackat the nearest yard.

4. Service limits given in the Maintenance Manual are for good maintenance practice and these are not safety limits. However, the measured values shall be compared with the service limits and degradation in values shall be discussed while finalizing the findings.

S. No.	Description	Observed Value (in mm)		Remarks
7.	Wheel gauge: For checking wheel gauge, three measurements at equal spacing on the inner periphery of the two wheels on the same axle is to be recorded. Check for bent axle, if any.	1		All measurements shall be taken on a level tangent un-canted track. Information is relevant in case of wheel disc shifting/*bent* axle only. For safety, similar limits as applicable for track gauge are relevant for wheel gauge also.
		2		
		3		
		4		
		5		
		6		

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5. **Measurement of other relevant items:**

S. No.	Description		Observed Value (in mm)	Remarks
1	Buffer /coupler height Measurement of parameters such as buffer length etc may also be done to check possibility ofbuffer entanglement.			All measurement shall be taken on a level tangent un-canted track. This measurement is required to be takenonly in case of trailing stock is with buffers.
2	Lateral clearances	End Axles (1,3,4 &6)		
		Middle Axles (2& 5)		
3	Lateral clearances	End Axles (1,2,3 &4)		Applicable for Bo-Bo locomotives only.
4	Longitudinal clearances, between axle box &bogie. Pedestal liner (for allaxles)			Except WDP3A,WDG4,WDP4, WDP4B, WAP5,WAP7, WAG9 locomotives
5	Longitudinalclearancesbetweenaxle box &bogiepedestal liner (for middleaxles)			Applicable to WDP3A locomotive only.
6	Height of Rail Guard from rail level			
7	Condition of suspensionSprings i.e. normal/ brokenfresh and old fracture ordeformities occurred afterderailment due to suddenimpact.			
8	Deflected height of coil spring after re-railing on level, uncanted track			
9	Condition of Rubber/ Elastomeric Spring Assembly at the Secondary stage			

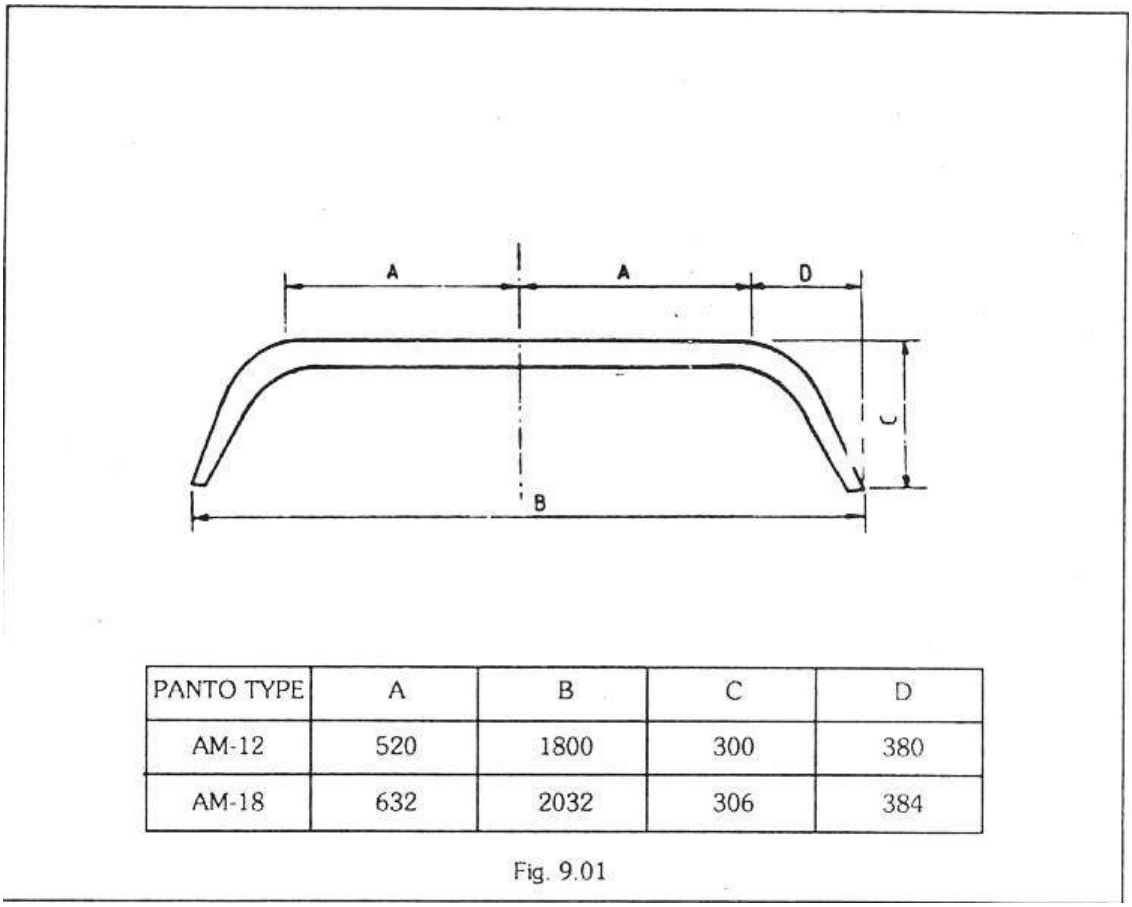
Note – Measurement of items (e) to (j) in Para 3& item 8 & 9 in Para 5 will be done as per site condition.

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Annexure 9.02

PANTO ENTANGLEMENTS : ITEMS TO BE CHECKED ON PANTOGRAPH

1. Check the fastening of wear strip with pantograph pan or bent strips or deep grooves on the strips. Pantograph strip joints must be smooth so as not to hinder smooth riding of the contact wire on the pan.
2. Check that the grease plate is properly fastened.
3. Check the bow plunger for free sliding while pressing. Check that the split pins are intact.
4. Check the horizontality of the panto pan and its free vertical movement. Check the transverse flexibility of the pan by pulling transversely at the middle cross member with a force of 50 kg. The displacement of the pan at the middle cross member should 36 + 5mm. Check that the positioning link is not bent/cracked or dislocated from the fixing pivots. Check the intactness of split pins.
5. Check the pantograph frame for any signs of bending or cracks. Check the springs for any cracks.
6. If possible, take the measurement of the pan as per the Fig. 9.01.
7. Check the broken or cracked fittings of the pantograph and see whether the cracks are old or fresh.



PANTO TYPE	A	B	C	D
AM-12	520	1800	300	380
AM-18	632	2032	306	384

Fig. 9.01

Annexure9.03

PROFORMA FOR RECORDING MEASUREMENT OF OHE IN CASE OF PANTO ENTANGLEMENT.

1. Location
2. Height of contact wire above main line.
3. Height of contact wire of turnout/cross-over-above R.L.
4. Stagger of contact wire of main line.
5. Stagger of contact wire of turn-out/cross-over.
6. Length of steady arm holding main line contact wire.
7. Length of steady arm holding turn-out/crossover contact wire.
8. Position of Registration tube and register arm dropper clip.
9. Track separation at obligatory point.
10. Position at which horn of pantograph Jumped above contact wire.
11. Vertical height of steady arm clamp from register arm.
12. Hitting marks on the steady/Registration arm tube, P.G. Clamps droppers contact wire, dropper dip, splices, Jumpers, if any.
13. Condition of cracked or broken OHE fittings such as damps, catenary suspension bracket, splices and clips etc. Check whether the cracks are fresh or old.
14. Check free vertical movement of the steady arm.

Above observations will be made on every mast within at least 500 m in the rear of the location of entanglement.

Annexure 9.04

A ITEMS TO BE CHECKED IN CASE OF FIRE IN A CONVENTIONAL LOCOMOTIVE

1. Position of master controller, SMGR drum and tap position of tap changer.
2. Condition of VCB, whether locked or in open condition?
3. Whether relays, particularly QLM, QRSI, QOP, QOA, are in tripped condition or normal?
4. Condition of HOBA, HQOP and HQOA knife switches.
5. Condition of fuses.
6. Condition of CGR1, CGR2, CGR3 and RGR.
7. Arc-chute of CGRs, line and shunting contactors, auxiliary circuit contactors.
8. Condition of contactors - whether found in wedged or welded condition.
9. Possibility of loose connections at the terminal points.
10. Possibility of overheating due to poor thimbling.
11. Identify the location of the cable where globules are found formed.
12. Identify the area / zone where the damage to the locomotive is extensive due to fire.
13. Condition of 25 kV bushings of the transformer- whether burnt after bursting or simply burnt or not damaged.
14. Possibility of transformer oil splashing with special attention to any sign of oil in conservator.
15. Condition of tap changer with particular attention to splashing of oil and flash-over of the taps.
16. Condition of other electrical equipment like rectifier block, inductive shunt, auxiliary machines and traction motors for any abnormality entailing fire in the locomotive.
17. Polarity of the smoothing reactor, if not damaged fully.
18. Condition of brake blocks, wheel disc for over-heating and melting of brake blocks. Search out molten pieces of brake blocks, if any on SL.
19. Whether the fire took place when dynamic brake was in applied condition. If so, whether" thermal relay of DBR was in working order. Examine the condition of DBR resistances.
20. Presence of any inflamable material like jute, rubber etc.
21. Abnormality, if any already indicated in the log- book by the Loco Pilot which could lead to fire.
22. Take this statement of crew and other personnel traveling on the locomotive about how the fire originated.
23. Whether specified fire extinguishers were available in the locomotive and used by the Loco Pilot and how many of them were found effective?

Annexure 9.04 B

ITEMS TO BE CHECKED IN CASE OF FIRE IN A THREE-PHASE LOCOMOTIVE

1. Position of master controller, Configuration switch 154.
2. Condition of VCB, whether locked or in open condition?
3. Check DDS for any fire alarm or Fire Detection Unit malfunction message?
4. Condition of contactors in SR and FB panel: whether found in wedged or welded condition
5. Condition of MCBs
6. Condition of Capacitors and resistors in SR, BUR, FB, HBB panels.
7. Possibility of loose connections at the terminal points.
8. Possibility of overheating due to poor crimping.
9. Identify the location of the cable where globules are found formed.
10. Identify the area / zone where the damage to the locomotive is extensive due to fire.
11. Condition of 25 kV bushings of the transformer- whether burnt after bursting or simply burnt or not damaged.
12. Possibility of transformer oil splashing with special attention to any sign of oil in conservator.
13. Condition of SR with particular attention to splashing of oil and flash-over of the taps.
14. Condition of other electrical equipment like Filter resistor, LA, auxiliary machines and traction motors for any abnormality entailing fire in the locomotive.
15. Condition of brake blocks, wheel disc for over-heating and melting of brake blocks. Search out molten pieces of brake blocks, if any.
16. Presence of any inflammable material like jute, rubber etc.
17. Abnormality, if any already indicated in the log- book by the Loco Pilot which could lead to fire.
18. Take this statement of crew and other personnel traveling on the locomotive about how the fire originated.
19. Whether specified fire extinguishers were available in the locomotive and used by the Loco Pilot and how many of them were found effective?

Annexure 9.05

ITEMS TO BE CHECKED UP BEFORE TAKING UP SPECIAL REPAIR OF FIRE/ACCIDENT DAMAGED LOCOMOTIVE

All the items given below need attention for a locomotive involved in a major accident, affecting the under-frame. However, checking up of only under-frame and item 3 is necessary in case a major fire damaged locomotive is taken for rehabilitation.

1. Electrical equipment

   1.1 Oil levels of power equipment.

   1.2 Fixing/foundation bolt of all equipment.

   1.3 Visual inspection for any damage

2. Mechanical equipment

   2.1 Under-frame

   a. Visually inspect the under frame main sills for crack/local deformation/squareness.
   b. Measure height of couplers/buffers
   c. Measure important dimensions of the under frame and examine for any bend/twist. (The typical dimensions which are required to be recorded for WAG-5 class of locomotive are given in Fig. 9.02 (Sheet 1, 2) as an example.)
   d. Measure camber by running a piano cord from end to end of the locomotive. If there is a negative camber, the under-frame is likely to have under-gone a permanent set. It is normally not possible to set right such deformation except when it is localised or is on a non-stress bearing member.
   e. Any separation between under frame and shell.
   f. Coupler, coupler pin, draft lugs (inside the coupler pocket) for crack/deformation, (g) Holding arrangement of each equipment and shear checks, etc.

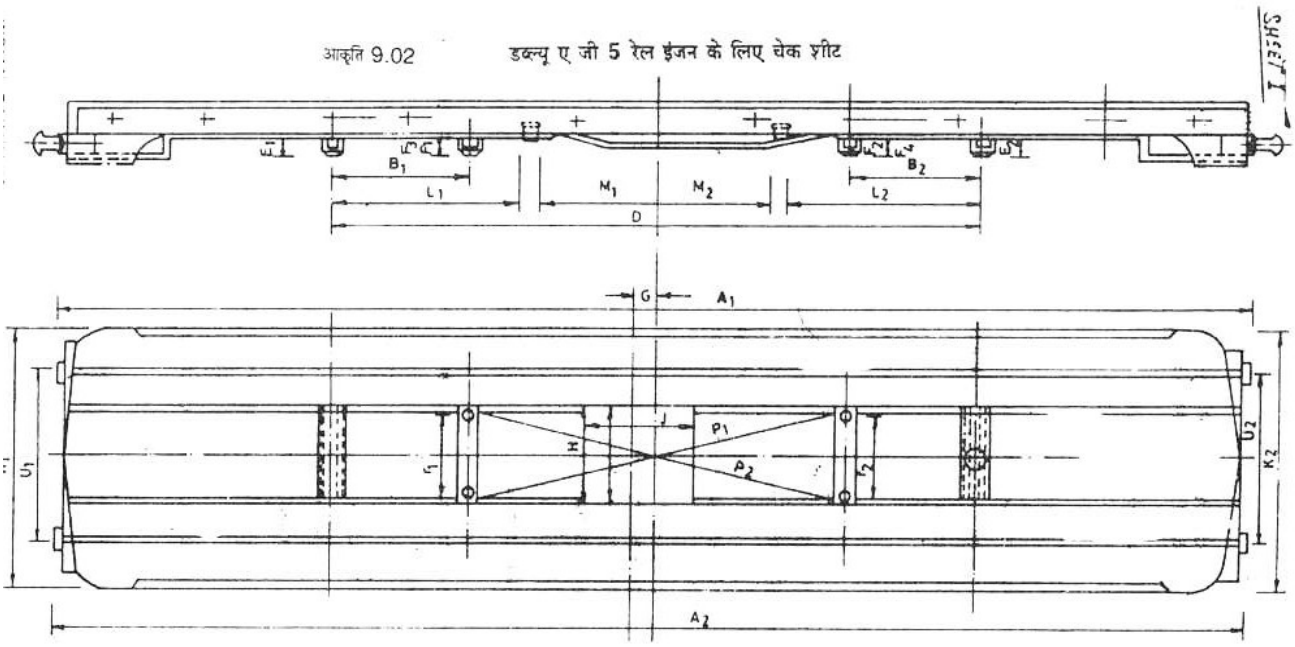
   2.2 Bogie and Brake rigging

   a. Visually examine the bogie frame and brake rigging for any damage with special attention to cracks.
   b. Measure all dimensions of bogie frame and examine for its deformation/squareness.
   c. Condition of the interfaces of the bogie frame with underframe.
   d. Condition of axle box roller bearing and horn liners/spheriblocs.
   e. Bending of axle and traction motor shaft.
   f. Cracks/deformation of equaliser beam, spring and spring seats.

3. Miscellaneous :

Visual inspection of all equipment of locomotive for any damage and deficiency.

आकृति 9.02 डब्ल्यू ए जी 5 रेल इंजन के लिए चेक शीट



CHECK SHEET FOR WAG5 LOCOMOTIVE

FIG. 9.02

FIG (आकृति) 9.02
SHEET(शीट) 2

TYPICAL DIMENSION OF UNDERFRAME
अंडरफ्रेम के प्ररूपी आयाम

S No. क्र.सं.	Test	परीक्षा	Dimension (mm) आयाम (मि.मी. में)
1	B_1	$बी_1$	1568 ± 5
2	B_2	$बी_2$	1568 ± 5
3	D	डी	12580 ± 1.5
4	E_1	$ई_1$	219 ± 0.5
5	E_2	$ई_2$	219 ± 0.5
6	F_1	$एफ_1$	238
7	F_2	$एफ_2$	238
8	F_3	$एफ_3$	238
9	F_4	$एफ_4$	238
10	P_1	$पी_1$	9529 + 1
11	P_2	$पी_2$	9529 ± 1
12	r_1	$आर_1$	1270 ± 2
13	r_2	$आर_2$	1270 ± 2
14	A_1	$ए_1$	18704 ± 10
15	A_2	$ए_2$	18704 ± 10
16	G	जी	282 ± 2
17	H	एच	1400 ± 4
18	J	जे	2078 ± 4
19	K_1	$के_1$	3050 ± 5
20	K_2	$के_2$	3050 ± 5
21	L_1	$एल_1$	3185 ± 1
22	L_2	$एल_2$	3185 ± 1
23	M_1	$एम_1$	203 ± 2
24	M_2	$एम_2$	203 ± 2
25	U_1	$यू_1$	1956 ± 4
26	U_2	$यू_2$	1956 ± 4

Height of the rail guards from rail level :-
रेल पटरी से रेल गार्डों की ऊंचाई:-

Cab-1 कैब-1	LH बाईं ओर RH दाईं ओर	115^{+3}_{-0}
Cab-2 कैब-2	LH बाईं ओर RH दाईं ओर	115^{+3}_{-0}

*****

31001 Annual Statements (Deleted)

Statements prepared and sent to HQ and Railway Board:-

31002 Monthly Statements

1. 4A (outages) & Inter Railway Financial Adjustments (IRFA) statements for statistical department
2. Holding & Target for Railway Board (Month …….. Year ……..)

S. No	Description	ELS1	ELS2	ELS3	Total	Cum. upto Month	
						Current Yr	Last Yr
1	**Holding**						
(a)	Average loco holding						
(b)	Average accidental loco						
(c)	Avg. under conversion/GRS						
(d)	Avg. Effective holding a-(b+c)						
2	**Availability (Outage)**						
(a)	Goods (Target)						
	Actual						
(b)	Passenger (target)						
	Actual						
3	**Ineffective**						
(a)	Minor Repair						
	Numbers						
	Percentage						
(b)	Statistical Ineffective						
	Statistical Numbers						
	Statistical percentage						
(c)	Ineffective Hourly						
	Hourly Numbers						
	Hourly Percentage						
4(i)	**Loco Failure (Territorial Basis)**						
	Statistical Failure						
(a)	Goods (OR+FR)						
(b)	Passenger (OR+FR)						
4(ii)	**Non-statistical Failure**						
(a)	Goods (OR+FR)						
(b)	Passenger (OR+FR)						
5	**EKM/day/engine in use(TB)**						
(a)	Goods						
(b)	Passenger						
6	**Engine KMs (TB)**						
(a)	Goods						
(b)	Passenger						

7	**EKM/St. engine failure (TB)**						
(a)	Goods (6a/4a)						
(b)	Passenger (6b/4b)						
8	**Major Inspection done during the Month**						
(a)	AOH						
(b)	MOH						
(c)	IOH						
(d)	POH						
9	**Major Insp O/due at the end of Month**						
(a)	AOH						
(b)	MOH						
(c)	IOH						
(d)	POH						
10	**Un-schedule Visit/lifting (Nos)**						
(a)	**Visit**						
	Own Railway						
	Foreign Railway						
(b)	**Lifting**						
	Own Railway						
	Foreign Railway						

31003 Daily Position

1. PCEE Position:
   a. Asset failures & Punctuality incidents incidences (Ownership & Territorial)
   b. Factors affecting train operations (FATO)
   c. Ownership & Territorial outages.
   d. Dead loco position.
   e. MU position (territorial & ownership)/Driving units.
   f. Schedules carried out.
   g. Any other unusual occurrences.
   h. Locos in shed position.
   i. Overdue schedule loco position.
2. Shed position & Holding and feedback of drives & unusual occurrences
3. Crew position fed in FOIS in RB format.

31004 Shed wise Performance (Deleted)

310005 Combined Driver's and Guard's Report (Deleted)

31006 Nomination for Foreign Railway

In additions to above, the locomotive nominated for foreign Railway shall be issued with Trip Card. The trip card is also sent to the statistical office after the loco touches the homing shed. This also helps to keep correct record of the performance the locomotive.

Reports relevant to operations are available in FOIS, which are as under.

1. Ineffective
2. Outage
3. Utilization
4. Kilometres
5. In shed
6. Speed
7. Light Engine (LE) movement
8. Average
9. Loco holding
10. Shed loco details
11. Shed wise loco holding in foreign Railway
12. Loco in shed before due dates
13. Overdue locos

On further development of FOIS, all reports pertaining to train operation can be obtained through FOIS.

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CHAPTER-11
TECHNOLOGICAL ADVANCEMENTS

31101 Introduction

Electric locomotive were introduced with D.C. traction motors. However D.C. Drive have inherent limitations.. In the 1990's IR took momentous decision to induct state-of-the-art three phase drives locomotives, incorporating elements like squirrel cage induction motors, GTO based converters and microprocessor based control. Regenerative braking available with 3-phase technology, provides energy efficiency during braking reducing the net energy consumption.

31102 IR's Initiatives

Keeping in view the emerging technological changes taking place in traction area, Indian Railways have taken up some projects, which are outlined below:

1. **IGBT based Propulsion System:** In view of the imminent obsolescence of GTO's and complexities in its drives and snubber circuits, IGBT based propulsion system has been developed, suitable for the existing 3-phase electric locomotives. The propulsion system comprises of Traction Converter, Auxiliary Converter, Traction Motor and Transmission system. The existing transformer is retained. Starting tractive effort of the locomotive is increased but the power shall remain the same. The propulsion system is suitable for working on IEC-61375 open controlled standards (TCN).
2. 12000 HP have been developed and manufactured by IR with the assistance of M/S Alstom successfully.
3. **Dry type Capacitors for existing Power Converters:** Development of dry type capacitors, in lieu of existing oil filled capacitors is being done to reduce fire hazard. These capacitors are having added advantage of self-healing feature.

31103 Development of 180 KVA Static Inverter in place of ARNO Convertor:

Conventional Electric locomotives on Indian Railway typically use a rotary Arno (single phase to three phase) converter feeding three phase and auxiliary loads. The system suffers with inherent drawbacks of low efficiency, poor power factor and unbalance in three phase output voltage, wide variation in output voltage & frequency, higher level of harmonics causing overheating & counter torque production, switching surges due to DOL switching of loads etc, which necessitates use of larger size motors.

To overcome these issues Static Converter has been developed which converts single phase power supply of 760 V / 830 V from the transformer winding to 415 V, 3 phase, 50 Hz out put suitable for feeding 3 phase induction motor used as auxiliary machine on 25 KV AC locomotives .

LOAD DUTY CYCLE

All the motors are turned ON along with the Static converter. The starting of the motors is with current limit starting resulting into less stress on the motors. The entire operation will be completed within 10 to 15 secs. All the motors along with Battery Charger are turned on along with the Static converter. Sequencing of the loads is control circuitry of the locomotive.

The hardware and firmware design take into account the worst conditions e.g. big variation of input voltage, output loads and severe environmental conditions. Static converter has a half-controlled single phase bridge rectifier at the input and a DC link filter and a three phase IGBT based PWM inverter. All functions are controlled by Digital Signal Processor together with a digital gates and analog amplifier. The single-phase half-controlled bridge rectifier ensures soft start feature during initial charging and regulates DC output for the DC link. Inductors are provided at the output to reduce the ripple and harmonics in the DC link voltage.

A communication port (RS 232 interface) is provided on the front panel for down loading the fault data. A VFD is provided on the front panel for selection of operation mode and text display of monitoring status. The converter is designed for forced air cooling. The heat generated by the power devices is transmitted to the heat sink having adequate cooling surface.

The rectifier circuit is has thyristors whereas the inverter consists of IGBTs. The DC link voltage is converter in to PWM sinusoidal waves by switching IGBTs at a high frequency. The width of the individual pulses in the PWM wave determines the amplitude of the output voltage and the width of the pulse block determines the output frequency. As the system consists constant voltage and frequency the output frequency is maintained at 50 HZ and controller output voltage is kept constant by Space Vector Pulse Width Modulation (SVPWM).

31104 Vigilance Control Device

A vigilance control device to monitor the alertness of the driver existed in three- phase drive locomotives. Similarly, VCD was designed and installed on conventional electrical locomotives as well. The VCD is for monitoring alertness of the engine crew through a multi-resetting system which gets reset by specified normal operational activities of the crew, in addition to acknowledgement of vigilance check by pressing a push button or pedal switch provided for this purpose. Absence of the normal driving functions and the acknowledgement at specified intervals shall activate vigilance control system to flash an indication which, if still not acknowledged, shall cause audio-visual warning. If audio-visual warning is also not acknowledged, it results in emergency brake application. Cab display panel (LCD display) is provided to show the current status of VCD i.e. VCD isolated, VCD in service. Internal fault and other events are recorded as an event in the memory of VCD.

31105 Microprocessor based control & fault diagnostic system

1. Conventional electric locomotives are provided with control based on electro- mechanical and Electro-pneumatic relays/contactors. Such controls involve large number of interlocks, contacts, inter-connections and cabling, which are not only maintenance intensive but are unreliable too. Microprocessor-based control is provided to replace some of the existing conventional relays, reduce cabling and provide additional fault diagnostic information with improved overall reliability.
2. The primary objectives of this system are
   a. To reduce the number of electromagnetic relays and interlocks by providing software based control logic using microprocessor.
   b. To provide the fault information in text form, status of various interlocks and input command switches displayed on the driver's desk in each cab and
   c. Traction/braking notch position to display through seven segment indication on the driver's desk in each cab.
   d. Analog inputs measurement.
3. The functions of QF1,QF2,QD1,QD2, Q20, Q30, QCVAR, QE, QV61, Q118, Q44, Q45, Q100, QTD105, QTD106, Q51, Q52, QV60, QV62, QV63, QV64, Q46, Q48, Q49, Q50, Q120, QVLSOL,

QRS, QWC relays of traction as well as dynamic braking circuit and at the same time minimise the requirement of total no. of N/O and N/C interlocks. The outputs for EFDJ, MTDJ, C118, VE1, VE2, C105, C106, C107, C101, C102, C103, J1FOR, J1REV, J2FOR, J2REV,CTF1 RUN, CTF2RUN, CTF3RUN, CTF1BRK, CTF2BRK, CTF3BRK, C145, EVPHGR, S11, S12, S13, IP, VESA1, VESA2, L1, L2, L3, L4, L5, L6, LSDJ, LSCHBA, LSGR, LSB, LSP AND LSRSI are controlled through the microprocessor. The notch display is performed through two seven- segment displays of 1 inch size instead of Selsyn notch indicator.

31106 Real-time Train Information System (RTIS) on Electric Locos

Real-time Train Information System (RTIS) is provided on Electric Locos for automatic acquisition of train operation data to improve operational efficiency and quality of passenger information. RTIS monitors and sends continuous information of geographical location of locomotive to a central server through GSAT-6 satellite. Provision of RTIS will enable Control Office Application (COA) in automatic charting and passengers will get accurate & real-time information. RTIS will assist in better utilization of resources and communication between Loco driver and control office in emergency condition. Interfacing of RTIS and control unit of locomotive is feasible, by which health of the locomotives shall be available in real-time enabling homing sheds to plan maintenance activities.





Working System of RTIS

Main Equipment of RTIS

Mobile Satellite Service Hub (MSS Hub) & Central Location Server (CLS)

Mobile Satellite Service hub communicates with GSAT-6 and located at Data Centre of CRIS along with Central Location Server.

Communication bands:

L-Band (1 to 2 GHz): Communication between locomotive & GPS/GGN/IRNSS

S-Band (2 to 4 GHz): Communication between locomotive & GSAT-6

C-Band (4 to 8 GHz): Communication among locomotive, GSAT-6 and MSS hub

RTIS Device consists of two parts: **Indian Rail Navigator (IRN)**, which comprises display, integrated communication model & power management unit, installed at locomotive cab and **Rail Mobile Satellite System (RMT)** installed outdoor on roof of the locomotive.



IRN Unit installed at Locomotive Cab



RMT Unit installed at Locomotive roof

Benefits of RTIS

1. Automatic capture of train running Information & automatic plotting of Control Charts in COA
2. Stress free work conditions for train controllers
3. Optimum utilization of resources
4. Accurate train running information to passengers
5. Improved Customer Services
6. Richer Management Information System(MIS) for management
7. Improvement in operational efficiency

31107 End of Train Telemetry (EoTT)

End to Train Telemetry (EoTT) is a device which provides information regarding end of train as an alternative of running trains with guard. It consists of two units:

End of Train (EoT) Unit:

EoT unit is installed on the Last Vehicle of train. It consists of Sense and Brake Unit (SBU), Radio transmitter & receiver, battery, Air turbine for battery charging, GPS device etc. It communicates with HoT device fitted in the locomotive.



End of Train (EoT)

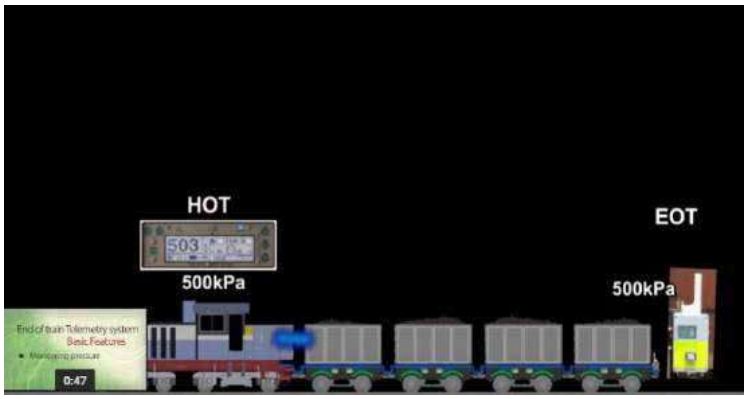
Head of Train (HoT) Unit:

HoT unit is fitted in the cab of locomotive. One display unit will be provided in each cab of the locomotive.



Head of Train (HoT)

EoT senses the brake pipe pressure of Last Vehicle and transmit to HoT unit where it can be seen on display unit of HoT. In case of a train parting, the system is designed to indicate to the driver the parting of the train and to apply brakes to the rear unit, thus averting the collision of the rear portion with the front portion of the train.



End of Train Telemetry (EoTT) system

Some of the main features of EoTT system are as under:

1. EoTT system is based on AAR-S-9152 & TFR international standards.
2. Two way Telemetry system has been adopted in this specification.
3. EoT senses the brake pipe pressure of Last Vehicle and transmit to HoT unit where it can be seen on display unit of HoT by the Loco Pilot.
4. The system is designed to indicate to the driver the parting of the train and to apply brakes to the rear unit.

5. There is a provision of High Visibility Marker Light (HVML) and Disable Train Warning Light (DTWL) in the Last Vehicle of the train.

31108 Distributed Power Wireless Control System (DPWCS)

R have been considering to increase through put per train to meet increased traffic demands as well as to reduce the cost of operation. This is being achieved by improving in design and wagon having better pay to tare weight ratio, increasing number of wagons per train, increase in axle load etc. One important operational method is running Long Haul trains which require multiple locomotives. Electric locomotives are provided with electrical wire coupler at both ends to facilitate working in multiple units (MU). However, due to limitation of coupler capacity and other operational factors, the number of locomotives that can be attached in front of the train is limited.

The concept of the distributed power was developed to operate the long haul trains as per operational requirements.. Distributed Power refers to the physical distribution of locomotives at intermediate points throughout the length of a train. Distributed Power Wireless Control System (DPWCS) provides coupling between locos through RF communication. Using Distributed Power Wireless Control System total 4 Remote Locomotives can be connected any where in the train consists. All the remote locomotive will always be synchronized with the lead locomotives. System reduces coupler forces when remote locomotive work either in the middle or rear of the train and therefore incidences of train parting are reduced. It also reduces the number of drivers and ensures efficient running of trains as all the engines will operate simultaneously during operation.

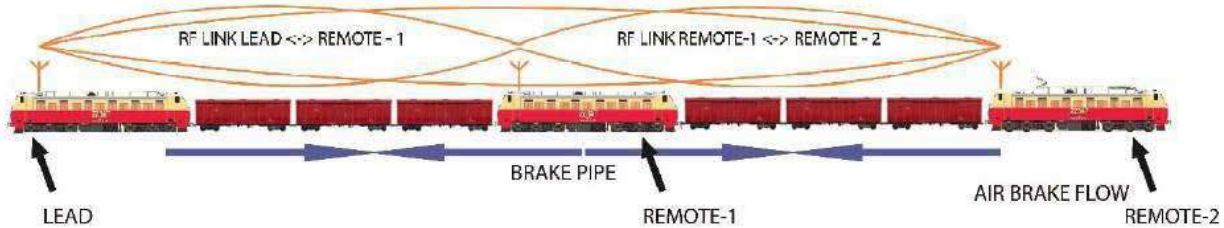
Conventional Train

With Conventional Train the Tractive Force is applied from the front due to lack of synchronizing possibility between the Locomotive.



DPWCS Enabled Train

With DPWCS Enabled Train, the locomotives can be anywhere in the train consist as all the locomotives are synchronized over the radio link.



Benefits of DPWCS

1. Reduced draft forces along a train will reduce the lateral force between wheel and rail on curves, thus reducing energy consumption and wear & tear on various running components.
2. Another benefit is quicker application of standard air brakes. With all braking control at the front on a conventional train, it can take several seconds for brake-pipe pressure changes initiated by the Loco pilot to propagate to the rear. Under radio-controlled distributed power operation, the brakes are set at remote locomotives simultaneously with the command initiated on the lead locomotive,

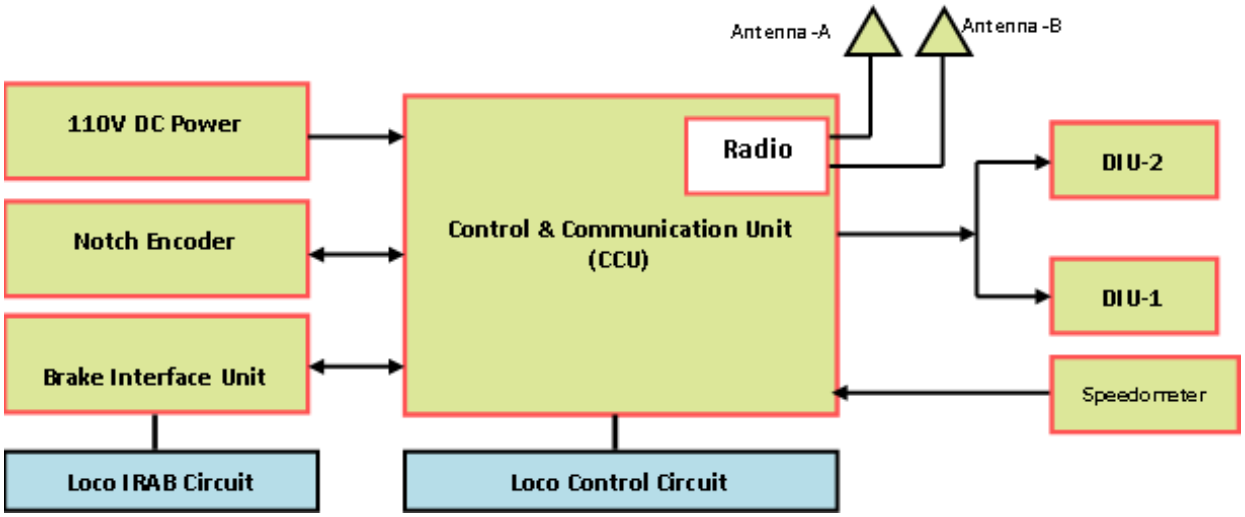
providing a more uniform air brake response throughout the train.

3. Higher throughput due to Quick turnaround time.
4. Reduce manpower Cost
5. Reducing the high input associated with forming and splitting up trains

System Description

The DPWCS is conceived to provide coupling between locos through wireless communicationThe remote locomotive will always synchronize with the lead Locomotives. The parameters of the remote locomotive like notch/TE position, dynamic Break position/BE, BP, BC, MR, FP, Airflow and Sanding etc. will be displayed in the Driver Interface Unit of the lead loco. Lead loco pilot can control the remote locomotive individually through touch screen options (Isolate Mode Idle Mode, Brake Mode, Synchronous Control Mode, Independent Control Mode, Brake Valve out Mode) of display unit.

System Architecture



The following are the main components in the system.

1. Control& Communication Unit
2. Display Unit
3. Brake Interface Unit
4. Radio Antenna
5. Notch Encoder(for tap changer locos only)
6. Pressure Transducers.

There are six operating modes available in the system to be used by Loco pilot as per requirement.

Synchronize Mode: In this mode, the Remote Locomotive will be synchronized with lead Locomotive by replicating the lead Loco pilot commands in Remote through DPWCS system. This mode will be selected for Synchronized operation of Remote Locomotives with Lead Locomotive.

Idle Mode: In this mode, the system will remain grouped condition but electrical signals like Traction and DB of Remote locomotive will not synchronized with lead locomotive. The Remote Loco will participate in only Pneumatic Braking. This mode may be used during the hauling of empty Rake or in down gradients where Loco Pilot wants the remote locomotive to participate only in Pneumatic braking mode.

BV Out Mode: In this mode, the system cuts out the charging or application of Brakes in Remote Locomotive. Remote locomotive will not participate in application/release of braking. Only the electrical operation of the Remote Locomotive remain synchronized with lead locomotive. This mode will be selected, whenever the loco pilot want the complete control of pneumatic braking only from the lead locomotive.

Isolate Mode: In this mode, the Remote Locomotive will be in grouped condition but it will not synchronize with the lead locomotive. This mode will also open the VCB and lower the pantograph. During the hauling of empty rakes; if the pilot does not require banker operation, this mode will be selected.

Independent Control Mode: In this mode, the electrical traction and dynamic braking functions of the remote locomotives can be independently control through options available on Driver Display unit. Loco Pilot can increase or decrease the traction and braking through DDU options. He can also raise or lower the pantograph and can close or open the VCB of remote locomotives. This mode will be used in camel humps terrain where the loco pilot required different traction in lead and banking locomotives or required traction in lead locomotive and dynamic braking in remote locomotive or vice versa. This mode can be used during the placement of locomotive in the loading points where the electrification is not available at the Lead/Remote position. This mode can also be used in the condition when lead locomotive fails to generate the traction to clear the section, by using this mode traction can be generated in the banking locomotives.

Brake Mode: In this mode, the remote locomotive will only participate in braking (Pneumatic and regenerative). The traction in remote will not be synchronize with lead locomotive. This mode will be utilized in heavy down gradients where the loco pilot wants the banker to be assist in only pneumatic and regenerative braking.

31109 EP assisted Brake System

In the present brake system the Brake Pressure (BP) is depleted in the locomotive to apply brake in the train. The brake is applied in the engine as well as in the train. To release brake, the Brake Pressure (BP) is charged in the train through engine resulting in release of brake in the complete train.Application and release of brake from engine is not simultaneous in complete rake, rather it reaches to last coach with some time delay. EP assisted brake system is required to apply/release brake in the complete rake simultaneously. RDSO has developed specification No. RDSO/EL/SPEC/2018/038, Rev'0' to implement EP assisted brake system in the existing brake system (E-70/CCB) on Indian Railways. In EP assisted brake system each coach is provided with Brake application & Release solenoid valve operated with electric supply.

Advantages of EP assisted brake system

1. EP assisted brake system may be fitted with existing brake system on IR.
2. In case of failure of EP assisted brake system, train operation is continued with existing air brake system.
3. Brake application & its release are simultaneous in the whole train, Therefore, no jerk during application of brake/release which improves the passenger comfort.
4. Braking distance is reduced by approx. 15% with the use of EP assisted brake system.
5. Reduction in journey time by use of EP assisted brake system.

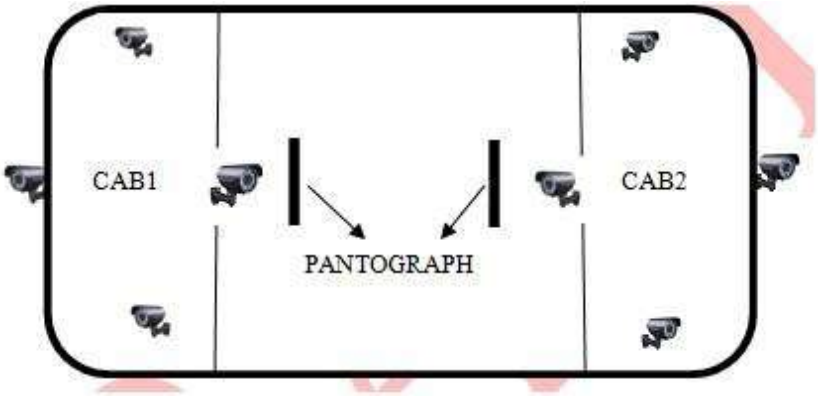
31110 Crew Voice & Video Recording System (CVVRS)

'Crew Voice & Video Recording System' (CVVRS) is provided in Electric locomotives/ EMUs to

ensure effective and tamperproof video and voice recording of locomotive cab/EMUs driver's cab, loco/EMU roof and track view for post event analysis.

Brief description of the equipment

1. IP based Digital cameras (2 Nos. inside each cab and 2 nos. outside cameras at each end. One of the outside cameras will face the track & other one will be installed on roof facing towards pantograph (Total 08 cameras).The tentative location of cameras are as under:



2. Network Video Recorder (NVR) with processing system and data storage capable of receiving standard Real Time Streaming Protocol (RTSP) stream from connected IP cameras. 8 channel NVR shall be provided in each cab of electric Locomotive.
3. DC-DC Converter to feed the system from loco/EMU control voltage, if required.

31111 Head on Generation - Hotel Load Converter

Presently, a power Car equipped with diesel generator capable of generating adequate power of 3 phase 50Hz 415 V/ 750 V AC is provided at either end of the train rake to supply power to coaches and Pantry Car (also referred to as Hotel Load). This system is not only highly inefficient but also creates noise and smoke pollution to passengers.

Traction transformers of WAP5 and WAP7 is provided with a hotel load winding to cater for the power supply to coaches (also referred to as Hotel Load). With the introduction of LHB type of coaches, adoption of "Head on Generation" (HOG) scheme in place of existing End-on Generation(EOG) was facilitated as the rake integrity with these coaches is expected to be maintained due to the specific design of their inter vehicle mechanical coupling. In order to provide environment friendly and noise free power supply to coaches and pantry car (also referred to as Hotel Load) from locomotive itself, RDSO/CLW have successfully developed hotel load converter for WAP 7 locos.

CLW had turned out first HOG based electric loco No. 30277 (WAP7) in the month of July 2010 having M/s Siemens make 2X500 KVA Hotel Load Converter installed in the locomotive. This locomotive is in regular train service in 12005/06 NDLS-KLK Shatabdi Express since 21.02.2011 over Northern Railway. The Hotel Load Converter fitted in WAP-7 locomotive is of the rating of 2x500 kVA at power factor of 0.8.

After getting satisfactory performance in Shatabdi Express trains, the trial was taken in Rajdhani Express on HOG. One rake of Mumbai Rajdhani Express was modified to suit HOG operation. HOG operation in New Delhi – Mumbai Rajdhani Express (train No. 1951/52) with WAP-7 locomotive having 2x500 kVA hotel load converter along with modified loco transformer having two independent hotel load winding (7775 kVA) was flagged off on dtd. 30.12.15. This 2x500 kVA hotel

load converter is capable to supply power for operation of 24 coach Rajdhani Express trains.

Special Maintenance Instruction (SMI) No. RDSO/2016/EL/SMI/0296 (Rev. '0') has been issued by RDSO to standardize Operational, Maintenance and Trouble Shooting practices of 2x500 kVA, IGBT based Hotel Load Converter of WAP7 locomotives.

31112 Push -Pull operation of WAP5/WAP7 locomotives

In a normal Multiple Unit (MU) operation, the wired communication is established between the front and the rear loco through UIC control cables. The operational data are communicated between the front and rear locomotives based on the established communication protocol. However, in the concept of Push-Pull operation, the front and rear locomotives are operated in Multiple Unit (MU) formation separated by the coaches in between. Thus, the principle of working of Push-Pull is same as that exists in MU operation but with rear loco at a distance and without connection of MR & BC equalizing pipes. To achieve Push-Pull operation, software logic and MU hardware installed in the locomotive have been optimized.

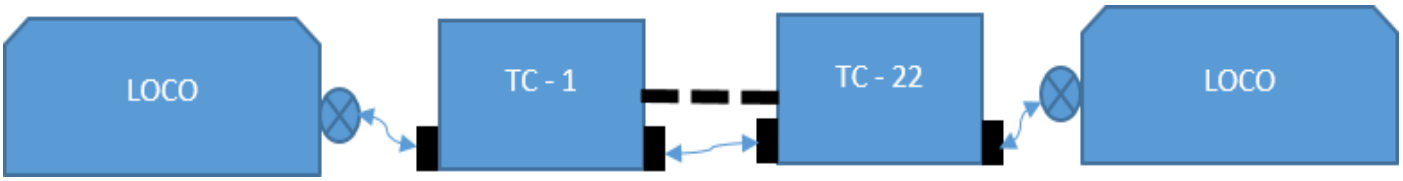
Indian Railways has started the operation of Train No. 22221/22222 Special

Rajdhani Express from CSTM to NZM on synchronized Push-Pull concept. In synchronized Push-Pull concept, the locomotives are connected on the both ends of the rake and are operated such that the tractive and electrical braking efforts are always synchronized. The data transfer between the two locomotives is based on ABB proprietary train network protocol. The similar scheme as in WAG9 MU adopted for operation of WAP5/WAP7 in MU formation. The WAP5/WAP7 shall be connected on each end of the train and control signals will be communicated by running control cable in the rake end-to-end.

Scheme of Push-Pull

The operation of WAP5/WAP7 in Push-Pull shall be done by formation of MU of two WAP5/WAP7 locomotives with rake between the locomotives. Scheme has been shown in Fig 4.1 below. Therefore, WAP5/WAP7 shall be connected on each end of the train and control signals will be communicated by running control cable in the rake end-to-end. To facilitate the MU operation in Push-Pull mode the control signal communication needs to be established between the two locomotives with train rake in-between. For this purpose 22 core cables are run throughout the rake. Spare 22 core cables throughout the rake are laid for redundancy purposed. At present only 18 cores are used. 4 cores are kept as spare for future extension. For 22 coach formation, the cable length from end to end shall be about 600 meters.

The cable layout is as follows:



WAP7/WAP5

Schematic Diagram for Push-Pull with WAP7/WAP5

22 Pin Circular UIC connector

Suitable connector

RDSO has issued modification sheet No. RDSO/2019/EL/MS/0477 (Rev.0) dtd. 18.06.2019 to facilitate

operation of WAP5/WAP7 locos in Push-Pull mode which lists modifications to be done as under:-

1. Modification in loco software
2. Modification in loco wiring
3. Modification for duplication of BL key, BLDJ & BPFA of slave locomotive in master locomotive.
4. Modification in operation of compressors
5. Modification in the cabling scheme

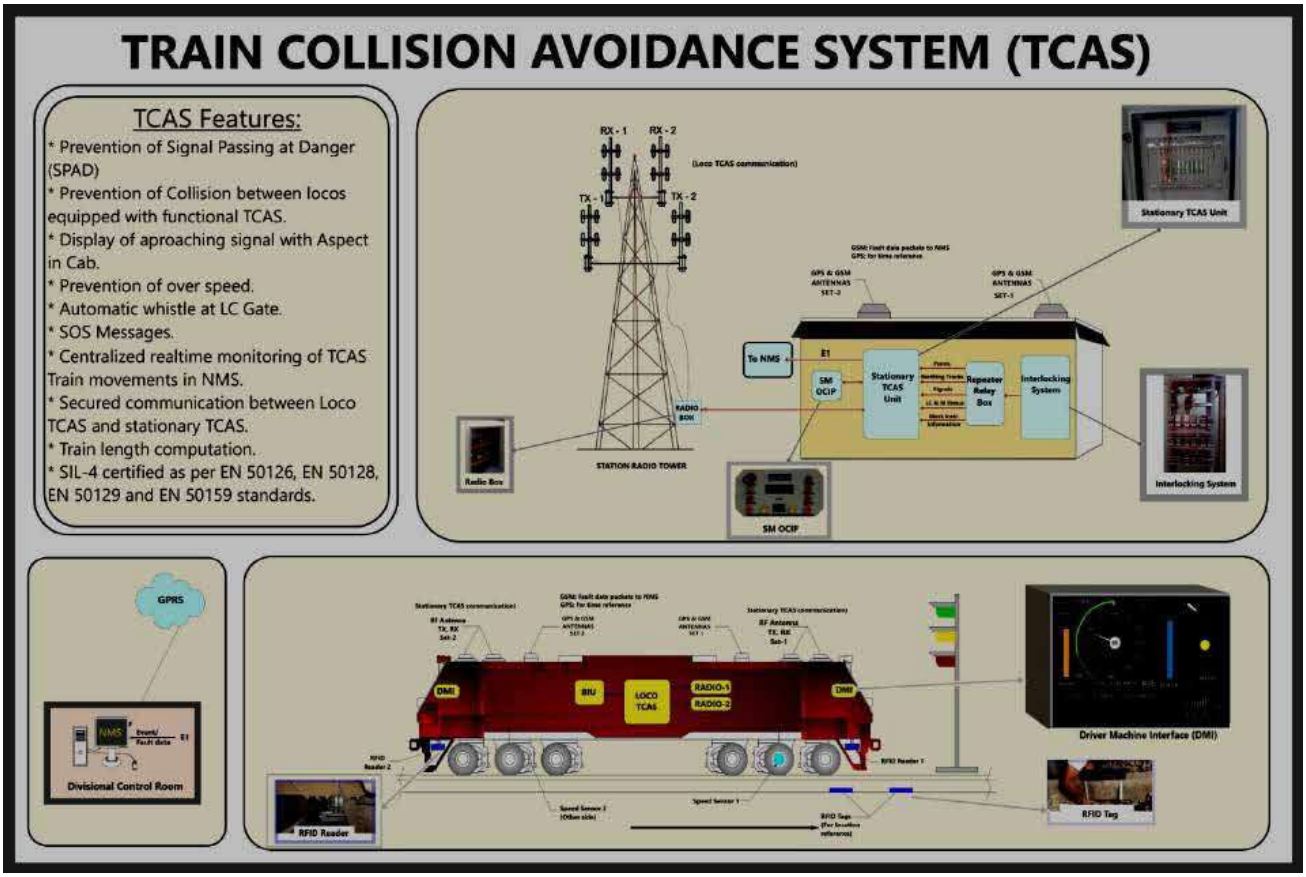
RDSO has also issued Modification Sheet jointly by PS&EMU & Carriage Directorate for provision of cabling scheme for wired train bus for new coaches and also for retro- fitment in the existing coaches and specification of required material vide Modification Sheet No. RDSO/PE/MS/AC/0080 – 2019 (Rev. '0') dated 30.08.2019.

RDSO has issued a compendium on Push-Pull operations of WAP5/WAP7 locomotives over Indian Railways vide Report No. RDSO/2019/EL/RM/0188, Rev. '0'-September 2019.

31113 KAVACH

KAVACH is meant to provide protection by preventing trains to pass Signal at Danger (RED), excessive speed over turnouts / Speed restrictions and to avoid the situation in which more than one trains are on the same track to prevent collision, in case manual operations are not able to control. It also provides assistance to Loco Pilots by means of real-time display of signal aspects in Loco Pilot's cab. It is based on the determination of location of trains through distance traversed from RFID tags installed on track and transmission of signalling related information from Stationary Unit such as Station Interlocking information through use of UHF Radio/LTE. The IRATP system is compliant to SIL-4 in accordance with EN50126, EN-50128 and EN-50159 standard. RDSO has issued Specification No. RDSO/SPN/196/2012 Version 3.2 for KAVACH.

The concept diagram is shown in following figure:



The KAVACH is meant to provide protection by

1. Preventing trains to pass signal at Danger (Red),
2. Preventing trains to pass at excessive speed over turnouts / Speed restrictions
3. To avoid the situation in which more than one trains are on the same track to cause collision, in case operations are not able to control so.



Driver Machine Interface (DMI) of KAVACH

31114 Train Protection & Warning System (TPWS)

Train Protection & Warning System (TPWS) is a continuous supervision system based on ETCS (European Train Control System) Level -1 that –

1. Provides safety in train operations by dynamically monitoring the speed of the train against specified limits.
2. Eliminates risks arising due to cases of Signal Passing at Danger (SPAD). The speed limits are specified dynamically based on signal aspect, route to be followed, sectional speed limits, permanent speed restrictions etc.
3. Internationally proven system, with multi-vendor operability.

TPWS work on the principle of target distance and target speed. RDSO has issued Specification No as RDSO/SPN/183/2016, Version 3.0 for TPWS. The TPWS equipments consist of following:

1. Track side system comprising of

a. Balises:

i. **Switchable balises** – This balises are interfaced to signal aspect through LEU. The telegrams/ data transmitted by these balises depend on the aspect of the signal. These are provided at a location near the signal. The Permanent Speed Restriction & track topography related information is also transmitted by these balises within the telegram/data related with signal aspect.

ii. **Infill balises** – These balises are also interfaced to signal through LEU. The telegrams/ data transmitted by these balises depend on the aspect of the signal. These are provided in advance of the signal to update the movement authority in advance. These balises cannot effect change of mode of On board system.

iii. **Fixed balises** – These balises are provided wherever required. These balises transmit fixed telegrams/ data only. These can be used for enforcing Temporary speed restriction etc.

iv. **Repositioning data balises** – These balises are provided wherever required to correct the previously given information.

v. **Line side electronic unit (LEU)**, its power supply & interfacing system with signalling

vi. **Communication link** (data cable) between the LEU & the balise.

b. On board system comprising of

i. On Board Computer (OBC).

ii. Juridical Recorder Unit (JRU) for data logging for diagnostics & investigation.

iii. Drivers' indication-cum-control panel (SDMI or DMI), indications & and audio alarms.

iv. Balise Transmission Module (BTM)

v. Balise antenna fixed to the under frame

vi. Speed and distance measurement unit

vii. Train Interface Unit (TIU)

viii. Interface to existing brake control system which in turn controls application of service/ emergency brakes or interface to existing brake system directly.

ix. Power supply arrangement

x. System Isolating Unit (Both Electrical & Mechanical)



31115 High Reach pantograph

High reach pantographs are suitable for working on High Rise OHE of DFC and IR as well as under the existing OHE of IR and provide satisfactory current collection at varying heights from 4.58m and up to 7.57 meter of contact wire. Width of panto pan of High Reach pantograph is 2030mm as opposed to 1800mm in Conventional pantographs. These pantograph use state-of-the art technology (air springs in lieu of mechanical coil spring) for its raising and lowering, thereby ensuring improved dynamic behaviour during current collection.

High Reach Pantograph consists of Base Frame, Air Bellow with Cam & Rope Assembly, Lower Arm, Control Rod, Parallel Rod, Upper Arm and Panto pan Assembly and Pneumatic Control. Pneumatic Control consists of Air filter, Pressure Regulator with Gauge, Lowering and Raising speed regulation valves. It is equipped with Auto Dropping Device (ADD) and Over Reach Detection (ORD) system. The basic purpose of Auto Dropping Device is to initiate the immediate lowering of the pantograph in the event of collector head failure to avoid further damage to pantograph and OHE due to entanglement. Over Reach Detection (ORD) Device operates when the working height goes beyond limits:-

1. Due to snapping of contact wire in mainline: In such case locomotive may be worked with another pantograph and pantograph may be re-setted after clearing the trip.
2. In unwired section of yards: In this case it will require re-setting after taking Power Block. The Over Reach Detection Device performs a very important function in this case.

Mechanism assembly insulator is not used in High Reach Pantograph thereby reducing the failures and improving the reliability.

Salient Features of High Reach Pantograph specification's various revisions:

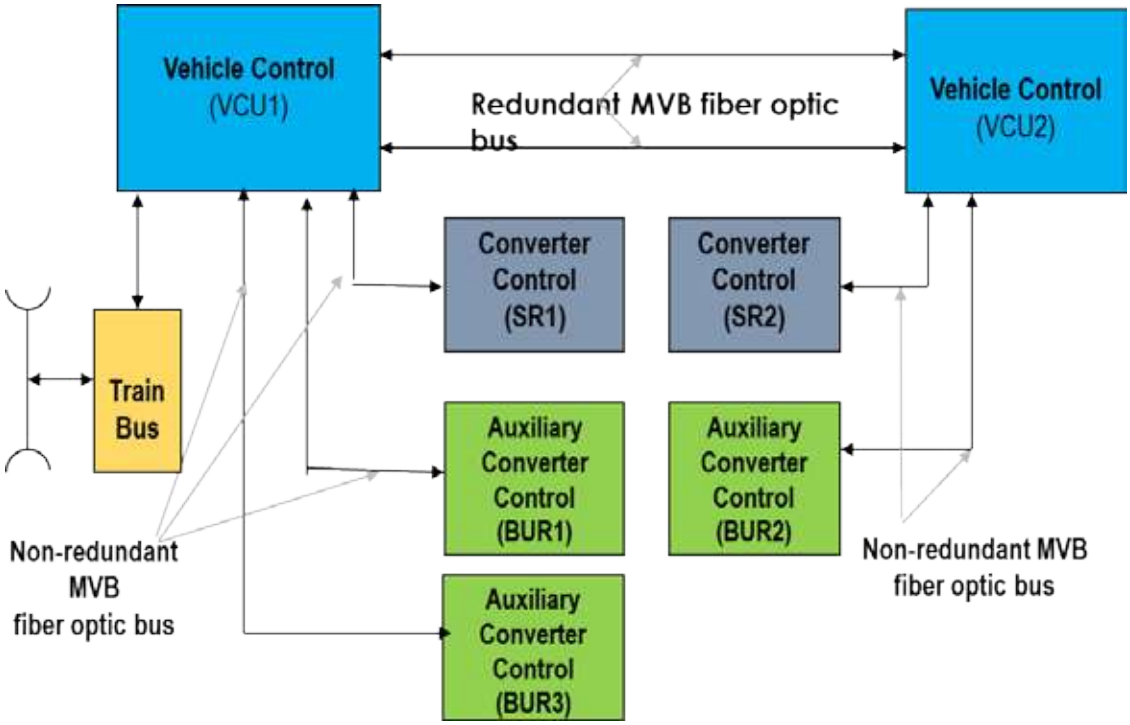
Parameters	Rev. '0'	Rev. '1'	Rev. '2'
Auto Dropping Device System	No	Yes	Yes
Over Reach Detection System	No	Yes. ORD activation height is not specified.	Yes, should get activated at 3.7meter height.
Working range	0.10m to 3.3m	0.15m to 3.3m	0.15m to 3.4m

Maximum Extension from the locked down Height(Min.)	3.5m	3.5m	3.6m
Overall length (including shunt: in folded condition) from rear panto mounting foot insulator	Not specified.	2100mm (Max.)	2100mm (Max.).
Maximum Folded height	275 mm. (so as to be within existing MMD of Electric Loco)	295 ± 5 mm. above mounting insulator (so as to be within existing MMD of Electric Loco)	295 + 5 mm. above mounting insulator (so as to be within existing MMD of Electric Loco)
Speed potential	110kmph	140kmph for normal OHE 110kmph for high rise OHE	200kmph for both OHE
Width of pan	1800mm	1800mm	2030mm
No. of High Reach pantograph in service	Nil.	156 supplied by Schunk, which were modified for working height as per spec Rev.'2' i.e. 3400mm.	Around 1400 in service comprising M/s Schunk and M/s Faiveley make.

31116 Open Control VCU

The three-phase locomotives currently in service on Indian Railways, viz. WAG9, WAG-9H, WAP-7 (Co-Co) and WAP-5 (Bo-Bo) employ a distributed architecture for control and data communication using MICAS-S2 (Micro Computer Automation System – Series 2) which is proprietary protocol. The vehicle control system consists of the following bus stations to manage the functions of the vehicle:-

1. Vehicle Control Unit (1 & 2)
2. Converter Control Electronics (1 & 2)
3. Auxiliary Converter Electronics (1, 2 & 3)



MICAS-S2 Architecture

Several drawbacks of the system were faced as full information about communication protocol was not available, being based on MICAS-S2 proprietary of M/s ABB. As a result difficulties were faced during Modification/upgradation on account of specific compatibility of available hardware with software. Hardware architecture is based on old slow processors and components resulting in more number of processor cards. As a result the benefits of advancements in the field of microelectronics could not be exploited.

In order to sustain the control system in a rolling stock during its lifetime and take advantage of advances in microelectronics, it becomes necessary to update the technology continuously and tackle the obsolescence. Also, to ensure interchangeability of control electronics from various sources, need was felt to standardize the control hardware and software. In this context, Indian Railways in association with Centre for Development of Advanced Computing (CDAC), Thiruvananthapuram developed indigenously, using state-of-the-art hardware and software, an open architecture technology for functional equivalent Vehicle Control Unit.

The salient features of Open Control VCU are:-

1. Communication Protocol based in IEC-61375 also calledTCN (Train Communication Network)
2. Application Software coding is based of PLC languages as per IEC-61131
3. Real Time OS : Micrium µC/OS-II RTOS
4. Handles external communication on multiple protocols (MVB, CAN, Ethernet, HDLC, RS232).
5. Development of application program using a standard package like ISaGRAF.

The advantages of Open Control VCU are:

1. Use of high speed processors
   a. enables compact system
   b. less numbers of PCB cards

c. faster signal processing
d. better control characteristics for locomotive.

2. Use of Remote I/O Modules (RIOMs).
3. No special tool required for downloading and troubleshooting.
4. Compatible state-of-the-art DDU driver interface and troubleshooting.
5. The electronics components are compliant to work on elevated temperatures.
6. Improved reliability

31117 Fog PILOT ASSISTANCE SYSTEM for SAFETY (FogPASS)

FogPASS is a non-vital and non-signal system. Aim of this system is to assist the Loco pilot by giving pre-warning about the approaching Landmarks such as Signal, LC gate, PSR etc. where the Loco Pilot's attention is required. Route survey for collecting the GPS/GNSS co-ordinates of landmarks to be carried out separately & programmed into FogPASS.

Landmark is the fixed location such as Signal, level crossing gates, Permanent speed restrictions, neutral section or any other location as identified by the user as landmark. Pre-warning distance is the distance from a landmark from where the warning shall be given while approaching that landmark. Short Description of Landmark is the text to be displayed on LCD panel to indicate about the approaching landmark. This may consist of Station code/ LC gate No., its description in short, location etc. FogPASS is suitable for train speeds up to 160 KMPH. FogPASS is suitable for all types of electric and diesel locomotives, EMUs/MEMUs/ DEMUs and any other self propelled vehicle treated as train. FogPASS is capable of working in all types of electrified as well as non electrified territories. FogPASS have built-in re-chargeable battery back-up for 18 hrs. Duration when fully charged.

31118 Software for Loco Asset Management (SLAM)

A computer application 'Software for Loco Asset Management (SLAM)' has been developed for electric loco maintenance in sheds and trip sheds. The System for Locomotive Asset Management (SLAM) project is for management of Electric Locomotive for Loco Maintenance, Operation, Schedules Planning, Execution and Monitoring. This software system envisages development of software for interlinking sheds (including out pits), divisional/Zonal headquarter, workshops, CLW, RDSO and Railway Board (Ministry of Railways). Besides management at loco sheds it aims to provide a portal based Custom built application module for providing specified functionalities. The System for Locomotive Asset Management (SLAM) software has been developed using web technology and is deployed on web based central server.

OBJECTIVES:

1. Setting up SLAM Pilot Phase (Stage-1) aimed.
2. Achieve online information of electrical locomotives & equipments
3. Accelerate the loco/trip shed maintenance & support activities.
4. Automate shed maintenance processes, Shop floor management.
5. Material management, document management, messaging.
6. Failure analysis, Cyclic Checks, condition monitoring.
7. Operational & analytical reports and dashboards.
8. Build information for Decision support system.

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CHAPTER-12
TRAINING AND COMPETENCY CERTIFICATES

I. TRAINING

31200 Introduction

Electric traction are a specialized field. Efficient operation and maintenance of the traction installations and equipment is only possible if the staff concerned have acquired adequate knowledge maintenance and operation of the equipment. A thorough knowledge of the special rules and procedures on the part of the staff is also essential to ensure safety of equipment and personnel. These requirements call for a specialized training for all categories of staff before they can be safely entrusted with the responsibility for maintenance or operation.

31201 Planning of Training

Before electric traction is commissioned on any section, adequate strength of well- trained operating, maintenance and running staff should be kept ready for operating the services. Planning the recruitment and training of such staff well in advance is one of the most important tasks of the open line administration. This applies in particular to steam/diesel running staff who would become surplus to requirements on introduction of electric traction and hence have to be absorbed as running staff to operate electric rolling-stock. Timely release of such staff for training should be pre-planned and ensured by the Electrical Department in co-ordination with the Mechanical Department. It is also necessary to establish suitable training facilities for imparting the training in advance.

31202 Categories to be trained

Categories of staff for whom special training is required to be organized are generally as under—

1. Degree and Diploma holders recruited directly as Supervisors.
2. Apprentice Mechanics to be absorbed as Supervisors.
3. Trade Apprentices to be absorbed as skilled artisans.
4. Diesel Loco Pilots to be trained as Loco Pilots of electric locos and EMUs.
5. Artisans and supervisory staff to undergo Refresher Courses.
6. Running staff to be posted as TLCs etc.

31203 Initial Training

1. Categories of staff mentioned below should be imparted initial training in a training establishment before they are posted to working posts—
   a. Directly recruited supervisors.
   b. All categories of running staff, whether directly recruited or absorbed from steam/diesel sections.
   c. Skilled and semi-skilled artisan staff for maintenance.
   d. Any other category to be approved by PCEE.
2. The period of initial training for typical categories is given IN PARA 31214, which may be modified by PCEE in accordance with local requirements.

3. In addition to theoretical training, the trainees should receive thorough practical training on the work they will have to perform on completion of training. In all cases they should have a period as under-study to senior and experienced staff in Actual execution of the type of work they have to perform on completion of training.
4. For artisan staff the practical training should be oriented to enable them to understand and be able to carry out independently skilled work of the type covered by 'inspection books', 'inspection charts', 'trouble-shooting charts' and "technical charts'.

31204 Promotional Courses

1. No employee can be promoted unless he passes the trade test or other prescribed departmental test. The purpose of the semi-skilled category is to enable a man to study under the skilled man and take the trade test in due course.
2. When an employees is promoted, he should, as a rule, receive a of training to enable him to discharge his responsibilities in the higher post e.g., a semi-skilled fitter on promotion as a skilled fitter. Such training should precede the departmental tests to determine suitability for promotion. The training should be generally on the same lines as initial training, but the period in most cases can be curtailed since the employee would already have a certain amount of background knowledge on account of his experience.
3. Particular attention should be paid to the older candidate, who although very proficient in the practical aspects of their work, are unable to pass the prescribed trade tests etc. in regard to the theoretical aspects because of their poor educational background. It often happens in consequence that they are blocked for promotion although they are fit for promotion in every other respect. By paying individual attention to such men and teaching them elementary theory, they could be made sufficiently proficient to pass the trade tests in full. This not only ends their frustration, but boosts up staff morale as a whole.

31205 Refresher Courses

1. In accordance with instructions current on the subject, refresher courses should be arranged. This is obligatory for those categories of staff dealing with "safety of train operation or having daily contacts with the public". The following is an illustrative list of staff coming within the scope of these instructions:-

   Loco Pilots, Asst. Loco Pilots, Motormen, Shunters, Engine Turners,

   Supervisors and Artisans responsible for examination and certification of fitness of running gear of locos and EMUs.

   TLCs and Driving Inspectors

2. Similar refresher courses are also desirable for other categories of maintenance staff. The categories of staff for whom refresher courses are to be arranged can be decided by the General Manager in accordance with para 117(a) of the Indian Railway Establishment Manual.
3. The object of the refresher courses is to reinforce the knowledge of the staff and bring them up-to-date in regard to the latest rules and procedures and instructions regarding operation and maintenance in the light of operating experience. The duration of the refresher course for each category may be decided by PCEE to suit local conditions. The duration for typical categories is given below for guidance—

   a. Supervisors — 2 weeks
   b. Loco Pilot, Asst. Loco Pilot — 3 weeks
   c. Artisan Staff — 2 weeks

4. For categories of staff liable for inter-divisional transfers, programming of refresher courses should be arranged by the headquarters office. For staff confined to a particular division, the programming should be done at the divisional level.
5. Apart from rules and regulations, the refresher courses for running staff should lay emphasis on troubleshooting procedures for various types of locos and EMUs. Loco Pilots have to deal with some types of failures only rarely and hence they tend to forget the details. Though such details are given in the Trouble-Shooting Manuals, actual drilling during the refresher course will be of great benefit. This involves repetition of the same exercise several times so as to make a lasting impression and not to be forgotten easily.
6. During the refresher courses, it will be very useful to arrange group discussions amongst the trainees on specific problems encountered during the course of work. Such group discussions will be of great assistance in view of the opportunity for exchange of information based on actual experience in working.

31206 Facilities for Training

1. Facilities have been provided on an All India basis for the intensive specialized training of officers and staff of the Electrical Department. In addition the facilities available with the different Zonal Railways have to be utilized to best advantage.
2. Training schools for Loco Pilots are attached to major electric loco sheds. These schools should be used to a limited extent for training of artisan staff and supervisors. Apart from cut-models, charts, circuit diagrams etc. the training schools should contain "simulators' to demonstrate the functioning of locos, the circuit combinations resulting from operation of the master controller etc. These simulators should be used to drill the trainees in the correct method of operation and systematic trouble-shooting.
3. The 'simulator' provided consists of the HT and LT control apparatus as provided in the locos and working models of items such as pantograph, tap-changer etc. A driving cab similar to the cab in a loco is available, complete with master controller, brake controller, control switches, gauges, indicator lamps etc. From this driving position the equipment in the simulator can be operated to demonstrate the functioning of the various components. By actually handling the controls, the trainees can learn the correct sequence of operation and get a 'feel' of the equipment as actually functioning.

   The Instructor can reproduce faults similar to those occurring in actual practice e.g., tripping of circuit breaker due to overload, earth faults, traction motor faults etc. The trainees can get familiar with the correct method of trouble-shooting as detailed in the trouble-shooting directory and by repeated practice become fully acquainted with the correct procedure.
4. In any traction training establishment, the essential equipment to be provided for instructional purposes should include the following:-
   a. Special tools and instruments used in electric traction.
   b. Cut-models to show constructional details of equipment.
   c. Circuit diagrams, sectionalising diagrams, etc., preferably illuminated and arranged to show the sequence of operations.
   d. Samples of damaged equipment with tablets explaining the nature of failures and preventive checks.
   e. Publicity boards with slogans and illustrations emphasizing safe methods of working.
   f. Boards illustrating 'Do's' and 'Don'ts'.
   g. Preferably full working models.

31207 Training in General and Subsidiary Rules

Electric running staff as well as supervisors, when required, should receive initial training as well as refresher courses in General and Subsidiary Rules normally in the Zonal Transportation Schools, which usually have excellent model rooms to facilitate the proper understanding of the rules and systems of working. In exceptional cases when such training cannot be arranged conveniently in the Zonal Schools, PCEE may authorize the training in GRs & SRs to be included in the syllabus for training in Loco Training Schools. Separate Instructors well-versed in the subject should, however, be provided invariably.

31208 Responsibility of Officer and Supervisors

Apart from those in-charge of training establishments, other of officers and supervisors in- charge of operation and maintenance should also take a keen personal interest in the training of all grades of staff attached to them. They should deem it as part of their duty to guide the trainees and watch their progress. Training is a continuous process which helps the officers as much as the trainees not only in developing contacts on a personal level, but also in understanding the finer points of operation and maintenance. A record of progress achieved, the period of training given etc. should be maintained for every trainee.

31209 Examination at the end of Training

All trainees should pass prescribed examination on completion of training. The scope of examination and the level of officers and supervisor responsible for examining will be laid down by PCEE. The examination should have a practical bias. The examination of Loco Pilots, for instance, should include practical tests in trouble shooting as well as correct driving and techniques.

31210 Specialized Training

1. Selected supervisors and officers from the user Railways should be deputed to CLW and ICF to be associated with the production of each batch of electric loco and EMU stock. Such association of the maintenance staff at the production stage will be of great help in giving them an insight into constructional details of the equipment.
2. Similarly when large contracts are entered into for supply of electric traction equipment incorporating new designs and technology, it is usual practice to include in the contract a clause which permits some staff of the consignee Railways to be deputed to the manufacturer's works during the production stage for practical training on the equipment, so that they may get thoroughly acquainted with the operation and maintenance of the equipment, taking advantage of the training facilities available with the contracting firms.

31211 Syllabi

Guidelines for syllabus of two categories of staff are given below. Syllabus on the same lines shall be prepared for all training courses.

1. Loco Pilots Grade 'C (Conversion from Steam/Diesel) Duration: 20 weeks.

A. Theoretical:

a. Basic principles of electricity - clear understanding about voltage, current, power, resistance etc. - use of electrical measuring instruments for measuring voltage, current and insulation resistance - clear concept of ac and dc simple electrical circuits.

b. Principles of ac and dc generators, transformers, rectifying devices - tap-changers, lead acid and alkaline cells, relays, magnetic and pneumatic contactors.

c. Study of power and control circuits of different types of locos used in hauling freight trains -familiarization with the names, symbols and physical location of all equipment.
d. Essential details of mechanical equipment of different types of locos used in freight trains.
e. Details of pneumatic and brake equipment.
f. Procedure for preparation of locos for service - principles of driving, acceleration, speed control, use of gradient marks, procedure to be followed at neutral sections, correct use of electrical and mechanical brakes.
g. Study of rules especially applicable to electric traction.
h. Safety precautions, prevention of wheel-slip and parting.
i. Procedure for obtaining emergency power block for roof inspection.
j. Rules regarding firefighting in electrical installations and practice use of common types of fire extinguishers.
k. Study of standing instructions.

B. Practical:

a. Work with the maintenance staff to get familiar with equipment.
b. Detailed study of trouble-shooting directory for each type of loco and actual practice of each case.
c. Practice inspection of outgoing and incoming locos in shed.
d. Driving under the supervision of a senior and experienced Driver after learning road.

2. Supervisor (Electric Loco) - Direct Recruits - Degree or Diploma Holders Duration: 18 months.

A. Theoretical:

a. General principles of 25 kV traction installations and rolling stock.
b. Detailed study of mechanical and electrical details of all types of locos in the Railway including bogies and suspension, power transmission, braking system, hauling capacity, power and control circuits and details of all traction and auxiliary equipment. Become thoroughly familiar with circuit diagrams, symbols and physical location of all equipment.
c. Maintenance organization of electric loco shed - section-wise distribution of work with particular reference to responsibility of each supervisor in the shed, functioning of PPO, Maintenance schedules, inspection books, inspection chart, technical charts etc.
d. Work done during POH of loco.
e. Rolling-stock operation-outstation maintenance, loco links, control over running staff, Traction Loco Control.
f. Procedure for indenting and accountal of stores T & P Register.
g. Rules and regulations - Factories Act, HOER, Payment of Wages Act, Workmen's Compensation Act, Leave and Pass Rules, Rules for Overtime Working etc.

B. Practical

a. In the shed some time should be spent in each section to study details of maintenance carried out by designated workmen and some time to understudy the section supervisor. When attached to E1 and M1 sections, the trainee should undertake trouble-shooting independently.
b. In the POH shop, in a similar manner as above in each section.

II COMPETENCY CERTIFICATES

31212 Authorized Person

An "authorized person" is one who is duly authorized to perform specific duties pertaining to his employment, the authorization being made by an official of the Railway Administration empowered for that purpose.

31213 Competency Certificate

Each authorized person will be given a "Competency Certificate", defining the works which he is authorized to carry out after he has been trained, examined and found fit.

The following categories of rolling stock staff shall be issued with the certificates by the official indicated against each category after written/oral test as shown:

1. Asstt. Loco Pilots.	TR-10	DEE(RS)/DEE(OP) after (Elec. Loco) written, oral and practical tests as prescribed.
2. Loco Pilots (Elec. Loco)	TR-11	
3. Motorman (EMU train)	TR-12	
4. Shunter/Engine Turner	TR-13	

Psycho test: Psycho test is mandatory for

1. Initial recruitment
2. For working high speed trains, RB Letter No. 2007/Safety-I/2/8/3, dt. 2.1.2008.
3. Crew involved in SPAD as per Railway Board letter No. E (MPP)2016/19/2, dt. 9.11.2016 (RBE No. 130/2016)

Aptitude Test : Aptitude test is mandatory for single man working trains (motorman) as per Railway Board letter No. 2014/M(L)/467/3,dt. 15.10.2014

31214 Period of Training

The period of training mentioned in the following paragraphs may be modified, if considered essential by PCEE, taking local circumstances into account.

Running Staff

S. No	Training	No. of days at ZRTI	Divisional Handling (Days)	Periodicity
1.	Initial training for ALPs (Elec/Dsl) Single traction	103	20	--
2.	Initial training for ALPs (Elec+Dsl)	151	20	--
3.	Promotional course from ALP to LP(Shunting)/ LP(Goods)	60	18	--
4.	Promotional course from LP(Goods) to LP(Pass)	42	06	--
5.	Refresher course for ALPs(including 3-phase)	22		3 years
6.	Refresher course for all LPs (including 3-phase)	22		3 years
7	Initial Course for LI @	18		
8	Refresher Course for LI	6		3 years
9	Initial DR App. Motor Man	52 weeks		
10	Initial course Motorman from LP Electrical	13 weeks		

S. No	Training	No. of days at ZRTI	Divisional Handling (Days)	Periodicity
11	Initial course Motorman from LP Diesel	20 weeks		
12	Refresher Course for Motorman	12		18 Months
13	Pre-promotional Course For CLI from Motor man	18		
14	Orientation course new technology EMU Rakes	-		

Electrical Supervisors(SSE/JEs) & Staff

S. No	**COURSE**	**No. of Days**	**Periodicity**
1	Initial Training of Directly Recruited JE & SSE's (Through RRB, Compensation Ground & LDCE) including Drawing Cadre #	52 Weeks	
2	Initial Training of Promotee JE (From MCM) *	13 weeks	
3	Refresher Course of Electrical Supervisors	2 Weeks	3 years
4	Refresher Course of Drg. Cadre Supervisors	2 Weeks	5 years

Railway Board letter No. E (MPP)2012/3/1,dt. 15.12.2014 (RBE No. 143/2014)

* Railway Board letter No. E (MPP)2017/3/6 dt. 20.12.2017 (RBE No. 200/2017)

Group C & D Staff (Other than JE & SSE)

S. No	**Description**	**Duration (in Wks)**
1	Initial Course for Group 'D' all trades	02
2	Disaster Management	01
	ELECTRICAL TRD	
3	Promotional Course from Unskilled to Skilled Artisans (Technician OHE)	03
4	Promotional Course from Unskilled to Skilled Artisans (Technician PSI & RC)	03
5	lnitial Course for Apprentice Technician OHE PSI & RC (ITI)	26
6	Initial Course for Apprentice Technician OHE PSI & RC (NON-ITI)	78
7	Refresher Course for Technician OHE (Once in 5 years)	02
8	Refresher Course for Technician PSI & RC (Once in 5years)	02
9	Promotional course from Technician to Supervisors(TRD)	03
10	Refresher Course Tower Wagon Operation & Maintenance	01
	ELECTRICAL (G)	
11	Promotional Course from Unskilled to Skilled Artisans & Technician Plant (Technician Electrical)	03
12	Promotional Course from Unskilled to Skilled Artisans (Technician TL/AC)	03
13	Initial Course for Apprentice Technician (Elect) & Plant (ITI)	26
14	Initial Course for Apprentice Technician (Elect) & Plant (NON-ITI)	78
15	Initial Course for Apprentice Technician TL/AC (ITI)	
16	Initial Course for Apprentice Technician TL/AC (NON- ITI)	78
17	Refresher Course for Technician (Elect) & Technician Plant (Once in 5 Years)	02
18	Refresher Course for Technician TL/AC (Once in 5years)	02
19	Promotional course from Technician to Supervisors(Elect)	03

S. No	Description	Duration (in Wks)
20	Promotional course from Technician to Supervisors(TL/AC)	03
	ELECTRICAL LOCO	
21	Promotional Course from Unskilled to Skilled Artisans (Technician Elect Loco)	03
22	Initial Course too Apprentice 1echnician Elect Loco (ITI)	26
23	Initial Course for Apprentice Technician Elect Loco (NON-ITI)	78
24	Refresher Course for Technician Elect Loco (Once in 5years)	02
25	Promotional course from Technician to Supervisors(Elect Loco)	03
	ELECTRICAL EMU	
26	Promotional Course from Unskilled to Skilled Artisans (Technician EMU)	03
27	Initial Course for Apprentice 1echnicianEMU/MEMU (ITI)	26
28	Initial Course for Apprentice Technician EMU/MEMU (NON-ITI)	78
29	Refresher Course for Technician EMU(Once in 5years)	02
30	Promotional course from Technician to Supervisors(EMU)	03

31215 Drivers, Asstt. Drivers and Motormen

Loco Pilots, Asst. Loco Pilots and Motormen should undergo courses of training and tests indicated below before they are issued with the Competency Certificates:—

1. A prescribed course of training in General and Subsidiary Rules in the Zonal Training School or other approved training establishment followed by a written, oral and practical test.
2. A course of training as indicted in paras 31203 and 31211 in the Electric Loco School in the operation of the particular types of Locos/EMUs trainees are expected to work, including trouble-shooting procedures to be followed by written, oral and practical tests.
3. Training for a period of one month to "learn the road" in the specified section, at the end of which trainees should sign a declaration for being fully conversant with the road.
4. Practical training for a period of 2 months in the actual driving of the particular type of Loco/EMU under the supervision of a qualified Loco Pilots or Driving Instructor followed by a driving test by Sr.DEE(RS)/Sr.DEE(OP).
5. Prescribed medical examination.

Fresh training to the extent authorized by PCEE and tests as per items (2) and (4) above will be required before the employee is allowed to operate any other type of Loco/EMU.

31216 Register of Certificates

A register of Competency Certificates shall be maintained in the office of every supervisory official, as per proforma given in Annexure 12.01, showing all staff working under him who have been issued with the Certificates:

31217 Service Record

An entry should be made in the service sheet of every employee who has been issued with a Competency Certificate.

31218 Inspections

During inspections Officers and Supervisors should make it a point to check the certificates in the possession of the various staff and also test-check their knowledge of the rules pertaining to their work.

.....RAILWAY ELECTRICAL DEPARTMENT

No.....

CERTIFICATE OF COMPETENCE No.Tr-10

(For Asst. Loco Pilots of Elec. Locos)

…… (Name)……..... Is authorized to work as an Asst. Loco Pilots in the Section between and.....on the following types of Electric Locomotives:—

His /Her written declaration* dated ……..……. that he is fully familiar with the signals in the above section has been noted in issuing this certificate. He/She is NOT authorized to operate a locomotive independently. Dated……

..... DEE(RS)/DEE(OP)

* This declaration must be countersigned by Driving Inspector and personally scrutinized by the officer before issuing this certificate. Before countersigning the declaration, the Driving Inspector shall orally examine the employee for his knowledge of road.

.....RAILWAY ELECTRICAL DEPARTMENT

No.....

CERTIFICATE OF COMPETENCE No.TR-11

(For Loco Pilots of Elec. Locos)

…… (Name) ……....……. Is authorized to work as a Loco Pilots of Elec. Locomotives of the following types.....

in the section between.....and …… on Goods/ Passenger/Mail and Express trains.

His/Her written declaration* dated …….....… that he is fully familiar with the signals in the above section has been noted in issuing this certificate. Date.....

..... DEE(RS)/DEE(OP)

* This declaration must be countersigned by Driving Inspector and personally scrutinized by the Officer before issuing this certificate. Before countersigning the declaration, the Driving Inspector should orally examine the employee for his knowledge of road.

.....RAILWAY ELECTRICAL DEPARTMENT

No.....

CERTIFICATE OF COMPETENCE No. Tr-12

(For Motormen of EMU trains)

…… (Name) ……. Is authorized to work as a Motorman in the Section between .....and…… on the following types of EMU trains:—

His/Her written declaration* dated that he is fully familiar with the signals in the Section has been noted in issuing this certificate. Dated.....

..... DEE(RS)/DEE(OP)

* This declaration must be countersigned by Driving Inspector and personally scrutinized by the Officer before issuing this certificate. Before countersigning the declaration, the Driving Inspector should orally examine the employee for his knowledge of road.

.....RAILWAY ELECTRICAL DEPARTMENT

No.....

CERTIFICATE OF COMPETENCE No.TR-13

(For Shunters/Engine Turners of Elec. Locos and EMUs)

…… (Name) ……..……. Is authorized to work as a Shunter/Engine Turner of Electric Locos/EMU trains in the electrified yards and sidings of the section between..... and.....

His/Her written declaration* dated ……..…… that he is fully familiar with the signals in the above yards and sidings has been noted in issuing this certificate.

He/She is NOT authorized to operate Electric Locos/EMUs outside the limits of the above yards and sidings.

Dated.....

..... DEE(RS)/DEE(OP)

* This declaration must be countersigned by Driving Inspector and personally scrutinized by the Officer before issuing this certificate. Before countersigning the declaration, the Driving Inspector shall orally examine the employee for his knowledge of road.

Annexure 12.01

Proforma of Competency Certificates

Name	Designation	Certificate No.	Date of test and issue	Name of the official who conducted the test	Station where the employee is posted		Date of periodic check	Remarks

उपबन्ध -I
APPENDIX-I

विद्युत इंजन पुर्जों के कूट लघु नाम
CODE ABBREVIATIONS FOR ELECTRIC LOCO COMPONENTS

कूट लघु नाम CODE ABBREVIATION	मद	ITEM
A 1/1-1/2	कैब-1 के लिए ऐमीटर	Ammeters for cab-1
A 2/1-2/2	कैब-2 के लिए ऐमीटर	Ammeters for cab-2
AF	वायु बहाव संसूचक	Air flow indicator
ARNO	आर्नो परिवर्तक	Arno converter
ASMGR 1	टैपचेंजर 10° टैप की वायु मोटर पर सहायक संपर्क	Auxiliary contacts on the air motor of the tap changer 10° tap.
ASMGR 2	टैपचेंजर 90° टैप की वायु मोटर पर सहायक संपर्क	Auxiliary contacts on the air motor of the tap changer 90° tap.
ATFEX	ब्रेकन ऊर्जन के लिए ट्रांसफार्मर	Transoformer for breaking excitation
BA	बैटरी	Battery
BCR 1-2	वात ब्रेक हौज़ दाब के लिए बज़र	Buzzer for air breake reservoir pressure
BL 1-2	कैब 1, कैब 2 स्विच बक्सों पर सहायक संपर्क	Auxiliary contacts on the switch boxes cab 1, cab 2.
BL 1-2 CP	स्वचल संपीड़क स्विच	Automatic copressor switch
CPD	संपीड़क सीधा स्विच	Copressor direct switch
DJ	उच्च वोल्टता परिपथ वियोजक स्विच	High voltage circuit breaker switch
PRR	पश्च शीर्ष बत्ती	Rear head light
LF	मार्कर और डेस्क लैम्प	Marker & Desk's Lamps
LM	डिब्बा लैम्प स्विच	Compartment Lamp switch
PR	शीर्ष बत्ती मन्दन स्विच	Head Light dim switch
PRF	अग्र शीर्ष बत्ती स्विच	Front head light switch
PV	निर्वात पम्प स्विच	Vacuum pump switch
QPV	कैब 1, 2 रेचकों के लिए उच्च गति के लिए स्विच	Switch for high speed of the Exhausters cab 1, cab 2.
RA	तापन स्विच	Heating switch
RDJ	उच्च वोल्टता परिपथ वियोजक रीसैटिंग स्विच	High voltage circuit breaker resetting switch
SN	न्यूट्रल सैक्शन स्विच	Neutral section Switch
VMT	कर्षण मोटर ब्लोअर स्विच	Traction motors blowers switch
ZLF	मार्कर लाल और सफेद बत्ती स्विच	Marker (red & white) lamps switch
BP1DJ	डीजे आरंभ परीक्षण के लिए पुश बटन	Push button for testing DJ opening
BP2DJ	डीजे बन्द परीक्षण के लिए पुश बटन	Push button for testing DJ closing

कूट लघु नाम CODE ABBREVIATION	मद	ITEM
BPLSGE	VSGE परीक्षण के लिए पुशबटन	Push button for testing VSGE
BPPI-2	GR मोटर अनुक्रम में प्रचालन पुशबटन	Push button operating GR motor in progression
BPQ 100	Q 100 के लिए पुशबटन	Push button for Q 100
BPRI-2	GR मोटर विलोमक्रम में प्रचालन पुशबटन	Push button operating GR motor in regression
BV	HOM स्विच के लिए सहायक संपर्कित्र	Auxiliary Contacts of HOM Switch
BVGR 1-2	सतर्कता नियंत्रण के लिए बज़र	Buzzer for vigilance control
BPT	सिगनल लैम्प के आत्म परीक्षण के लिए पुशबटन	Push button for self check of signal lamps
C 101	संपीड़क मोटर के लिए त्रि-ध्रुव संपर्कित्र	3-Pole contactor for motor compressor
C 105	कर्षण मोटर ब्लोअर न. 1 के लिए त्रि-ध्रुव संपर्कित्र	3-Pole contactor for the Traction Motor Blower No. 1
C 106	कर्षण मोटर ब्लोअर न. 2 के लिए त्रि-ध्रुव संपर्कित्र	3-Pole contactors for the Traction Motor Blower No. 2
C 107	ट्रांसफार्मर तेल शीतक ब्लोअर के लिए त्रि-ध्रुव संपर्कित्र	3-Pole contactors for the transformer oil cooler blower
C 111	रेचक न. 1 के लिए त्रि-ध्रुव संपर्कित्र	3-Pole contactors for exhauster No. 1
C 118	आर्मो प्रवर्तक संपर्कित्र	Amo starting contactor
C 121	रेचक न. 2 के लिए त्रि-ध्रुव संपर्कित्र	3-Pole contactors for exhauster No. 2
C 145	ब्रेकन ऊर्जन संपर्कित्र	Braking excitation contactor
CCA	सहायक नियंत्रण परिपथ के लिए फ्यूज	Fuse for aux. control circuit
CAPTFWA 1-2	TFWA के लिए संधारित्र	Condenser for TWFA
CAPTFP 1-2	TFP के लिए संधारित्र	Condenser for TFP
CAPTFP 3-6	TFP टर्मीनलों a 3- a 6 के लिए संधारित्र	Condensers for TFP terminals a3-a6
CAPVS	VSGE के लिए संधारित्र	Condensers for VSGE
CCBA	बैटरियों के लिए फ्यूज	Fuse for batteries
CCCHBA	बैटरी चार्जर के लिए फ्यूज	Fuse for batteries charger
CCGE	जनित्र के लिए फ्यूज	Fuse for Generator
CCDJ	MTDJ या MTDJ परिपथों के लिए फ्यूज	Fuse for EFDJ or MTDJ circuits
CCLC	कैब गलियारा H.T. कम्पार्टमेंट बत्ती और दीवार सौकेट	Fuse for Cab corridor H.T. Compartment Lighting and Wall Sockets
CCLF 1-2	मार्कर और पीसी लैम्पों के लिए फ्यूज	Fuse for Marker and PC/Lamps
CCPT	नियंत्रण परिपथों के लिए फ्यूज	Fuse for control circuits
CCRA 1-2	कैब हीटरों के लिए फ्यूज	Fuse for Cab Heaters
CCRT	RTPR के लिए फ्यूज	Fuse for RTPR
CCLS	संकेतन परिपथ के लिए फ्यूज	Fuse for signalling circuit
CCLSA	वात ब्रेक संकेतन परिपथ के लिए फ्यूज	Fuse for air brake signalling circuit
CCTFS	सेल्सिन ट्रांसफार्मर के लिए फ्यूज	Fuse for Selsyn Transformer
CCUA	वोल्टामीटर UA 1-2 के लिए फ्यूज	Fuse for Voltmeter UA 1-2

कूट लघु नाम CODE ABBREVIATION	मद	ITEM
CCVT	कैब पंखा मोटरों के लिए फ्यूज	Fuse for Cab Fan Motors
CGR 1-2-3	टैप चेंजर संपर्कित्र	Tap Changer contactors
CHBA	स्थिर बैटरी चार्ज़र	Static battery charger
CP 1-2-3	मुख्य संपीड़क	Main Compressors
CPA	सहायक संपीड़क	Auxiliary Compressor
CTF 1-2-3	कर्षण ब्रेकन प्रतीपक	Traction Braking Inverser
DJ	उच्चवोल्टा परिपथ वियोजक	High Voltage circuit breaker
DMVSI 1-2	दिष्टकारी ब्लोअर मोटर 1 और 2 के लिए बचाव स्विच	Protection Switch for Rectifier Blower Motor 1 & 2
ECC	फ्यूज टेस्टर	Fuse Tester
EFDJ	उच्च वोल्टता परिपथ वियोजक को बन्द करने के लिए इलैक्ट्रोवाल्व	Electrovalve for the closing fo the high voltage circuit breaker
ELM	ऊर्जन के लिए धारा ट्रांसफार्मर	Current Transformer for excitation
ET 1	छत प्रोत्कर्ष निरोधक	Roof Surge Arrester
ET 2	छत बुशिंग प्रोत्कर्ष निरोधक	Roof bushing's surge arrester
ETTFP 1-2	प्रोत्कर्ष निरोधक ट्रांसफार्मर पावर कुंडलन के लिए	Surge Arrester for Transformer Power Winding
EVPHGR	जीआर तेल लैम्प के लिए इलैक्ट्रोवाल्व	Electrovalve for GR Oil Pump
GCR	वात ब्रेक हौज दाब के लिए गवर्नर	Governor for air brake reservoir pressure
GR	टैपचेंजर	Tap Changer
GE	जनित्र	Generator
HBA	बैटरी विलगन स्विच	Battery Isolating Switch
HCP	संपीड़क मोटर संपर्कित्र के लिए वियोजक स्विच	Disconnecting Switch for Compressor Motor Contactor
HOBA	बैटरी भूसंपर्क यंत्र के लिए चेंज-ओवर स्विच	Changeover Switch for Battery Earthing Device
HOM	लोको भूसंपर्कन स्विच	Loco Earthing Switch
HPH	तेल पम्प मोटर के लिए वियोजक स्विच	Disonnecting Switch for Oil Pump Motor
HPT 1	पेंटोग्राफ 1 के लिए छत विलगन	Roof Isolating Switch for Pantograph 1
HPT 2	पेंटोग्राफ 2 के लिए छत के लिए विलगन	Roof Isolating Switch for Pantograph 2
HQOA	सहायक परिपथ के भूसंपर्कन के लिए चेंज ओवर स्विच	Changeover Switch for Auxiliary Circuuit's Earthing Relay
HMCS	हाथ प्रचालित मोटर कटआउट स्विच	Hand Operated Motor Cut out Switch
HGE/HQCVAR	जनित्र के लिए विलगन स्विच	Isolating Switch for Generator
HQOP 1-2	मुख्य परिपथ के भूसंपर्कन रिले के लिए चेंजओवर स्विच	Changeover Switch for Main Circuit's Earthing Relay
HQPDJ	QPDJ के लिए शंटिंग स्विच	Shunting Switch for QPDJ
HSMGR	SMGR के लिए स्विच	Switch for SMGR
HUBA	UBA के लिए चेंजओवर स्विच	Changeover Switch for UBA

कूट लघु नाम CODE ABBREVIATION	मद	ITEM
HVMT 1-2	कर्षण मोटर ब्लोअर संपर्कित्र के लिए वियोजक स्विच	Disconnecting Switch for Traction Motor Blower Contactors
HVRH	तेल शीतक ब्लोअर मोटर के लिए वियोजक स्विच	Disconnecting Switch for Oil Cooler Blower Motor
HVSI 1-2	दिष्टकारी ब्लोअर के लिए चेंजओवर स्विच	Changeover Switch for Rectifier Blower
HVSL 1-2	समकारी प्रतिघातक ब्लोअर मोटर के लिए वियोजक स्विच	Disconnecting Switch for Smoothing Reactor Blower Motor
J 1-3	कर्षण मोटर दोहरा प्रतीपक	Traction Motor Double Reverser
L 1-6	कर्षण मोटरों के लिए लाइन संपर्कित्र	Line contactors for traction motors
LA 1-1/1-2	कैब 1 के एमीटरों के लिए लैम्प	Lamps for the ammeters of Cab. 1
LA 1-2/2-2	कैब 2 के लिए एमीटरों के लिए लैम्प	Lamps for the ammeters of Cab. 2
LBL 1-1/1-2	स्विच बक्स बी एल 1 के लिए लैम्प	Lamps for switches box BL 1
LC 1-1/1-2	कैब 1 के लिए छत बत्ती	Ceiling lamp for cab. 1
LC 2-1/2-2	कैब 2 के लिए छत बत्ती	Ceiling lamp for cab. 2
LECC	फ्यूज परीक्षक लैम्प	Fuse tester lamp
LE 1-2	एसी 2 पेनल बत्ती	AC-2 panel light
LE 3-4	प्रवेश मार्ग बत्ती	Entrance light
LF 1/D-2/G	मार्कर बत्तियां कैब 1 (दायें और बायें)	Marker lights cab 1 (right & left)
LF 2/D-1/G	मार्कर बत्तियां कैब 2 (दायें और बायें)	Marker lights cab 2 (right & left)
LM 1-6	गलियारा बत्तियां	Corridor lights
LM 7 & 9	एच टी कम्पार्टमेंट बत्ती	H.T. compartment light
LP 1-6	माप यंत्र बत्तियां	Instrument lightings
LSAF 1-2	वायु बहाव सूचक लैम्प	Air flow indicator lamp
LSBCR 1-2	वात ब्रेक हौज दाब सूचक लैम्प	Air brake reservoir pressure indicator lamp
LSCHBA 1-2	स्थिर बैटरी चार्जर के लिए संकेतन लैम्प	Signalling lamp for static battery charger
LSDJ 1-2	उच्च वोल्टता परिपथ वियोजक संकेतन लैम्प (लाल)	High voltage circuit-breaker signalling lamp (red)
LSGE 1-2	जनित्र के लिए संकेतन लैम्प	Signalling lamp for Generator
LSGR 1-2	टैपचेंजर जीरो संकेतन लैम्प (नीली)	Tap Changer zero signalling lamp (blue)
LS Group 1-2	कैब में रिकैपीचुलेशन बत्ती (लाल)	Recapitulation lamp in cab (red)
LSOL 1-2	ड्राइवर डेस्क पर रिकैपीचुलेशन बत्ती (नीली)	Recapitulation lamp on driver's desk (blue)
LSP 1-2	स्लिपिंग संकेतन लैम्प (पीली)	Slipping singnalling lamp (yellow)
LSR 1-2	रनिंग और ब्रेकन नियंत्रण परिपथ संकेतन लैम्प (बैंगनी)	Running and braking control circuit signalling lamp (violet)
LSRSI 1-2	दिष्टकारी संकेतन लैम्प (सफेद)	Rectifier signalling lamp (white)
LSTR 1-2	संक्रमण संकेतन लैम्प	Transition signalling lamp
LSVGR 1-2	सतर्कता नियंत्रण के लिए संकेतन लैम्प	Signalling lamp for vigilance control
LTBA	बैटरी प्रोत्कर्ष निरोधक	Battery surge arrester

कूट लघु नाम CODE ABBREVIATION	मद	ITEM
LU 1-2	U 1-2 वोल्टमीटर के लिए लैम्प (कर्षण मोटर वोल्टता)	Lamp for voltmeter U 1-2 (Traction Motor voltage)
LUA 1-2	UA 1-2 वोल्टमीटर के लिए लैम्प	Lamp for voltmeter UA 1-2
M 1-6	कर्षण मीटर 1-6	Traction meter 1-6
MCP 1-3	मुख्य संपीड़क मोटर	Main compressor motor
MCPA	सहायक संपीड़क मोटर	Auxiliary compressor motor
MF 1-6	कर्षण मोटर 1-6 के लिए मेन फील्ड	Main field for traction motor 1-6
MP 1-2	मास्टर नियंत्रक कैब 1-2	Master Controller cab 1-2
MPF 1-2	ब्रेकन नियंत्रक	Braking Controller
MPH	तेल पम्प मोटर	Oil pump motor
MPJ 1-2	मास्टर नियंत्रक के लिए रिवर्सर	Reverser of the master Controller
MPS 1-2	मास्टर नियंत्रक का क्षेत्र मंदन नियंत्रक	Field weakening controller of the master controller
MPV 1-2	निर्वात पम्प (रेचक) मोटर 1-2	Vacuum pump (exhauster) motor 1-2
MTDJ	उच्च वोल्टता परिपथ वियोजक इलैक्ट्रोवाल्वधारी	High voltage circuit-breaking holding electrovalve
MVMT 1-2	कर्षण मोटर ब्लोअर के लिए मोटर	Motor for traction motor blower
MVRF	ब्रेकन प्रतिरोधक ब्लोअर के लिए मोटर	Motor for Braking resistor blower
MVRH	तेल शीतक ब्लोअर के लिए ब्लोअर मोटर	Blower motor for oil cooler blower
MVSI 1-2	सिलीकन दिष्टकार ब्लोअर मोटर	Silicon rectifier blower motor
MVSL 1-2	समकारी प्रतिघातक के लिए ब्लोअर मोटर	Blower motor for smoothing reactor
MVT 1/1-1/2	कैब पंखा मोटरें कैब 1	Cab fan motors cab 1
MVT 2/1-2/2	कैब पंखा मोटरें कैब 2	Cab fan motors cab 2
P	रेलइंजनों के बीच संबंधनों के लिए युग्मक	Couplers for connections between the locomotives
PCLX 1-3	दीवार सौकेट	Wall socket
PH	तेल पम्प	Oil pump
PR 1-2	शीर्षबत्ती कैब 1, कैब 2	Head light Cab 1, Cab 2
PSA 1-2	सैंडिंग इलैक्ट्रोवाल्व पैडल	Sanding elctrovalve pedal
PT 1-2	पैंटोग्राफ 1 और 2	Pantograph 1 & 2
PV 1-2	रेचक 1-2	Exhauster 1 & 2
PVEF 1-2	लोको ब्रेक विलोपन के लिए पैडल स्विच	Pedal switch for loco brake elimination
Q 20	अति वोल्टता रिले	Over voltage relay
Q 30	शून्य वोल्टता रिले	No-voltage relay
Q 44	उच्च वोल्टता परिपथ वियोजक ट्रिपिंग रिले	High voltage circuit-breaker tripping relay
Q 45	परिपथ वियोजक रीसैटिंग रिले	Circuit breaker resetting relay
Q 46	टेप चेंजर रक्षण रिले	Tap-changer protection relay
Q 47	रेचक मोटरों के लिए उच्च गति के लिए रिले	Relay for high speed for the exhuster motor
Q 48	स्लिपिंग यंत्र अन्तराल और संकेतन रिले	Slipping device time-lag and signalling relay

कूट लघु नाम CODE ABBREVIATION	मद	ITEM
Q 49	तुल्यकालिक युक्ति रिले	Synchronizing device relay
Q 50	नियंत्रण J, CTF, C 145 और DJ के लिए रिले	Relay for control J, CTF, C 145 & DJ
Q 51	सहायक रिले स्लिपिंग साधन	Auxiliary relay slipping device
Q 52	खांचा से खांचा रिले	Notch to notch relay
Q 100	बहु प्रचालन में C 118 संपर्कित्र के सहायक की अन्तर्पाशन रिले	Interlocking relay of the auxiliaries to the C 118 contactors in multiple operation
Q 118	नियंत्रण रिले के स्थान पर अन्तराल रिले	Time-lag relay superseding control relay
QCVAR	आर्नो के लिए लोड रक्षण रिले	Load protection relay for Arno
QE	ब्रेकन उत्तोजन के लिए अधिलोड रिले	Overload relay for braking excitation
QD 1-2	स्लिपिंग युक्ति व्यवकलोय रिले	Slipping device differential relay
QLM	उच्च वोल्टता अधिलोड रिले	High voltage overload relay
QOA	सहायक परिपथ भूसंपर्कन रिले	Auxiliary circuit earthing relay
QOP 1-2	मुख्य परिपथ-भूसंपर्कन रिले	Main circuit earthing relay
QPDJ	दाब स्विच	Pressure switch
QPH	तेल बहाव सूचक रिले	Oil flow indication relay
QPR 1-2	शीर्ष बत्ती के लिए रिले	Relay for head light
QF 1-2	ब्रेकन के लिए अधिलोड रिले	Overload relay for braking
QRSI 1-2	सिलीकन दिष्टकारी के लिए अधिलोड रिले	Over load relay for silicon rectifier
QTD 100	Q 100 के लिए समय विलम्ब रिले	Time delay relay for Q 100
QTD 105	C 105 के लिए समय विलम्ब रिले	Time delay relay for C-105
QTD 106	C 106 के लिए समय विलम्ब रिले	Time delay relay for C-106
QV 60	उच्च वोल्टता परिपथ वियोजक संकेतन रिले	High voltage circuit-breaker signalling relay
QV 61	बैटरी चार्जर संकेतन रिले	Battery charger signalling relay
QV 62	टैपचेंजर संकेतन रिले	Tap-changer signalling relay
QV 64	नियंत्रण परिपथ संकेतन रिले	Control circuit signalling relay
QV 63	दिष्टकारी ग्रुप संकेतन रिले	Rectifier group signalling relay
QVLSOL	पुनरावर्तन लैम्पों के लिए रिले	Relay for recapitulation lamps
QVMT 1-2	कर्षणमोटर ब्लोअर 1-2 के लिए वायु बहाव सूचक रिले	Air flow indication relay for traction motor blower 1-2
QVSL 1-2	समकारी प्रतिघातक ब्लोअर के लिए वायु बहाव सूचक रिले	Air flow indication relay for smoothing reactor blower
QVRH	ट्रांसफार्मर तेले शीतक ब्लोअर के लिए वायु बहाव सूचक रिले	Air flow indication relay for transformer oil cooler blower
QVSI 1 & 2	दिष्टकारी ब्लोअर प्रतिरक्षी रिले	Rectifier blower protective relay
QWC	वज़न प्रतिपूर्ति रिले	Weight compensation relay
R 118	आर्नो परिवर्तित्र के लिए प्रवर्तन प्रतिरोध	Starting resistance for arno converter
RA 1/1-1/2	कैब हीटर कैब 1	Cab heater Cab 1
RA 2/1-2/2	कैब हीटर कैब 2	Cab heater Cab 2

कूट लघु नाम CODE ABBREVIATION	मद	ITEM
RC 118	C 118 के लिए प्रतिरोधक	Resistance for C 118
RCAPTFP	TFP के लिए प्रतिरोधक	Resistance for TFP
RF 1-6	ब्रेकन प्रतिरोध	Braking resistance
RGAF	वायु बहाव मापक गवर्नर	Air flow measuring governor
RGR	टैप चेंजर प्रतिरोध	Tap changer resistance
RGCP	संपीड़क नियामक	Compressor regulator
RHOBA	बैटरी भूसंपर्कन युक्ति प्रतिरोध	Battery earthing device resistance
RPGR	टैप चेंजर रक्षी प्रतिरोध	Tap changer protective resistance
RPQOP	QOA के लिए प्रतिरोध	Resistance for QOA
RPQOP 1-2	QOP 1-2 के लिए प्रतिरोध	Resistance for QOP 1-2
RPS 1-6	मोटर 1-6 के लिए स्थायीक्षेत्र मंदन प्रतिरोध	Permanent field weakening resistance for motor 1-6
RQCVAR A & B	QCVAR (DC) के लिए सीमान्त प्रतिरोध	Limiting resistance for QCVAR (DC)
RQ 20	Q 20 के लिए सीमान्त प्रतिरोध	Limiting resistance for Q 20
RQ 30	Q 30 के लिए सीमान्त प्रतिरोध	Limiting resistance for Q 30
RQ 46	Q 46 के लिए सीमान्त प्रतिरोध	Limiting resistance for Q 46
RQ 47	Q 47 के लिए सीमान्त प्रतिरोध	Limiting resistance for Q 47
RQ 48	Q 48 के लिए सीमान्त प्रतिरोध	Limiting resistance for Q 48
RQ 49	Q 49 के लिए सीमान्त प्रतिरोध	Limiting resistance for Q 49
RQ 50	Q 50 के लिए सीमान्त प्रतिरोध	Limiting resistance for Q 50
RQ 51	Q 51 के लिए सीमान्त प्रतिरोध	Limiting resistance for Q 51
RQ 52	Q 52 के लिए सीमान्त प्रतिरोध	Limiting resistance for Q 52
RQ 100	Q 100 के लिए सीमान्त प्रतिरोध	Limiting resistance for Q 100
RQOA	सहायक परिपथ भूसंपर्कन प्रतिरोध	Earthing resistance, aux. circuit
RQOP 1-2	पावर परिपथ भूसंपर्कन प्रतिरोध	Earthing resistance, Power Circuit
RQPR 1-2	रिले QPR 1-2 प्रतिरोध	Relay QPR 1-2 resistance
RQV 63	QV 63 के लिए सीमान्त प्रतिरोध	Limiting resistance for QV 63
RQWC	QWC के लिए सीमान्त प्रतिरोध	Limiting resistance for QWC
RS 1-2	विद्युत संपर्क सहित आपाती कॉक	Emergency cock with electrical contact.
RS 11, 12, 13 21, 22, 23 31, 32, 33 41, 42, 43 51, 52, 53 61, 62, 63	क्षेत्र मंदन प्रतिरोध	Field weakening resistances
RSI 1-2	सिलीकन दिष्टकारी कक्षक 1-2	Silicon rectifier cubicle 1-2
RSILM 1-2	दिष्टकारी धारा ट्रांसफार्मर	Rectifier current transformer
RTPR	शीर्षबत्ती वोल्टता स्थिरकारी	Head light voltage stabiliser
RU 1-2	वोल्टमीटर के लिए प्रतिरोध	Resistance for Voltmeter

कूट लघु नाम CODE ABBREVIATION	मद	ITEM
VGR 1-2	सर्तकता नियंत्रण साधन	Vigilance control device
VMT 1-2	कर्षण मोटर के लिए ब्लोअर	Blower for traction motor
VRF	ब्रेकन प्रतिरोध के लिए ब्लोअर	Blower for braking resistance
VRH	तेल शीतक के लिए ब्लोअर	Blower for oil cooler
VS	ब्लाकिंग डायोड	Blocking diodes
VSGE	बैटरी चार्जिंग ब्लाकिंग डायोड	Battery charging blocking diode
VSI 1-2	सिलकन दिष्टकारी के लिए ब्लोअर	Blower for silicon rectifier
VSL 1-2	समकारी प्रतिघातक के लिए ब्लोअर	Blower for smoothing reactor
VT 1/1-1/2	कैब 1 कैब पंखा	Cab 1 Cab fan
VT 2/1-2/2	कैब 2 कैब पंखा	Cab 2 Cab fan
ZCPA	सहायक संपीड़क के लिए स्विच	Switch for aux. compressor
ZLC 1-2	कैब बत्ती के लिए स्विच	Switch for cab light
ZLE 1-3	प्रवेश और एसी 2 पेनल लैम्पों के लिए स्विच	Switch for entrance & AC2 panel lamps
ZPT 1-2	पेंटोग्राफ के वरण के लिए स्विच	Switch for selection of the pantograph
ZPV	रेचक के वरण के लिए स्विच	Switch for selection of the exhauster
ZRT	RTPR के लिए स्विच	Switch for RTPR
ZSM-GR	टैपचेंजर वायु मोटर के वैद्युत और वात एवं बिजली प्रदाय के लिए स्विच	Switch for electrical and pneumatic feeding of the tab changer air motor
ZSM-S	GR वायु मोटर के लिए नियंत्रण परिपथ की सहायता हेतु पैको स्विच	Pacco switch to help control circuits for GR air motor
ZVT 1-2	कैब पंखों के लिए स्विच	Swtich for Cab fans

कूट लघु नाम CODE ABBREVIATION	मद	ITEM
VGR 1-2	सर्तकता नियंत्रण साधन	Vigilance control device
VMT 1-2	कर्षण मोटर के लिए ब्लोअर	Blower for traction motor
VRF	ब्रेकन प्रतिरोध के लिए ब्लोअर	Blower for braking resistance
VRH	तेल शीतक के लिए ब्लोअर	Blower for oil cooler
VS	ब्लाकिंग डायोड	Blocking diodes
VSGE	बैटरी चार्जिंग ब्लाकिंग डायोड	Battery charging blocking diode
VSI 1-2	सिलकन दिष्टकारी के लिए ब्लोअर	Blower for silicon rectifier
VSL 1-2	समकारी प्रतिघातक के लिए ब्लोअर	Blower for smoothing reactor
VT 1/1-1/2	कैब 1 कैब पंखा	Cab 1 Cab fan
VT 2/1-2/2	कैब 2 कैब पंखा	Cab 2 Cab fan
ZCPA	सहायक संपीड़क के लिए स्विच	Switch for aux. compressor
ZLC 1-2	कैब बत्ती के लिए स्विच	Switch for cab light
ZLE 1-3	प्रवेश और एसी 2 पेनल लैम्पों के लिए स्विच	Switch for entrance & AC2 panel lamps
ZPT 1-2	पेंटोग्राफ के वरण के लिए स्विच	Switch for selection of the pantograph
ZPV	रेचक के वरण के लिए स्विच	Switch for selection of the exhauster
ZRT	RTPR के लिए स्विच	Switch for RTPR
ZSM-GR	टैपचेंजर वायु मोटर के वैद्युत और वात एवं बिजली प्रदाय के लिए स्विच	Switch for electrical and pneumatic feeding of the tab changer air motor
ZSM-S	GR वायु मोटर के लिए नियंत्रण परिपथ की सहायता हेतु पैक्को स्विच	Pacco switch to help control circuits for GR air motor
ZVT 1-2	कैब पंखों के लिए स्विच	Swtich for Cab fans

Appendix II

CODE ABBREVIATIONS FOR THREE PHASE LOCOMOTIVES COMPONENTS

S.No.	Abbreviation	Details
ALG	Drive Control Unit	
SLG	Converter Control Unit	
ASC	Drive Inverter Control	
NSC	Line Converter Control	
ASR	Drive Inverter	
SR	Traction Converter	
BUR	Auxiliary Converter	
CEL	Central Electronics	
CSC	Constant Speed Control	
DDA	Display Data Control	
DIA	Diagnostic Data Control	
DDS	Diagnostic Data Set	
FBV	Vehicle Bus Administrator	
FLG	Vehicle Control Unit	
HB	Cubicle Auxiliary Circuit	
MCE	MICAS-S2 Control Electronics	
MR	Machine Room	
MUB	Over Voltage Protection Unit	
Pan	Pantograph	
PP	Pneumatic Panel	
SB	Cubicle Control Circuits	
STB	Low Voltage Cubicle Control	
TE/BE	Tractive/Braking effort	
VCB	Vacuum Circuit Breaker	
ZBV	Train Bus Administrator	
MVB	MICAS Vehicle Bus	
GTO	Gate Turn Off Thyristors	
IGBT	Insulated Gate Bipolar Transistor	

उपबन्ध -III
APPENDIX-III

इएमयू पुर्जों के कूट लघु-नाम
CODE ABBREVIATION FOR EMU COMPONENTS

कूट लघु नाम CODE ABBREVIATION	मद	ITEM
ABB	वात्या परिपथ वियोजक	Air Blast Circuit Breaker
ABR	वात्या परिपथ वियोजक रिले	Air Blast Circuit Breaker Relay
ARR	वात्या परिपथ वियोजक रीसैट रिले	Air Blast Circuit Breaker Reset Relay
ABG	वात्या गवर्नर	Air Blast Governor
ASR	सहायक सप्लाई दिष्टकारी	Auxiliary Supply Rectifier
AFI to AFII	सहायक फ्यूज	Auxiliary Fuses
BIS	बैटरी विलगन स्विच	Battery Isolating Switches
BIR	बुकोल्ज़ संसूचक रिले	Buchholz Indication Relay
BUD	बुकोल्ज़ यंत्र	Buchholz Device
BF 1,2	बैटरी फ्यूज	Battery Fuses
BCC 1, BCC 2	बैटरी चार्जिंग संपर्कित्र	Battery Charging Contactors
CF	नियंत्रण फ्यूज	Control Fuse
CLR 1, CLR 2	धारा सीमा रिले	Current Limit Relay
CBR	धारा सन्तुलन रिले	Current Balance Relay
CBAR	धारा सन्तुलन सहायक रिले	Current Balance Auxiliary Relay
CC 1	मुख्य संपीड़क संपर्कित्र	Main Compressor Contactor
CC 2	सहायक संपीड़क संपर्कित्र	Auxiliary Compressor Contactor
CCB	नियंत्रण परिपथ वियोजक	Control Circuit Breaker
CR	संपीड़क रिले	Compressor Relay
CG 1	मुख्य संपीड़क गवर्नर	Main Compressor Governor
CG 2	सहायक संपीड़क गवर्नर	Auxiliary Compressor Governor
CCS	नियंत्रण पथ परिवर्तन स्विच	Control Changeover Switch
DL	पात प्रतिरोधक	Dropping Reactor
DVB	ड्राइवर ब्रेक वाल्व	Drivers Brake Valve
DMH	अचेत प्रचालन हत्था	Dead Man's Handle
EFR	भूदोष रिले	Earth Fault Relay
EFRA 2	सहायक परिपथ के लिए भूदोष रिले	Earth Fault Relay for Auxiliary Circuit
EAC	भूसंपकन संपर्कित्र	Earthing Contactor
EAS	भूसंपकन स्विच	Earthing Switch
ELR	आपाती प्रकाश रिले	Emergency Lighting Relay
GS 1	केन्द्रीय गवर्नर के लिए गवर्नर बाईपास स्विच	Governor by Pass Switch for Control Governor
GS 2	उपस्कर गवर्नर के लिए गवर्नर बाईपास स्विच	Governor by Pass Switch for Equipment Governor

कूट लघु नाम CODE ABBREVIATION	मद	ITEM
AOVR	सहायक अतिवोल्टता रिले	Aux. Over Voltage Relay
ARS	एमीटर रोटरी शंट	Ammeter Rotary Shunt
AS	एमीटर शंट	Ammeter Shunt
EFRP	भूदोष रिले पावर	Earth Fault Relay Power
ETO	भूसंपर्क	Earth
HEFRP	भूदोष रिले पावर स्विच	Switch for Earth Fault Relay Power
EFRA	सहायक परिपथ के लिए भूदोष रिले	Earth Fault Relay for Aux. Circuit
NC 1 to NC 4	ऋणात्मक संपर्कित्र	Negative Contactors
HOBA	अतिलोड रिले	Earthing Switch for Battery
OVR	बैटरी के लिए भूसंपर्क स्विच	Over Veltage Relay
PFD	स्थायी फील्ड डाइवर्ट प्रतिरोधक	Permanent Field Divert Resistor
REFRP	EFRP के लिए प्रतिरोधक	Resistor For EFRP
ROVR	OVR के लिए अनुक्रम प्रतिरोधक	Series Resistor for OVR
RPP	EFRP के लिए भू-प्रतिरोधक	Earth Resistor for EFRP
REFRA 1	EFRP सहा 1 के लिए भूसंपर्क प्रतिरोधक	Earth Resistor for EFRP Aux. 1
REFRA 2	EFRP सहा 2 के लिए भूसंपर्क प्रतिरोधक	Earth Resistor for EFRP Aux. 2
RHOBA	बैटरी भूसंपर्क स्विच के लिए प्रतिरोधक	Resistor for Battery earthing switch
RPEFRA 1	EFR सहा 1 के लिए प्रतिरोधक	Resistor for EFR Aux. 1
RPEFRA 2	EFR सहा 2 के लिए प्रतिरोधक	Resistor for EFR Aux. 2
S	स्पीडोमीटर	Speedometer
SH 1 to SH 4	मोटर 1 से मोटर 4 के लिए प्रेरक शंट	Inductive Shunt for Motor 1 to Motor 4
SU	प्रोत्कर्ष दाब यूनिट	Surge Suppression Unit

कूट लघु नाम CODE ABBREVIATION	पद	ITEM
GS 3	मुख्य संपीड़क गवर्नर के लिए गवर्नर बाईपास स्विच	Governor by Pass Switch for Main Compressor Governor
GS 4	सहायक संपीड़क गवर्नर के लिए गवर्नर बाईपास स्विच	Governor by Pass Switch for Auxiliary Compressor Governor
HEFRA 2	EFRA 2 के लिए स्विच	Switch for EFR A 2
HEFRA 1	EFRA 1 के लिए स्विच	Switch for EFR A 1
K 1	TM 1 एवं 2 के लिए विपर्यायी स्विच	Reversing Switch for TM 1 & 2
K 2	TM 3 एवं 4 के लिए विपर्यायी स्विच	Reversing Switch for TM 3 & 4
KF 1, KF 2	रेडियेटर पंखे	Radiator Fans
LA	प्रोत्कर्ष अपवर्तक	Surge Diverter
LTR	कम तनन प्रूविंग रिले	Low Tension Proving Relay
M 1 to M 4	मोटर संपर्किंत्र	Motor Contactors
SBC	स्थिर बैटरी चार्जर	Static Battery Charger
BCFR	बैटरी चार्जर विफलता रिले	Battery Charger Failure Relay
MCS 1	TM 1/2 के लिए कटआउट स्विच	Motor Cut Out Switch for TM 1/2
MCS 2	TM 3/4 के लिए कटआउट स्विच	Motor Cut Out Switch for TM 3/4
MSWL	मोटर स्विच सफेद बत्ती	Motor Switch White Light
MC	प्रधान नियंत्रक	Master Controller
NR 1, NR 2	नाचिंग रिले	Notching Relay
NVR	शून्य वोल्ट रिले	No Volt Relay
OL 1 to OL 4	से के लिए अधि लोड रिले	Over Load Ready for TM 1 to 4
OL 5	दिष्टकारी अधिलोड प्रतिरक्षी रिले	Rectifier Over Load Protection Relay
OL 6	ट्रांसफार्मर अधिलोड प्रतिरक्षी रिले	Transformer Over Lead Protection Relay
OLP	अधिलोड आरंभिक रिले	Over Lead Primary Relay
OP	तेल पम्प	Oil Pump
RF	दिष्टकारी पंखा	Rectifier Fan
RFR	दिष्टकारी पंखा प्रूविंग रिले	Rectifier Fan Proving Relay
RFA	दिष्टकारी पंखा सहायक रिले	Rectifier Fan Auxiliary Relay
SL	समकारी दिष्टकारी	Smoothening Reactor
SR	प्रवर्तन रिले	Starting Relay
T 1 to T 9	पथ परिवर्तन संपर्किंत्र	Tap Changing Contactors
TL	पथ परिवर्तन प्रतिरोधक	Tap Changing Reactor
TSS	परीक्षण अनुक्रम स्विच	Test Sequence Switch
TT	ट्रांसफार्मर थर्मोस्टेट	Transformer Thermostat
TTR	ट्रांसफार्मर थर्मोस्टेट रिले	Transformer Thermostat Relay
W 1	कुंडली समूहन	Winding Grouping
W 2	स्विच संपर्किंत्र	Switch Contactors
WGR	कुंडली समूह रिले	Winding Grouping Relay
BR	ब्रेक रिले	Brake Relay
A	एमीटर	Ammeter

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