

केवल कार्यालयीन उपयोग हेतु
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भारत सरकार GOVERNMENT OF INDIA
रेल मंत्रालय MINISTRY OF RAILWAYS

INTRODUCTORY HANDBOOK ON WDG6G DIESEL LOCOMOTIVE (For Loco Pilot)



31अमा संRDS
रेल नमस्कृत Transforming Railways



Indian Railways
Centre for Advanced Maintenance Technology

IRCAMTECH/GWL/MECH/2022-
23/DIESEL/WDG6G/HB/1.0

FEBRUARY, 2023

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Foreword

High-powered locomotives are a priority for Indian Railways since they optimize freight traffic operations to meet growing demand and improve the organization's income generation. The Indian Railways and GE (now Wabtec) had an agreement that led to the introduction of WDG6G Diesel Locomotives on Indian Railways. In compliance with the agreement, Indian Railways will receive 300 WDG6G locomotives.

The key features of the most powerful Diesel Locomotive of Indian Railways include the incorporation of the latest technology in the field. The WDG6G Diesel Locomotive is based on GE's Evolution series and is fitted with a 16-cylinder V-16 Evolution series engine, a four-stroke fully turbocharged and inter-cooled machine. The locomotive includes an electronic fuel injection system for improved fuel efficiency and lower emissions compared to any other diesel locomotives used on IR which is in line with the priority to address issues regarding environmental adaptation.

The WDG6G Diesel Locomotive also marks a new high in features related to the Driver's Cab. The enhanced Operator and Cab amenities include the provision of HVAC (Heating, Ventilation, and Air-Conditioning), hot plate, heated windshields, urinal, and display screens for the use of the Loco Pilots on run. Adding to the technology upgrade in terms of loco safety, a Consolidated Control Architecture Control System has been provided with features such as trip optimizer, loco vision, and Cab Signaling with built-in future upgradability to digital solutions. Safety standards of the Loco get to the next level with the Cab frontal collision designed to withstand tough crash-worthiness norms. Packaging of electrical hardware and equipment has been optimally done to enable easy maintenance. The lightweight bogie frame also needs minimal maintenance.

This new breed of locomotives will greatly boost the carrying capacity of a freight train rake. Moreover, it will expand sectional capacity through more frequent rail services and improve operating effectiveness.

IRCAMTECH is thankful to Wabtec Corporation for their valuable input and for making this a comprehensive document. Please feel free to write us with any suggestions for further improvements.

RDSO, Lucknow
Date: February 2023

Jitendra Singh
Principal Executive Director

Preface

The enormous yet lightweight 6000 Horse Power Diesel Locomotive manufactured by General Electric (now Wabtec) has been inducted into Indian Railways. It is the most powerful diesel locomotive used on Indian Railways.

The integration of cutting-edge technology into its system makes WDG6G, one of the most effective diesel locomotive to be inducted into Indian Railways. The locomotive is fitted with a 16-cylinder V-16 Evolution series engine, a four-stroke fully turbocharged and inter-cooled machine. These engines have higher fuel efficiency and lower emissions as compared to any other diesel locomotives in use on Indian Railways.

The WDG6G Diesel Locomotive is also using state of the art technology as – remote monitoring and diagnostics, high crash-worthiness norms for Cab frontal collisions, lightweight bogie frame, integration of automatic engine start-stop with an Auxiliary Power Unit (APU), etc.

WDG6G Diesel Locomotives will play a significant role for Indian Railways, which is undergoing a positive transformational phase to bolster its transportation capabilities in the wake of challenges coming from other sectors.

We welcome any suggestions from our readers for further improvement.

IRCAMTECH, Gwalior
Date: February 2023

Manoj Kumar
Director / Mechanical

Quality Policy

“We at IRCAMTECH Gwalior are committed to maintain and update transparent standards of services to develop safe, modern and cost effective railway technology complying with statutory and regulatory requirements, through excellence in research, designs and standards by setting quality objectives, commitment to satisfy applicable requirements and continual improvements of the quality management system to cater to growing needs, demand and expectations of passenger and freight traffic on the railways through periodic review of quality management systems to achieve continual improvement and customer appreciation. It is communicated and applied within the organization and making it available to all the relevant interested parties”.

Our Objective

To upgrade maintenance technologies and methodologies and achieve improvement in productivity and performance of all Railway assets and manpower which inter-alia would cover reliability, availability, utilization and efficiency.

CAMTECH is continuing its efforts in the documentation and up gradation of information on maintenance practices of railway assets. Over the years a large number of publications on railway assets have been prepared in the form of handbooks, pockets books, pamphlets & video films etc. These publications have been uploaded on the internet as well as on rail net.

For downloading these publications please do following:

1. On internet visit: <https://indianrailways.gov.in/railwayboard> in Go to Railway Board Directorates → Efficiency & Research → CAMTECH Gwalior → Publications for download → Mechanical Engineering.
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Amendment and Revisions

The correction slips to be issued in future for this report will be numbered as follows:

IRCAMTECH/GWL/MECH/2022-23/DIESEL/WDG6G/HB/1.0# XX date

Where “XX” is the serial number of the concerned correction slip (starting from 01 onwards).

Version	Date	Corrections	Remarks
1.0	February 2023	First Issue	--

DISCLAIMER



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All technical information and guidelines are latest at the time of publishing and are subjected to change due to technology updates and requirements.

This report does not supersede any existing instructions from Railway Board, RDSO & Zonal Railways. This Report is not statutory and contents are only for the purpose of guidance.

1. INTRODUCTION

Diesel-electric locomotive WDG6G is used for freight operations by Indian Railways. The locomotive is a more powerful version of the WDG4G locomotive. The design platform is based on the GE Evolution Series and has a 4-stroke, 16-cylinder, fully turbocharged engine that produces about 6,000 horsepower.

Main components on the WDG6G locomotives are 16 Cylinder Diesel Engine, Propulsion System (5GMG201 Series Alternator, GEB32 Series Traction Motors), AC – AC Traction System (Auxiliary Cabinet with IGBT based Axle control Inverters, Control Area, HMI Displays), Engine support systems (Radiator, Cooling fan, lube oil system), Microprocessor controlled Air Brake, Screw Compressor etc.

WDG6G locomotive also have some of the components / equipment which are same, as well as different to those used on WDG4G locomotive. Below mentioned is the list of such components.

List of components / technologies which are common between WDG4G and WDG6G

- Air Brake rack & Air Brake controller/ back up brake
- Screw compressor
- Centrifuge filters
- Toilet / RLA Cabinet
- Buffers
- Coupler
- Primary & Secondary Suspension, Journal Bearings, Traction pin, Traction links, Axle Box, TBU
- Lube oil cooler
- HVAC
- Event recorder
- TM spin filters
- APU
- Battery- Sealed Lead acid
- HMI display
- Master controller
- IGBT's / Rectifiers
- Grid blower & Grid assembly
- Rad fan (Qty. 1 on WDG4G, Qty. 2 on WDG6G)
- Auxiliary Blower

List of the components / technology which are different in WDG4G and WDG6G:

- 16 Cylinder GEVO Engine (No. of cylinders are more – Power assembly is same)
- Higher capacity/ rating Lube Oil Filter
- Higher capacity Water tank
- Radiators – Qty. 2 & bigger as compared to WDG4G due to increased HP
- Wheel-Axle-Gear Assembly (Bigger diameter axle having different wheel hub ID, different gear ratio due to higher axle load)
- Box beam underframe (higher stiffness to weight ratio) as compared to I Beam

underframe on WDG4G

- Weldments/ compartments different due to bigger equipment packaged including
 - Operating Cab (longer due to dual consoles)
 - Engine Cab (longer due to bigger engine)
 - Radiator Cab (accommodates bigger and two radiators)
 - Blower cab (accommodates bigger alternator and alternator blower)
- Cable, Conduiting and Piping different due to Box Beam underframe and packaging
- Higher capacity/ rating Alternator
- Higher capacity/ rating Traction motor
- Higher capacity/ rating Alternator blower
- Higher rating / capacity laminated crossover Bus bars for 6000 HP
- External load box connection for full self-load capability

RDSO Technical Specification No. MP.0.08.00.74 (REV.02, Latest Amendment) - TECHNICAL SPECIFICATION FOR 1676 MM GAUGE 6000 HP & 4500 HP IGBT-BASED THREE-PHASE AC-AC DIESEL-ELECTRIC LOCOMOTIVES govern the key design features of WDG6G locomotive.

2. TECHNICAL DESCRIPTION

2.1. SPECIFICATION

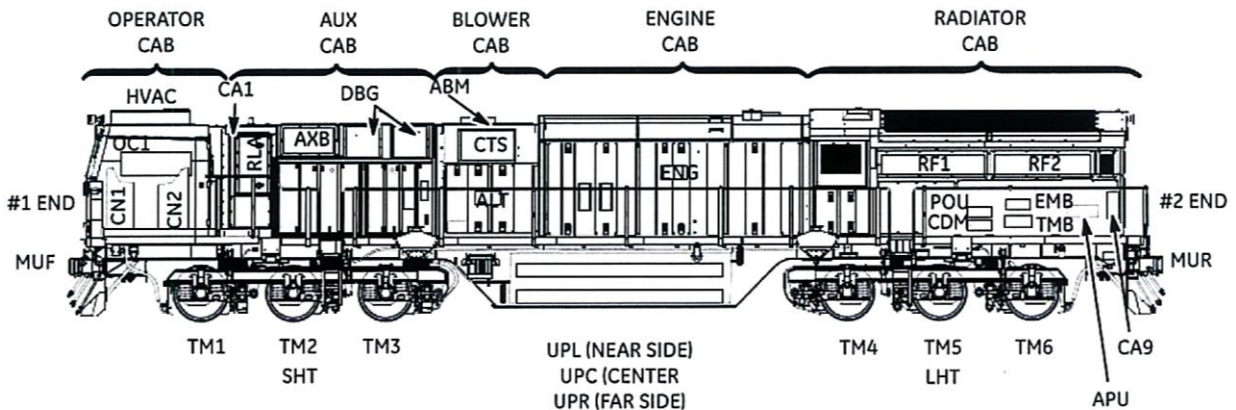
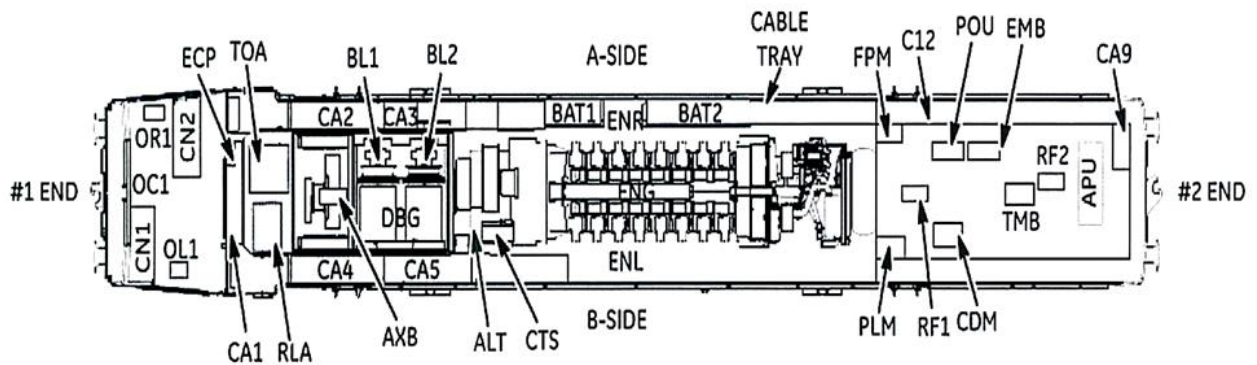
Major Dimensions	
Length (over couplers)	22313 mm
Height	4227 mm
Width	3200 mm
Traction Pin Centers	14224 mm
Truck/Bogie Wheel Base (Adjacent)	1900 mm
Engine Data	
Horsepower (Gross)	6000 HP (4474 kW)
Horsepower (Traction)	5686 HP (4240 kW)
Number of Cylinders	16
Model	GEVO 16
Bore and Stroke	250 mm x 320 mm
Compression Ratio	16.8:1
Max RPM	1050
Valves	2-Intake, 2-Exhaust
Cycle	4
Turbocharger	Two single stage

INTRODUCTORY HANDBOOK ON WDG6G DIESEL LOCOMOTIVE

Electronic Fuel Injection	Yes
Wheel Arrangement	Co-Co
Weight (Nominal)	138,000 kg
Minimum Track Curvature	
Single Unit	174 m radius
Coupled Pair	174 m radius
Brake System & Air Supply	
Air Brake	Fast Brake Electronic Loco Air Brake System
Air Compressor Type	Single air end, oil injected, rotary screw, air compressor
Compressor Drive	AC Motor
Compressor Minimum Delivery	178 CFM @ 145 psig & 1050 RPM
Filters	
Primary Air Filter	Self-Cleaning Inertial Filters
Secondary Engine Air Intake Filter	Air Intake Fiber-glass Baggie Air Filter
Electrical Equipment Intake Filter	Intake Self-Cleaning Inertial Filters
Secondary Electrical Equipment Air Intake Filter	Equipment Air Intake Paper Canister Filter
Consumables Capacity	
Fuel Tank (usable)	8000 L
Coolant	1468 L total
Lubricating Oil	1300 L total
Sand	170 L for each truck with 4 sand boxes of 85 L each
Electrical Equipment	
Traction inverters	6
Traction Motors (6)	5GEB32B5
Traction and Auxiliary Alternator	5GMG201F1
Traction Motor Blower	5GDY91H1
Auxiliary Cab Blower	5GDY102D1
Exhauster Blower	5GDY90C1
Alternator, Rectifiers, and Inverters Blower	5GDY131B
Blower Drives	AC Motors
Wheels & Traction	

Driving Wheel Diameter (new)	1092 mm
Minimum Wheel Diameter	1016 mm
Maximum Starting Tractive Effort	570 kN
Maximum Continuous Tractive Effort	420 kN
Gear Ratio	85:16
Maximum Speed (fully worn wheels)	100 km/h (62 mph)

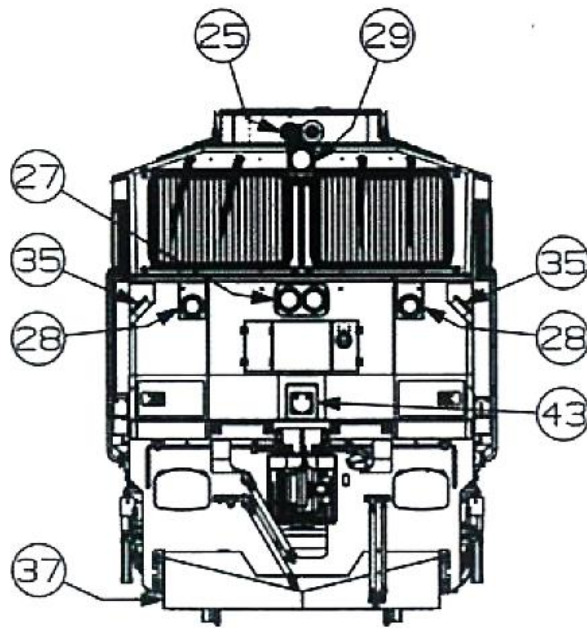
2.2. LOCOMOTIVE LAYOUT



REF.	DESCRIPTION	REF.	DESCRIPTION
ABM	ALTERNATOR/INVERTER BLOWER	ENR	ENGINE AREA RIGHT
AXB	AUX CAB BLOWER/EXHAUSTER	FPM	FUEL PUMP MOTOR
ALT	ALTERNATOR AREA	LHT	LONG HOOD TRUCK
BAT	BATTERY	OC1	OVERHEAD HATCH (#1 END)
CA1	CONTROL AREA 1	OL1	OVERHEAD CONSOLE LEFT
CA2	CONTROL AREA 2	POU	PNEUMATIC OPERATING UNIT
CA3	CONTROL AREA 3	PLM	PRE-LUBE MOTOR/PUMP

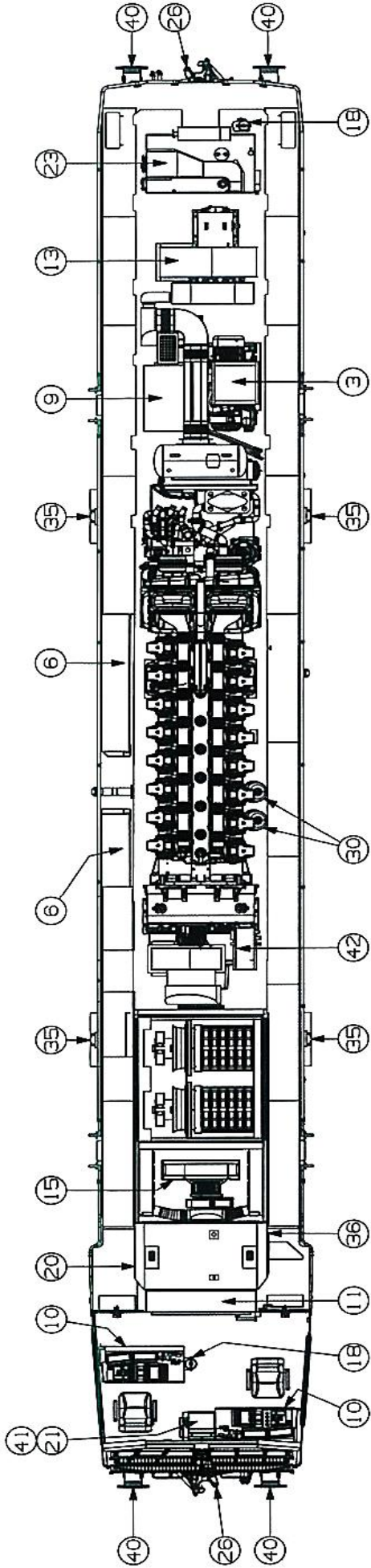
CA4	CONTROL AREA 4	RAD	RADIATOR CAB
CA5	CONTROL AREA 5	RF1-2	RADIATOR FAN 1 & 2
CDM	COMPRESSOR DRIVE MOTOR	RLA	RADIO EQUIPMENT AREA
CN1	OPERATOR CONSOLE (#1)	SHT	SHORT HOOD TRUCK
CN2	OPERATOR CONSOLE (#2)	TMB	TRACTION MOTOR BLOWER
CTS	CRANK TRANSFER SWITCH	TM1-6	TRACTION MOTORS
DBG	DYNAMIC BRAKE GRID BOX	UPC	UNDER PLATFORM, CENTER
ECP	ENGINE CONTROL PANEL (ECP/CA1)	UPL	UNDER PLATFORM, LEFT
ENG	ENGINE	UPR	UNDER PLATFORM, RIGHT
ENL	ENGINE AREA LEFT	MUR	MULTIPLE UNIT RECEPTACLE REAR
MUF	MULTIPLE UNIT RECEPTACLE FRONT		

2.3. EQUIPMENT LOCATION

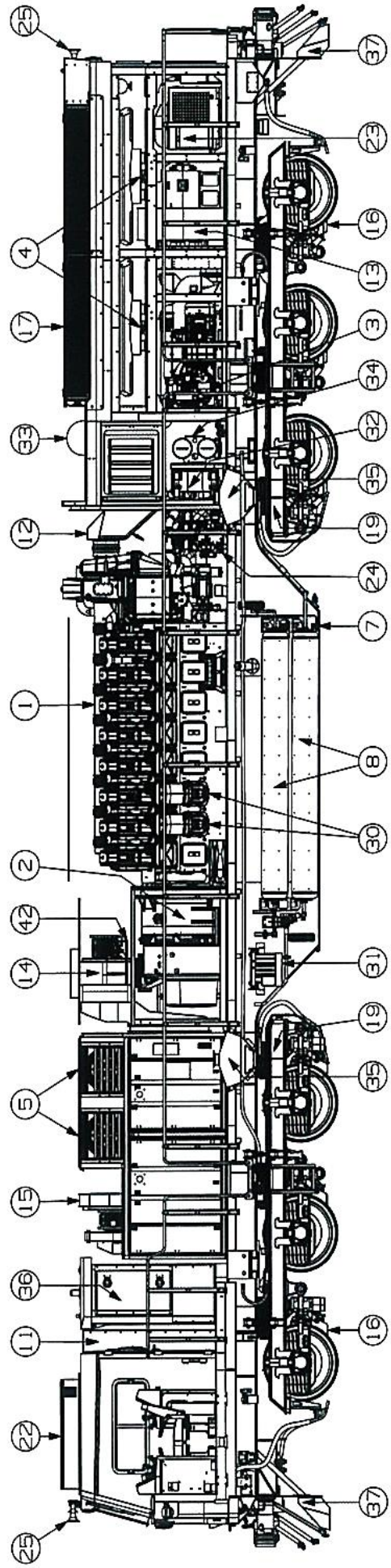


Front View

TOP VIEW



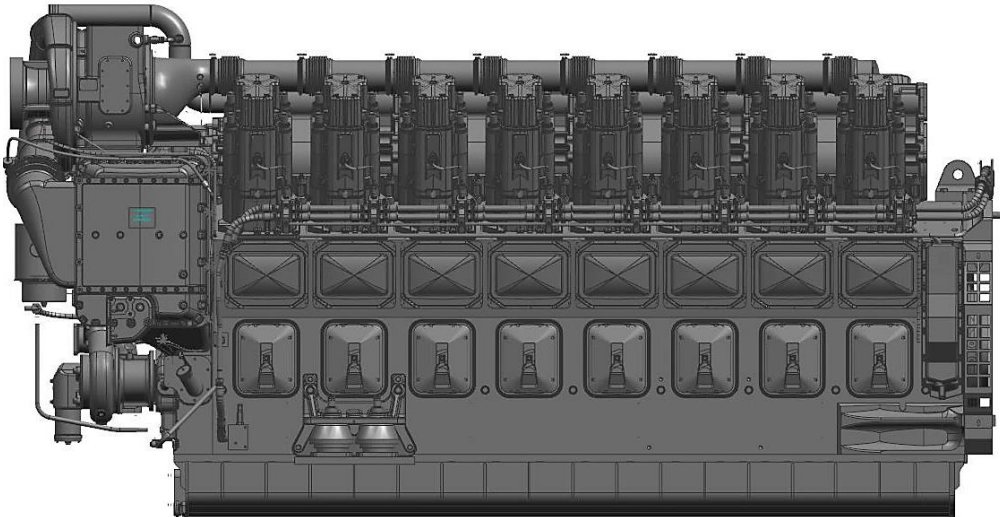
SIDE VIEW



REF.	DESCRIPTION	REF.	DESCRIPTION
1	ENGINE-16 CYLINDER	22	AIR CONDITIONER
2	ALTERNATOR	23	APU
3	AIR COMPRESSOR	24	OIL FILTER
4	RADIATOR FAN	25	HORN
5	DYNAMIC BRAKING BOX	26	COUPLER
6	BATTERY BOX	27	HEAD LIGHTS
7	FUEL TANK	28	CLASSIFICATION/MARKER LIGHTS
8	AIR RESERVOIRS	29	FLASHER LIGHT
9	AIR BRAKE EQUIPMENT	30	CENTRIFUGE OIL FILTER
10	CONTROL CONSOLE	31	AIR DRYER
11	CONTROL DEVICE COMPARTMENT	32	OIL COOLER
12	ENGINE AIR FILTER BOX	33	WATER TANK
13	TRACTION MOTOR BLOWER	34	FUEL FILTERS
14	ALTERNATOR BLOWER	35	SAND BOX
15	AUX BLOWER	36	ELECTRONICS LOCKER
16	TRACTION MOTORs	37	OBSTACLE DEFLECTOR
17	RADIATOR	40	SIDE BUFFER
18	FIRE EXTINGUISHER	41	TOOL BOX
19	BOGIE	42	CRANK TRANSFER SWITCH
20	URINAL	43	MU CONNECTIONS
21	HOT PLATE		

2.4. MAJOR EQUIPMENT ON THE LOCOMOTIVE

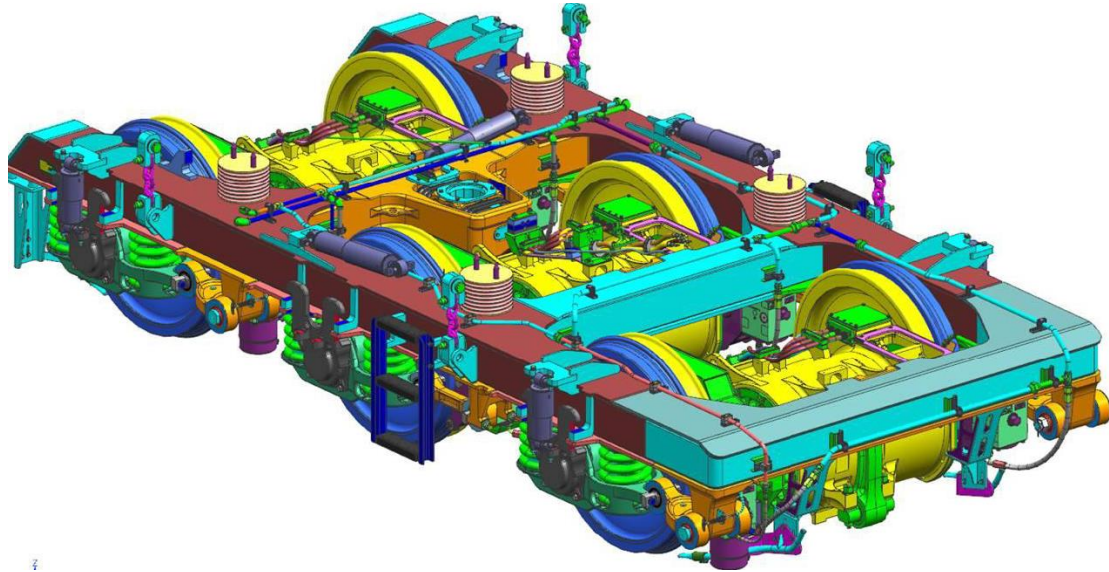
2.4.1. POWER PACK



16 Cylinder GEVO Diesel Engine

- 16 Cylinder, 4-Stroke Diesel Engine with Electronic Fuel Injection.
- 6000 GHP.
- Bosch Electronic Unit / fuel Injection system.
- BSFC@ N8 requirement ≤ 150 g/bhp-hr.
- Engine applied on isolated mounts for reduced vibration.

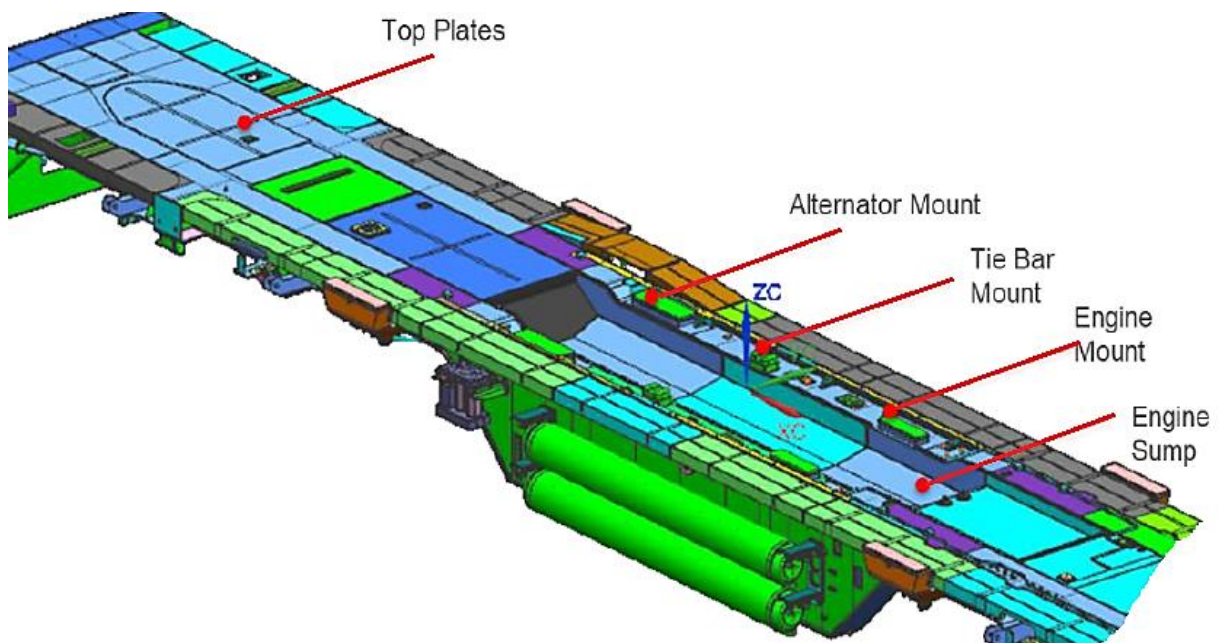
2.4.2. BOGIE



WDG6G BOGIE ASSEMBLY

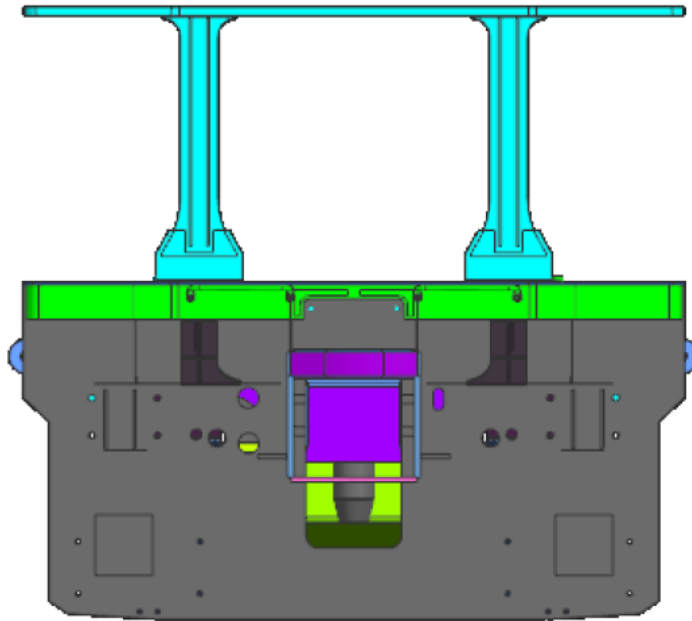
- Designed for maximum speed of 100 kmph.
- Fabricated bogie frame, designed, and fatigue tested.
- Coil spring primary suspension and laminated rubber secondary suspension provided
- Spring applied / Air release TBUs provided on each wheel with 2 TBUs / Bogie acting as parking brake also.
- No wear surfaces – maintenance friendly design.
- Designed for emergency braking distance for light locomotive 600 m or less.
- 2 Additional yaw dampers per bogie in longitudinal direction provided between bogie and underframe.

2.4.3. UNDERFRAME DESIGN



WDG6G Underframe

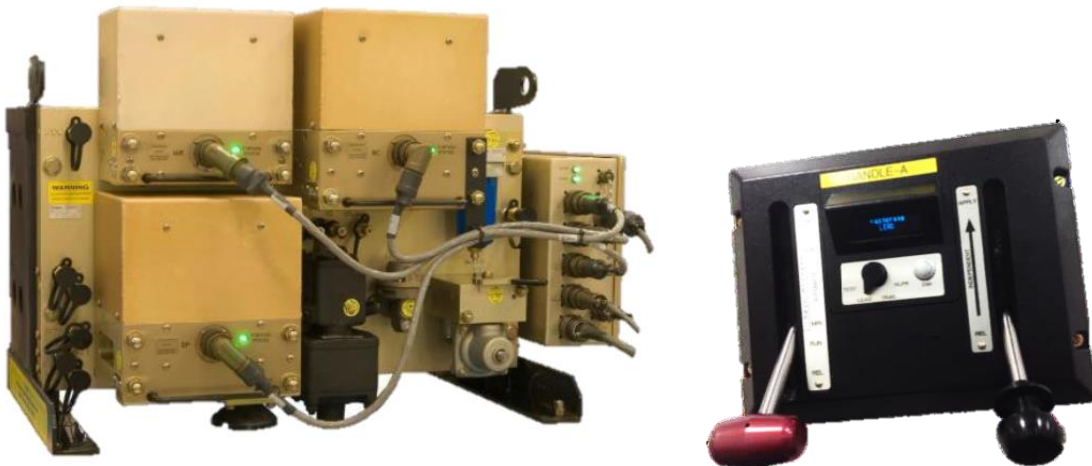
- Box-Beam Construction optimized for load transfer and weight.
- Anti-Climber crashworthiness protection.
- Compliance for Cab frontal collision protection.



WDG6G Underframe - Collision Post

- Designed for 400 tonnes compressive load (buff load).
- Anti-Skid walkways provided.
- Separation of cabling and piping on either side of underframe.

2.4.4. ELECTRO-PNEUMATIC BRAKING SYSTEM



Air Brake POU and Controller

- HMI features.
- Provision of LCD display on air brake controller for operator messages.
- Provision of bail off ring on the independent brake handle.
- Provision of Lead / Trail / Helper / Test selection switch on air brake controller.
- Provision of separate pneumatic backup handle for working of loco with self-power in event of failure.

- Selection of Passenger / Goods mode for loco BC creation as per UIC in computer control mode as well as in pneumatic backup mode.
- Other key features of the microprocessor controlled *Fastbrake* system
 - Air brake Integrated with Loco Control System for performance and feature optimization; seamless transfer of information to operator.
 - On-board diagnostics through operator HMI display; Advanced diagnostics embedded.
 - Fully automated software-based flow algorithm for break-in-two scenarios.
 - Fewer mechanical & pneumatic components susceptible to dust.
 - Ethernet based communication to loco control system for reliable and fast communication.
 - Electronic based redundant emergency applications.
 - Manifold and portions are aluminum block construction.
 - Pneumatic back up brake provided.

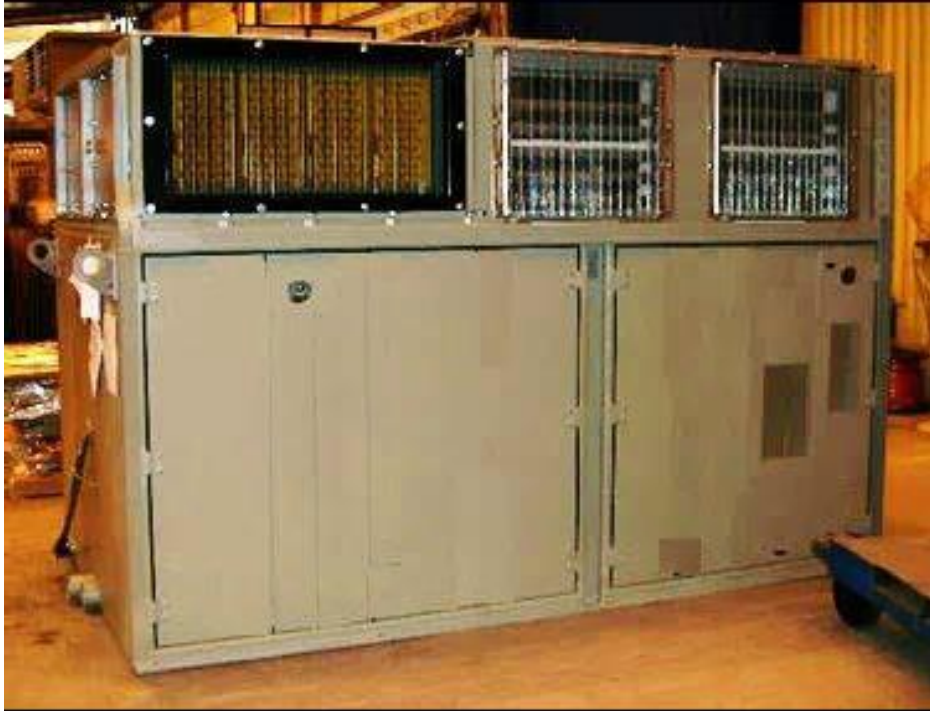
2.4.5. SCREW COMPRESSOR



Screw Compressor WDG6G

- Number of Stages: Single Stage, Oil Lubricated, Rotary Screw Compressor.
- Rated Speed: 1575 RPM (corresponding Engine speed - 1050 rpm).
- Maximum air pressure: 145 psig (10.19 kg/cm²)
- Compressor drive motor (CDM) is controlled by CDC contactors.
- Compressor can run in two modes, Low speed mode at higher engine RPMs and high-speed mode at lower engine RPMs. This motor is a pole changing motor
- Drive arrangements – Motor driven with gear box.
- Couplings – Elastomer Spider Coupling

2.4.6. AC-AC TRACTION SYSTEM



WDG6G Auxiliary Cab

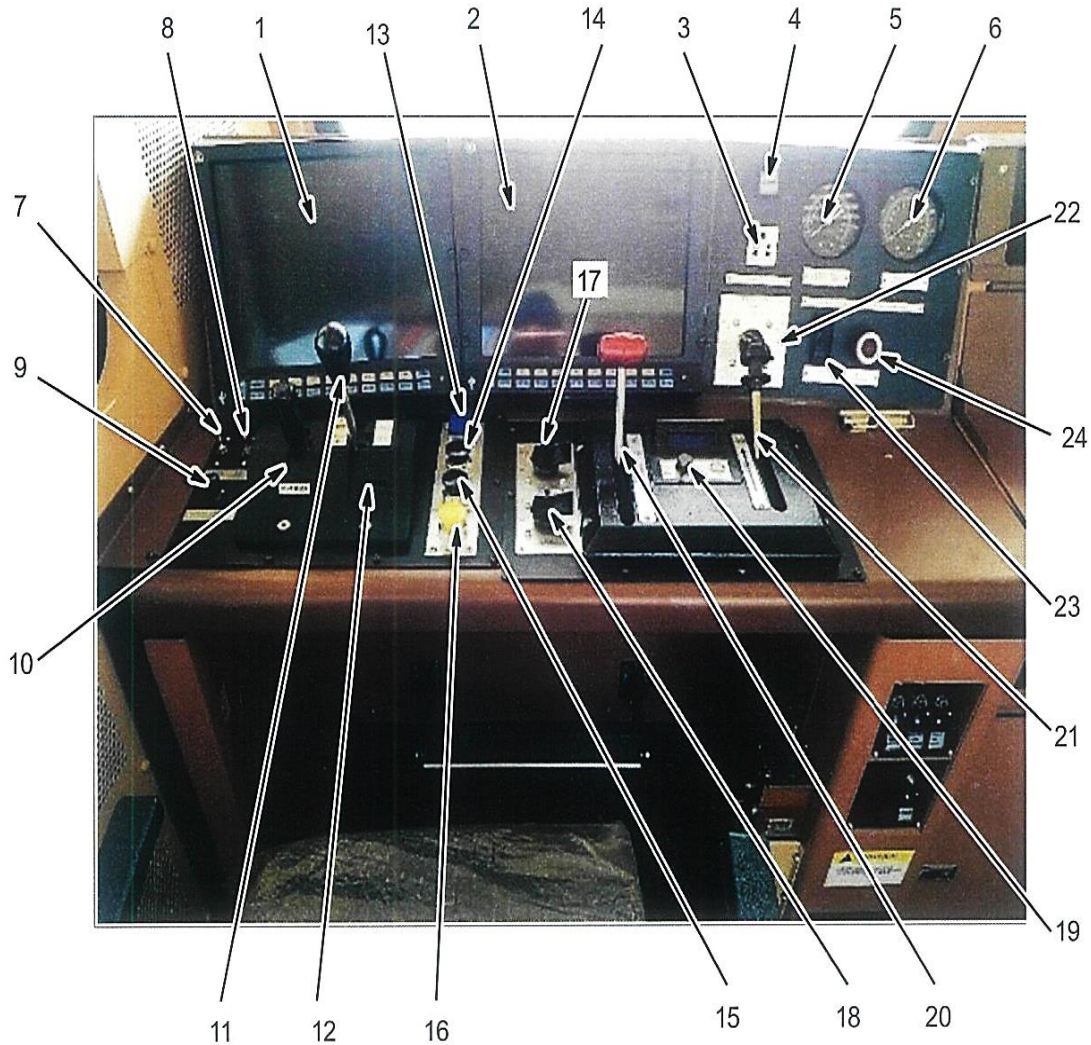
- Power and Control Electronics and electrical equipment are packaged as single module (Auxiliary Cab).
- Unitized packaging of Power and Control Electronics in a single cabinet with separation of high voltage and low voltage equipment enables reduced cabling, ease of maintenance, optimized ventilation.
- Fuses & Circuit Breakers are provided in all power and controls circuit to provide overcurrent/ short circuit protection.
- Battery Maintenance switch is provided to disconnect battery supply prior to maintenance work.
- Ground fault detection devices are provided in high voltage circuits.
- Bonding and Grounding provided on various electrical parts to provide least impedance path for potential ground fault currents.
- Fuses & Circuit Breakers are provided in all power and controls circuit to provide overcurrent/ short circuit protection.
- Battery Maintenance switch is provided to disconnect battery supply prior to maintenance work.
- Ground fault detection devices are provided in high voltage circuits.
- Bonding and Grounding provided on various electrical parts to provide least impedance path for potential ground fault currents.
- Inverter technology – IGBT and Individual Axle Traction Control enhances hauling power and helps to reduce slippage on start-ups, inclines and suboptimal track conditions.
- Microprocessor based Control system.
- Four, 15-inch LCD Operator HMI displays provided in each cab.
- Integrated with safety features such as Alerter, TE Limit switch, AEB.
- Loco equipped for operation with Distributed Power (Locotrol).
- Remote Monitoring & Diagnostics Capability of On-board Systems

2.5. OPERATING EQUIPMENT

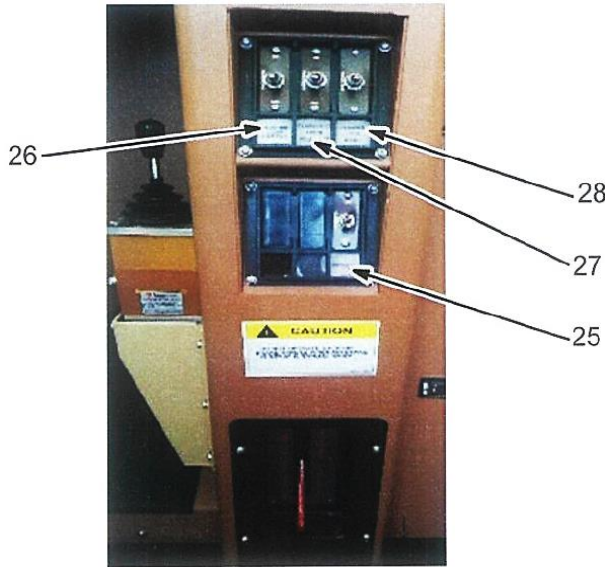
2.5.1. OPERATOR CONSOLE

For operating the locomotive in both directions, the Driver Cab is equipped with two desktop consoles: one console facing forward on the B-Side and the other console facing long hood forward positioned on the A-Side of the locomotive.

The Operator Console contains the Display screens and some of the switches, circuit breakers, pushbuttons, and controllers necessary to operate and monitor the locomotive during operation.



Console in Drivers Cab



Defogger & Flasher Light Switches

REF.	DESCRIPTION	REF.	DESCRIPTION
1	DISPLAY 1 (DS1)	15	HORN LONG HOOD END
2	DISPLAY 2 (DS2)	16	VIGILANCE RESET
3	RECEPTACLE FOR LAPTOP AND CELL PHONE CHARGING	17	HEADLIGHT CAB END
		18	HEADLIGHT LONGHOOD END
4	ALERTER	19	ELECTRONIC BRAKE VALVE (EBV)
5	AIR GAUGE MR/ER PRESSURE	20	INDEPENDENT BRAKE HANDLE
6	AIR GAUGE BC/BP PRESSURE	21	AUTOMATIC BRAKE HANDLE
7	GAUGE LIGHT SWITCH	22	DUAL CONSOLE SWITCH
8	LEAD AXLE SANDING	23	DYNAMIC BRAKE SWITCH
9	GAUGE LIGHT DIMMER	24	MU SHUTDOWN
10	MASTER CONTROLLER	25	DEFOGGER SWITCH
11	REVERSER HANDLE	26	FLASHER LIGHT CAB END
12	COMBINED POWER HANDLE	27	FLASHER LIGHT LONG HOOD END
13	SANDING	28	FLASHER LIGHT RESET
14	HORN CAB END		

Display

The Display 1 and 2 allow the operator to set up, control, and monitor locomotive operation. The Display receives softkey directions from the operator and displays the operating conditions of the locomotive.

Receptacle for Laptop and Cell Phone Charging

A receptacle is provided for the charging of a laptop computer or cell phone for operator and crew. The power adapter is a diode type (not transformer) and is rated at 123 V AC.

Alerter

The Alerter Indicating Light informs operator to press Alerter Reset pushbutton which manually resets the Alerter Vigilance system. The alerter reset push button will reset the alerter vigilance system.

Air Gauge / BP and BC Pressure

The BP and 6C air pressure gauge reads air pressure on the brake pipeline and air pressure on the brake cylinder pipe, in Metric units (kgf/cm²) and English units (psi). Pneumatic gauges will be active only during the pneumatic backup brake handle operation.

Air Gauge / MR2/ER

The MR2 and ER air pressure gauges reads air pressure on the MR2 pipe and air pressure on the Equalizing Reservoir pipe, in Metric units (kgf/cm²) and English units (psi). Pneumatic gauges will be active only during the air brake pneumatic backup operation.

Gauge Light Switch

The Gauge Light switch turns the gauge lights ON and OFF. The dimmer is located below the switch

Lead Axle Sanding

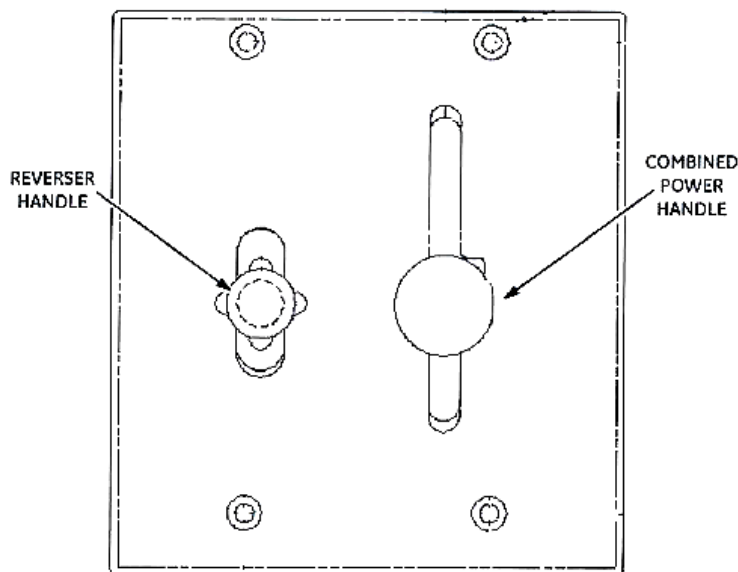
The Lead Axle Sanding switch turns the sanding for the lead axle ON and OFF.

Gauge Light Dimmer

The Gauge Light Dimmer adjusts the brightness of the gauge lights on the Operator Console.

Master Controller

The Master Controller is a two-handle controller used by the operator to command locomotive and consist motoring power, dynamic braking, and direction of travel. The two handles are the Reverser and the Combined Power.



Master Controller

Reverser handle - Used to command the desired direction of locomotive travel. It has three positions: Reverse (R), Neutral (N), and Forward (F). This handle is removable when set in Neutral position and simultaneously the Combined Power handle is set to Idle. The Reverser handle can only be changed when the Combined Power handle is in the Idle position.

Combined Power handle - Used to command the requested motoring power or dynamic braking level. The motoring power range consist of a series of notch positions from 1 to 8. Moving the handle towards the notch 8 position increases the requested motoring power.

The braking power positions consist of a linear range between the b and B positions. Move the power handle to the b position to request the brake setup mode. When moving the handle away from the " b "position a click will be heard. Moving the power handle away from the operator to the " B" position increases the requested amount of braking. The power handle can only be moved to a braking position when the reverser handle is in a Forward (F) or Reverse (R) position.

Operation as a Lead or Single Unit Operation

1. The Combined Power handle must be in neutral (N).
2. Set the Reverser handle for the desired direction of operation (Forward or Reverse).

Operation in Power Made

Move the Combined Power handle from neutral (N) to a power application (away from the operator).

Operation in Dynamic Brake Mode

1. Move the Combined Power handle from neutral (N) to a desired braking position.
2. Braking will be applied automatically by the control system.

Operation as Trail Unit

Both the Combined Power handle and the Reverser handle on the trail unit are required to be in the idle or neutral (N) position for the locomotive to run in trail.

Sanding

The Sanding pushbutton controls the sand application.

Horn Cab End / Long Hood End

The Horn pushbutton turns the locomotive horn on and off for as long as the Horn pushbutton is pressed. Pressing horn push button from active console will activate the horn.

Cab End Headlight Switch

The Cab End Headlight switch controls the operation of the short-hood (or #1 End) headlights and has three settings: OFF, DIM, and BRIGHT. On the Engine Control (EC) panel the Headlight circuit breaker must be set to ON.

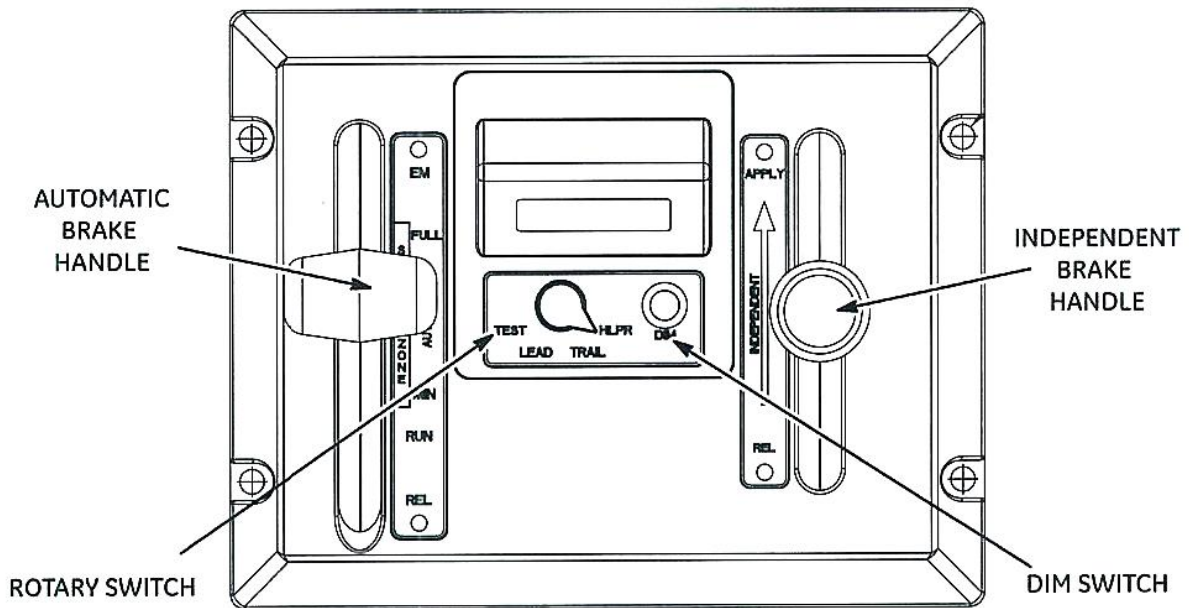
Long Hood End Headlight Switch

The Long Hood End Headlight switch controls the operation of the long-hood (or #2 End) headlights and has three settings: OFF, DIM, and BRIGHT. On the Engine Control (EC) panel the Headlight circuit breaker must be set to ON.

Electronic Brake Valve (EBV)

The Electronic Brake Valve (EBV) provides the operator control of the locomotive Electric Air Brake (EAB) operation through the Automatic brake handle (including

emergency position), the Independent Brake handle, and the bail-off ring (on top of the Independent brake handle).



Electronic Brake Valve

Independent Brake Handle: The Independent Brake handle is part of the EBV (Electronic Brake Valve). To operate the Independent Brakes move the Independent Brake handle toward the FULL position. The braking effort will increase as the handle is moved to the FULL position. The Independent Brakes are released when the handle is in the release (REL) position.

To make a quick release of an Automatic Brake application on the local locomotive and formation locomotive (bail-off), lift the bail off ring located on Independent Brake handle. Spring action will return the ring to the original position when released.

NOTE: Automatic Brake application will not release the train brakes.

The Independent Brake handle should always be in the RELEASE (REL) position when set up as a Trail unit in multiple unit formation or is being towed Dead.

Automatic Brake Handle : The Automatic Brake handle is part of the Electronic Brake Valve (EBV). The Automatic Brake handle operates through five control positions

1. **RELEASE (REL) Position** - Position is used to quickly release the train brakes. It is a spring-loaded position on the handle. Moving the automatic brake handle to this position creates an overcharge by boosting the BP release pressure above its normal level. After a programmed time BP pressure is gradually returned to its normal level. Operation of overcharge feature shall increase the brake pipe pressure by 0.5 kg/cm^2 over the normal BP level.
2. **RUN (RUN) Position** - Run is the handle position that commands the brake system to charge the brake pipe to 5 kg/cm^2 resulting in a release of the automatic brake application.
3. **MINIMUM REDUCTION (MIN) Position** - When making a Service Brake application, move the Automatic Brake handle to the MIN position, which will provide a 0.4 to 0.5 kg/cm^2 reduction in the brake pipe pressure and increase the

brake cylinder pressure to 0.9 to 1.1 Kg/cm². If necessary to Increase the reduction, move the handle progressively toward the FULL SERVICE (FS) position, bearing in mind that the further the handle is moved into the service zone, the greater will be the reduction. The system will automatically maintain Brake Pipe leakage within the approved range.

4. **EMERGENCY (EM) Position** - An Emergency Brake application is obtained by moving the brake handle to the EM position. The message "AUTOMATIC HANDLE EMERGENCY" will appear in the air brake message box on the HMI screen for 60 seconds. The operator will then be instructed to recover by moving the brake handle to RUN (RUN). Release only after the locomotive comes to a complete stop and the reason for the emergency has been cleared.

Rotary Switch: Air Brake can be configured as Lead or Trail or Helper or Test using the rotary switch provided on the air brake handle.

CAUTION : *Before carrying out any mode changes on the air brake, ensure that the locomotive is brought to a complete stop and reverser is centered.*

Lead - For switching to Lead mode, in addition to above conditions, automatic brake handle must be moved to FULL position before moving the rotary switch to Lead. When configured as Lead, the operator controls the braking functions. Automatic brake handle controls ER and is cut in so ER controls brake pipe pressure. The independent handle is active.

Helper - When switch is moved to helper position, the brake system is cut out from affecting BP pressure. The emergency position is available. The operator has full control of the Independent brakes. The system shall respond to pressure changes in the main Brake Pipe to control its own automatic brake cylinder pressures.

Trail - In this mode, the brake system is configured to isolate the air brake system from the operator's controls and to operate electronically on command of pneumatic signals issued by the lead locomotive. Both electrical and pneumatic energy are required in the Trail mode. The EAB controls the pressure in the brake cylinders in response to automatic brake applications through the BCE pipe. Automatic emergency braking is available from the operator controls or from the lead locomotive

Test - The system may be set to Test function for standard BP leaking tests where the amount of BP leakage is measured. When operating in test function, full independent braking is automatically applied and BCE is pressurized to full independent pressure regardless of independent handle position. Air brake ensures safe system state while operating in Test. If air brake detects any unsafe conditions, it shall enter an Emergency state.

Dim Switch : Dim switch is a pushbutton provided to allow the operator to dim the display.

Dual Console Switching

Console 1 Selection Switch	Console 2 Selection Switch	Effect
OFF	OFF	No Console is selected as Active Console. Locomotive will not be able to be powered. Engine can only be started by pressing engine start button.
Isolate	OFF	Console 1 is selected as Active Console. Engine can be started but can't Motor/Self Load
Run	OFF	Engine can be started, if engine already running, can go to motoring/self-load with console 1
OFF	Isolate	Console 2 is selected as Active Console. Engine can be started but can't Motor/Self Load
OFF	Run	Engine can be started, if engine already running, can go to motoring/self-load with console 2
Isolate	Isolate	Invalid Selection, incident logged, no console Selected. Vehicle Control will show HMI message on console mismatch
Isolate	Run	
Run	Isolate	
Run	Run	

Dynamic Brake

The Dynamic Brake cut out switch turns the Dynamic Brake of the locomotive ON and OFF.

MU Shutdown

The MU Shutdown pushbutton will shut down all diesel engines on all locomotives in the formation.

Defogger Switch

The Defogger switch turns ON and OFF the windshield defogger.

Flasher Light Cab End

The Flasher Light Cab End switch turns the Cab End flasher lights of the locomotive ON and OFF.

Flasher Light Long Hood End

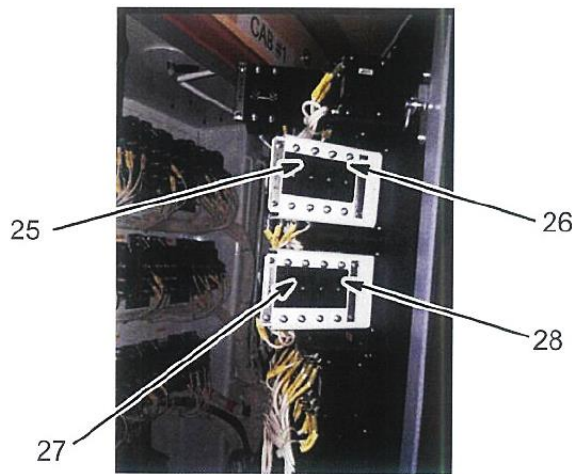
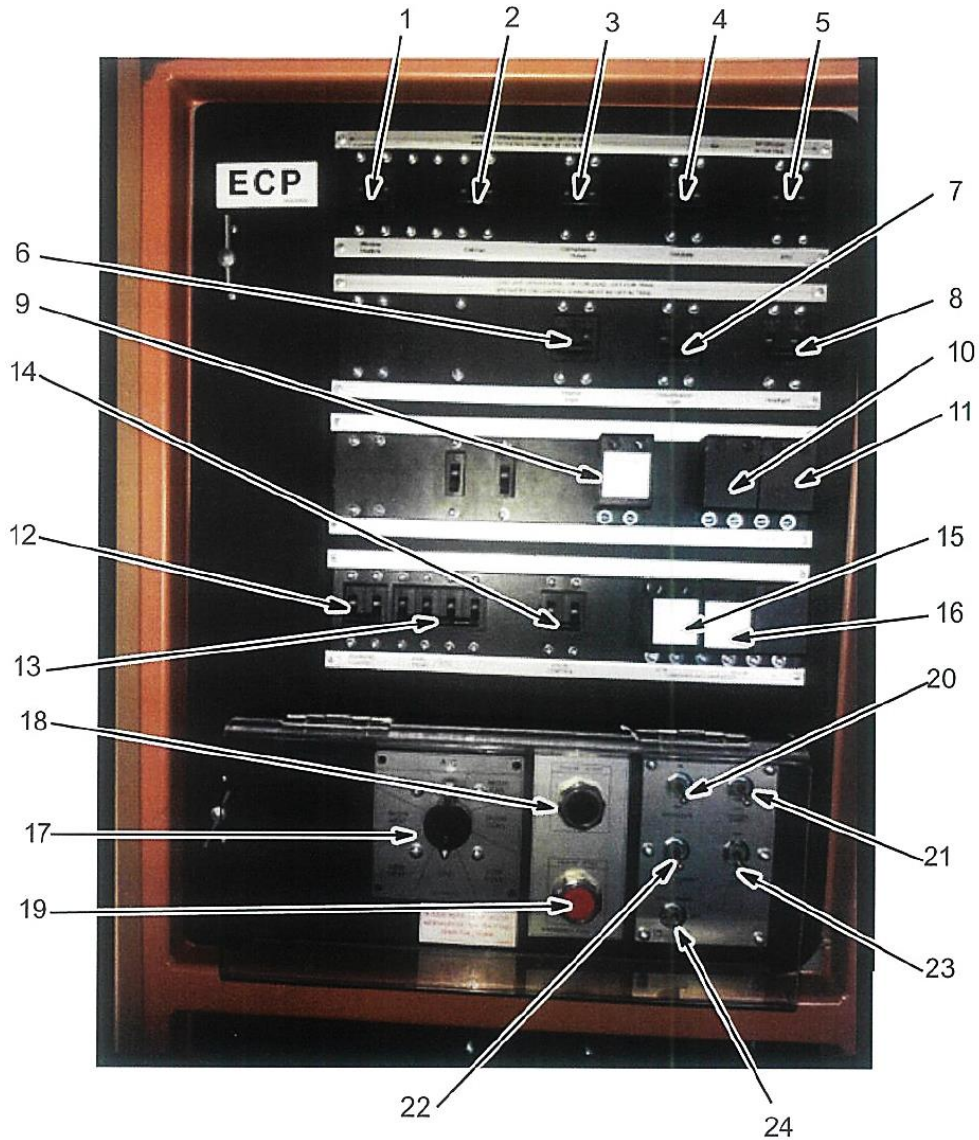
The Flasher Light Long Hood End switch turns the Long Hood End flasher lights of the locomotive ON and OFF

Flasher Light Reset Switch

The Flasher Light reset switch resets automatic activation of the flasher lights of the locomotive. Flasher light activates automatically due to on EAB emergency or penalty brake application. If required, flasher light can be turned OFF using flasher light reset switch.

2.5.2. ENGINE CONTROL (EC PANEL)

Engine Control panel is located on the #2 End wall of the Cab. Mounted on this panel are various switches, circuit breakers, push buttons, and controllers used during locomotive operation.



Engine Control Panel

REF.	DESCRIPTION	REF.	DESCRIPTION
1	WINDOW HEATER CIRCUIT BREAKER	16	BATTERY CHARGER AND COMPUTER POWER SUPPLY CIRCUIT BREAKER (BCCB)
2	CAB FAN CIRCUIT BREAKER	17	ENGINE CONTROL SWITCH
3	CONVENIENCE OUTLET CIRCUIT BREAKER (MCB)	18	ENGINE START SWITCH (EST)
4	HOT PLATE CIRCUIT BREAKER	19	ENGINE STOP SWITCH (ESP1)
5	APU CIRCUIT BREAKER	20	STEP LIGHTS SWITCH
6	FLASHER LIGHT CIRCUIT BREAKER	21	CONTROL COMPARTMENT LIGHT SWITCH (CCLS1)
7	CLASSIFICATION LIGHT CIRCUIT BREAKER	22	GROUND AND LADDER LIGHT SWITCH
8	HEADLIGHT CIRCUIT BREAKER	23	DOME LIGHT SWITCH (DOLS)
9	AIR DRYER CIRCUIT BREAKER (ADCB)	24	CAB 1 FORWARD CLASSIFICATION LIGHT SWITCH
10	AIR BRAKE #1 CIRCUIT BREAKER (ABCB1)	25	DISPLAY NO. 3 CIRCUIT BREAKER (D3CB)
11	AIR BRAKE #2 CIRCUIT BREAKER (ABCB2)	26	DISPLAY NO. 4 CIRCUIT BREAKER (D4CB)
12	CAB LIGHT #1 CIRCUIT BREAKER	27	DISPLAY NO. 1 CIRCUIT BREAKER (D1CB)
13	FUEL PUMP / ECU CIRCUIT BREAKERS	28	DISPLAY NO. 2 CIRCUIT BREAKER (D2CB)
14	LOCAL CONTROL CIRCUIT BREAKER (LCCB)		
15	CAB DISPLAY COMPUTER (MTB)		

Window Heater Circuit Breaker

The Window Heater circuit breaker supplies power and circuit protection to the window heater.

Cab Fan Circuit Breaker

The Cab Fan circuit breaker supplies power and circuit protection to the cab fans.

Convenience Outlet Circuit Breaker (MCB)

The Convenience Outlet circuit breaker (MCB), provides power and circuit protection for the 123 V AC receptacles located on the consoles.

Hot Plate Circuit Breaker

The Hot Plate circuit breaker provides power and circuit protection for the hot plate.

APU Circuit Breaker

The APU circuit breaker provides power and circuit protection for the APU.

Flasher Lights Circuit Breaker

The Flasher Lights circuit breaker provides power and circuit protection for the flasher lights.

Classification Lights Circuit Breaker

The Classification Lights circuit breaker provides power and circuit protection for the classification lights

Headlight Circuit Breaker

The Front Headlights circuit breaker provides power and circuit protection for the headlights at the #1 end of the locomotive.

Air Dryer Circuit Breaker (ADCB)

The Air Dryer circuit breaker (ADCB) provides power and circuit protection for the air dryer equipment.

Air Brake #1 Circuit Breaker (ABCB1)

The Air Brake circuit breaker (ABCB1) provides power and circuit protection for the air brake equipment (POU and air brake components).

Air Brake #2 Circuit Breaker (ABCB2)

The Air Brake circuit breaker (ABCB2) provides power and circuit protection for the air brake equipment (POU and air brake components).

Cab Light #1 Circuit Breaker

The Cab Light #1 circuit breaker supplies power and circuit protection to the cab light.

Fuel Pump Circuit Breaker

The Fuel Pump circuit breaker provides power and circuit protection for the fuel pump.

Local Control Circuit Breaker (LCCB)

The Local Control circuit breaker (LCCB) provides power and circuit protection to a variety of relays, switches, and subsystems of the locomotive.

Multi-task Circuit Breaker (MTB)

The Multi-task circuit breaker (MTB) provides power and circuit protection to the IPM(EAB). Regulated power supply, as well as to portions of the Electronic Air Brake (EAB) system.

Battery Charge and Computer Circuit Breaker (BCCB)

The Battery Charge and Computer circuit breaker (BCCB), provides power and circuit protection to the locomotive control power supply and the controller units.

Air Conditioning / Heater Switch

The Air Conditioning/Heater switch controls the roof mounted air conditioning and heating (HVAC) unit This unit provides ventilation, heating, and cooling. When the unit is operating and damper is pulled down, it provides forced fresh air into the Operator Cab.

The Control Switch has eight positions:

OFF - Shuts off the Air Conditioner and Fan unit.

LOW FAN - Provides air circulation at low fan speed.

HIGH FAN - Provides air circulation at high fan speed.

LOW COOL - Provides low cooling air at low fan speed.

HIGH COOL - Provides maximum cooling air at high fan speed

LOW HEAT - Provides low heat at low fan speed.

HIGH HEAT - Provides maximum heat at high fan speed.

CAUTION :

- *The fresh air damper handle of the outside air inlet should be closed when operating in trail position, tunnel operation or when otherwise adverse condition exists.*
- *Do not block the return air grill.*

NOTE :

- *The Air Conditioner circuit breaker, located on the Engine Control (EC) panel, must be set to ON to operate the air conditioner and heater.*
- *When locomotive has been soaked at high ambient, fully open doors and windows as well as fresh air damper for 2-5 minutes and start HVAC in High Cool mode to allow ambient air replace the hot air inside cabin. Once the air inside Cab reached ambient temperature, tightly close doors and windows to allow HVAC cool the Cab down. For faster Cab temperature also, close fresh air damper.*

Engine Start Pushbutton

Pressing the Engine Start Pushbutton initiates the engine start sequence.

Engine Stop Pushbutton

Pressing the Engine Stop Pushbutton shuts down the engine and APU.

Strip Lights Light Switch

The Strip Lights Light switch turns ON and OFF the strip lights.

Control Compartment Light Switch (CCLS)

The Control Compartment Light Switch (CCLS) turns ON and OFF lights for the control compartments.

Ground and Ladder Light Switch

The Ground and Ladder Light switch turns ON and OFF lights for the ground and ladder.

Dome Light Switch (DOLS)

The Dome Light switch (DOLS) turns ON and OFF the dome light for the control compartments.

Cab End / Long Hood Forward Light Switch

The Cab End / Long Hood Forward Light switch (CCLS) turns ON and OFF the Cab End / Long Hood forward lights.

Display #3 Circuit Breaker

The Display #3 circuit breaker provides power and circuit protection for the #3 Display

Display #4 Circuit Breaker

The Display #4 circuit breaker provides power and circuit protection for the #4 Display.

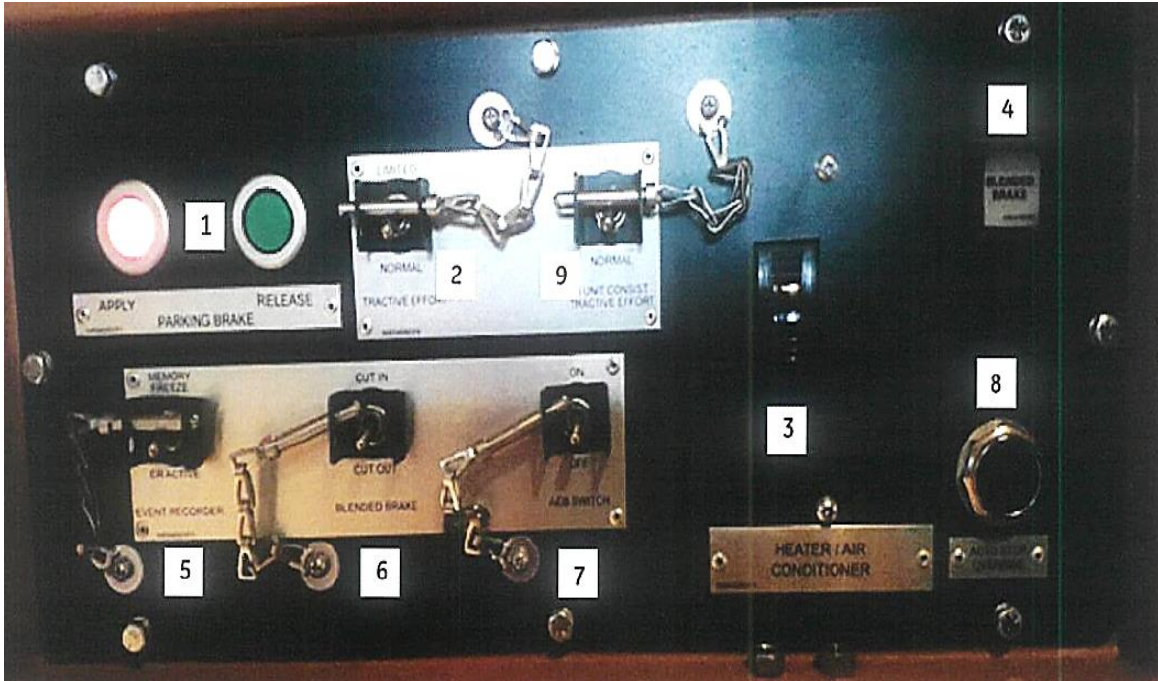
Display #1 Circuit Breaker

The Display #1 circuit breaker provides power and circuit protection for the #1 Display.

Display #2 Circuit Breaker

The Display #2 circuit breaker provides power and circuit protection for the #2 Display.

2.5.3. CB PANEL



CB Panel

REF.	DESCRIPTION
1	PARKING BRAKE APPLY/RELEASE PUSH BUTTONS
2	TRACTIVE EFFORT LIMIT SWITCH
3	HEATER/AIR CONDITIONER CIRCUIT BREAKER
4	BLENDED BRAKE INDICATOR
5	EVENT RECORDER SWITCH
6	BLENDED BRAKE SWITCH
7	AEB SWITCH
8	AUTO STOP OVERRIDE PUSHBUTTON
9	3 UNITS CONSIST - TRACTIVE EFFORT LIMIT SWITCH

Parking Brake Apply Pushbutton

Pressing the Parking Brake Apply Pushbutton applies the parking brake.

Parking Brake Release Pushbutton

Pressing the Parking Brake Release Pushbutton releases the parking brake.

Tractive Effort Limited / Normal Switch

The Tractive Effort (TE) Limited or Normal switch can be used to activate TE Limit function by turning it to "Limited" position. When the switch is in "Limited" position, the TE will not exceed 294 kN (30 t). When the switch is in "Normal" position, the full TE is available.

Three Unit Consists Tractive Effort Limited / Normal Switch

An additional TE limit switch to limit the TE equivalent to that of 2-unit when locomotives are coupled in 3-unit formation is provided on the EC panel. This TE limit switch is to be used to enable / disable TE limiting for the entire duration of 3-loco formation operation.

CAUTION:

- *WDG6G loco is designed for 2 WDG6G unit formation operation with full tractive effort. Whenever a formation of 3 locomotives is made and prior to the start of the trip, "3-UNITS CONSIST TRACTIVE EFFORT SWITCH" located on the EC panel should be moved to "LIMITED" position on all WDG6G locomotives in the formation and shall remain that way for the entire duration of the trip till the 3 unit formation is uncoupled.*
- *WDG6G locomotive shall always be placed in the lead or middle positions of the formation, only in case of a 3-unit formation with other type of locomotives in the formation.*
- *It may be noted that "3-UNITS CONSISTS TRACTIVE EFFORT SWITCH" is different than the "TRACTIVE EFFORT SWITCH" on the EC Panel which is used for limiting TE on bridges and structures.*

Heater / Air Conditioner Circuit Breaker

The Heater / Air Conditioner circuit breaker supplies power and circuit protection to the heater / air conditioner.

Blended Brake Indicator

The Blended Brake Indicator light lights up when the locomotive is configured for Blended brake operation using the blended brake switch.

Event Recorder Freeze / Active Switch

Event Recorder Memory Freeze switch is a two-position toggle switch i.e. one position is "Active" and other is "Memory Freeze". Whenever the switch is at "Active" position the Event recorder is active and recording. Whenever switch is placed in Memory Freeze position, the Event Recorder is not recording.

Blended Brake Switch

The Blended Brake switch turns ON and OFF the Blended Brake function.

AEB ON/OFF

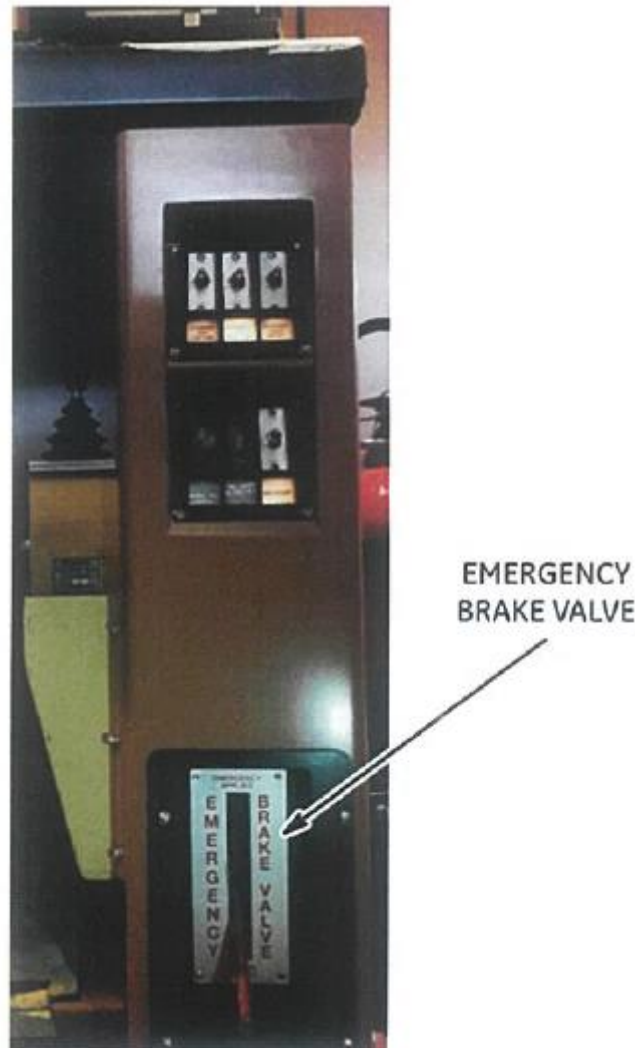
Overspeed limit setting toggle switch has two states either "ON" or "OFF". Whenever switch is in "ON" position locomotive overspeed limit will be limited to 30 KMPH and otherwise at 100 KMPH.

Auto Stop Override Pushbutton

The Auto Stop Override Pushbutton temporarily overrides the Auto Engine Start Stop (AESS) function.

2.5.4. EMERGENCY BRAKE VALVE / PNEUMATIC PARKING BRAKE

The Emergency Brake valve is located on each control console. There is a handle which controls the air brake pressure. Lifting this handle causes an Emergency Brake application.



Emergency Brake Valve on Control Console

The parking brake will be a spring applied, air released unit. This functionality will be built into four of the twelve self-contained braking units installed inside the truck / bogie frame. The system will apply brakes to two wheels, on two axles per truck / bogie. The parking brake holding force will be sufficient to hold the locomotive on a 1 in 37 grade.

The parking brake will have a parking brake control switches in the engine control panel in the driver cab, which can be operated by the loco pilot, and will also have manual release capability, at each tread brake unit, for cases where no air pressure is available.

The Parking Brake can be released in the following ways:

- Using the control pushbuttons on the EC panel.
- Manually, by pulling the releasing mechanism. (the manual release capability at each tread brake unit is applicable for cases where no air pressure is available.)

WARNING :

- *Before releasing the Parking brake manually, ensure the TBU parking brake cylinder air pressure is adequate to reapply the Parking Brake.*
- *If the Locomotive Control System is not functioning / responding or Locomotive battery is completely discharged, DO NOT release the Parking Brake manually till this Locomotive is coupled to a working Locomotive.*
- *If the Locomotive does not have adequate air pressure or Locomotive with discharged battery / Dead Locomotive and Parking brake is manually released Parking Brake cannot be reapplied again.*

2.5.5. DEVICES ABOVE THE LOCO PILOT AND CREW MEMBER SEATING

View of Drivers Cab

Overhead Fan Controls

The Overhead Fan Controls include a switch to turn the overhead fan ON and OFF, and a rheostat to control the speed of the overhead fan.

Overhead Fan

Overhead fan provides ventilation air to the cab.

Defogger Indicator Light

The Defogger Indicator Light will illuminate when the defogger is in operation. Defogger indicator light for long hood operation is located on Control Console 2.

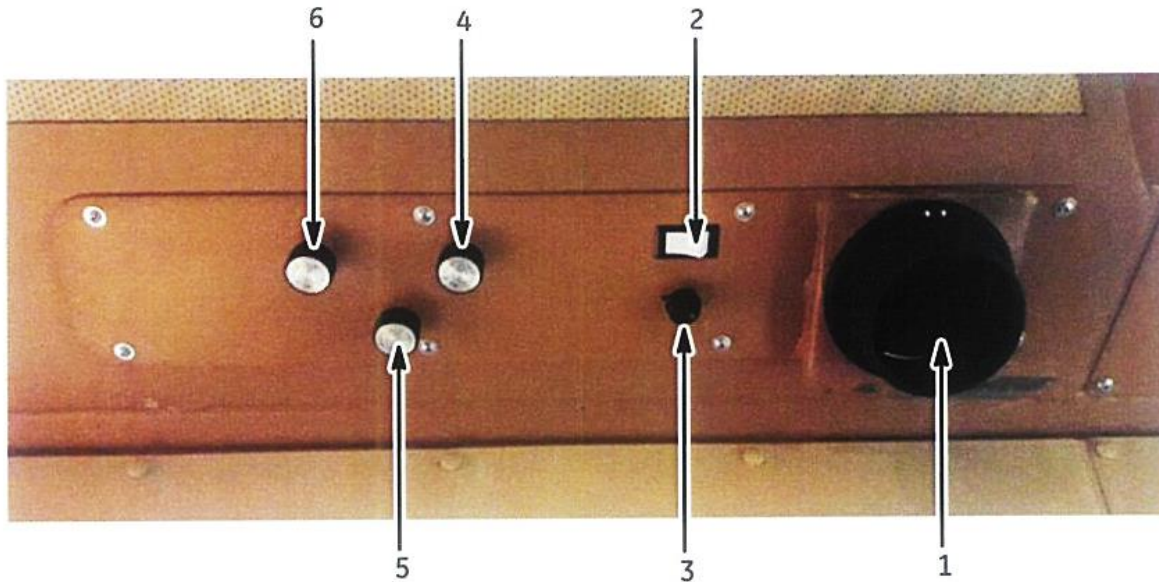
Audio Alarm Panel

The Audio Alarm Panel, located in the center of the Overhead Console, provides an audible alarm to the locomotive crew for a variety of systems, including the Alerter, and Locomotive Overspeed.

Desk Lights and Controls

The side-mounted Order Lights illuminate the writing surface in the middle of the both desks. Each light comes equipped with a dimmer control and a toggle switch to turn the light OFF and ON.

The Wiper knobs and Washer pneumatic pushbuttons control the front windshield wipers and washers. Turn the wiper knobs clockwise to turn on the wipers and anti-clockwise to turn the wipers OFF.



Desk Lighting & Controls

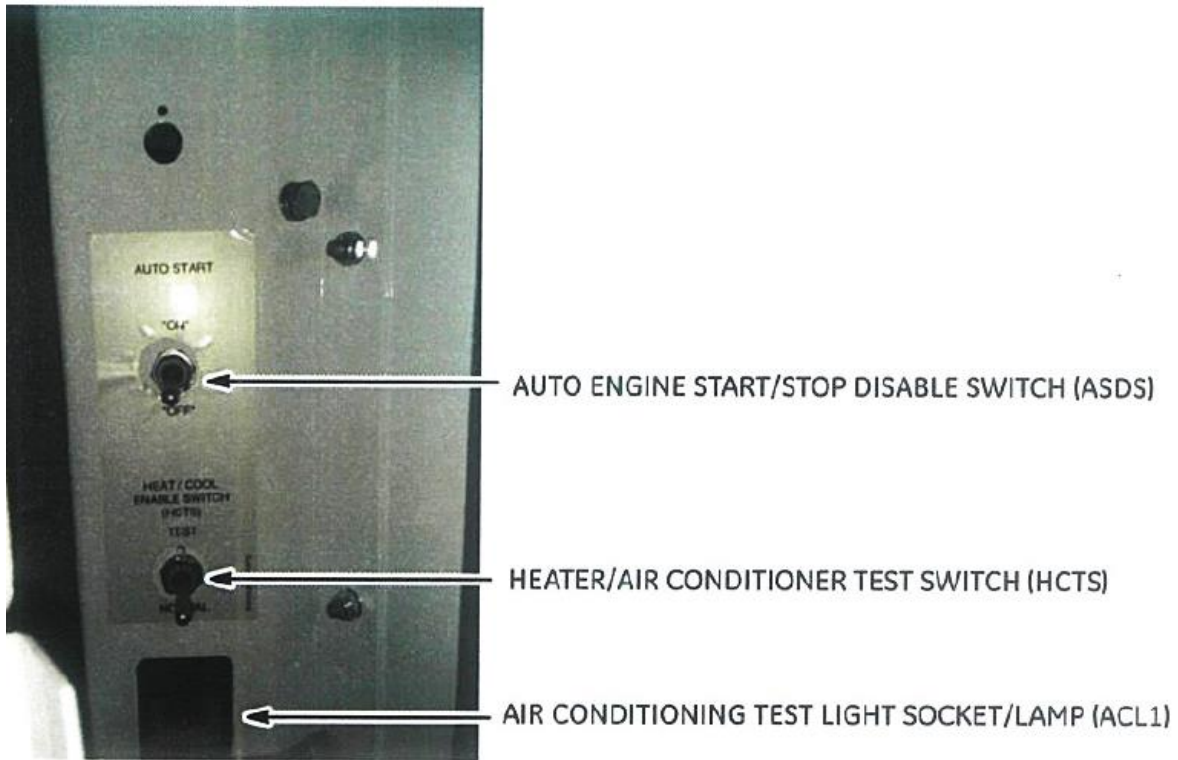
REF.	DESCRIPTION	REF.	DESCRIPTION
1	LIGHT	4	FRONT WINDOW WIPER CONTROL
2	LIGHT SWITCH	5	WINDOW WSHER CONTROL
3	DIMMER SWITCH	6	FRONT DOOR WIPER CONTROL

2.5.6. DEVICES IN CONTROL AREA 1 (CA1)

Control Area 1 is located behind the doors on the rear wall of the #1 End Driver Cab.

Auto Engine Start/Stop Disable Switch (ASDS)

The Auto Engine Start / Stop Disable switch (ASDS) is located in CA1 and is accessible from the Driver Cab. For general operation ASDS is in the OFF position.



Control Area 1 Switches

Heater/Air Conditioner Test Switch (HCTS1)

The Heater / Air Conditioner Test switch (HCTS1) is located in CA1 and is accessible from the Driver Cab. For general operation HCTS is set to the NORMAL position. If the HCTS is switched to the TEST position for at least 1 or 2 seconds, the unit goes into TEST mode for a cycle lasting 15 minutes. After the test, the air conditioning unit reverts to normal operation.

Air Conditioner Test Light (ACL1)

The Air Conditioner Test Light (ACL1) is located in CA1 and is accessible from the Driver Cab. The ACL indicates that the air conditioning unit is in TEST mode if the light is illuminated.

Fuel Injection Test Receptacle

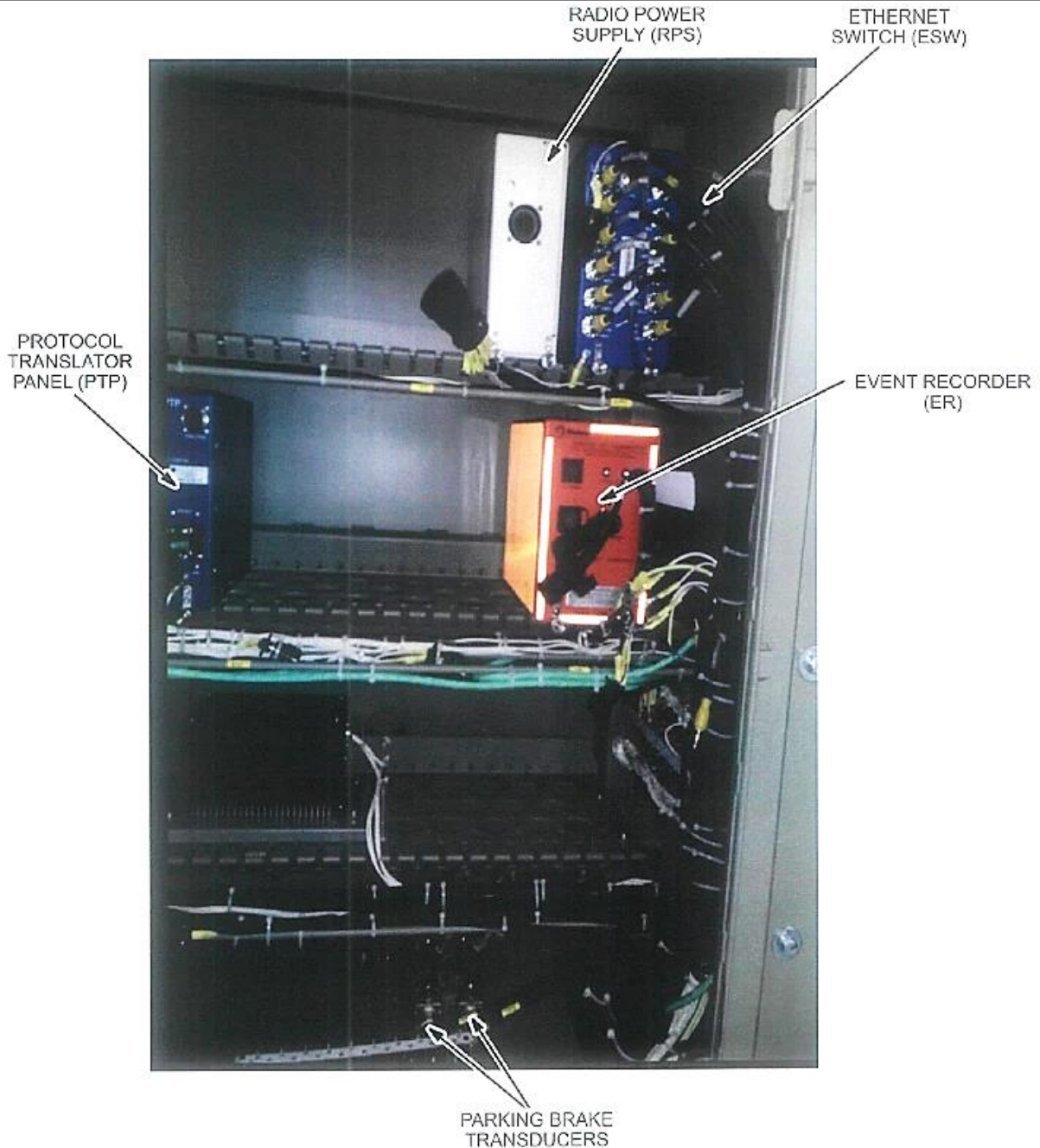
The Fuel Injection Test Receptacle (FIRS) is located in CA1 and is accessible from the Operator Cab.

2.5.7. ELECTRONIC EQUIPMENT LOCKER

The Electronic Equipment Locker is located on B-Side behind (outside) of the driver cab. The following descriptions detail the function and operation of the devices in the Electronic Equipment Locker.

Radio Power Supply

The 15-volt Power Supply provides power for the electronic devices mounted in the Electronic Equipment Locker, as well as other devices within the locomotive control system.



Electronic Equipment Locker

Ethernet Switch Module

The Ethernet Switch Module provides ports for multi-node connection of various devices for Ethernet communication and operation.

Protocol Translator Panel

The Ethernet Switch Module provides ports for multi-node connection of various devices for Ethernet communication and operation.

Event Recorder

Event Recorder is a crash hardened device for recording the pre-defined data set. Following are the parameters of pre-defined data set:

- Locomotive Speed (Km/h)
- Time (in hours, min &sec)

- Distance (in meters)
- Tractive Effort (in kN)
- Generator Power (in kW)
- EAB BP Pressure (In kg/cm²)
- EAB BC Pressure (In kg/cm²)
- EAB MR Pressure (In kg/cm²)
- Dynamic Brake Call
- Dynamic Brake Setup
- Throttle
- Direction Call
- Front Headlight Status
- Rear Headlight Status
- Horn
- PCS
- EAB Penalty
- TE Limit
- Memory Freeze
- Engine Speed
- Engine Water Temperature

Following indications will be available on the Event recorder:

- *Power LED* - ON when event recorder is ON.
- *Recording LED* - Always ON when event recorder is recording.
- *USB Transfer Status LED*. - ON whenever download is active on USB download port of event recorder otherwise OFF. Flashing if the connected USB drive has error.

Parking Brake Pressure Sensors

Two parking broke sensors are provided to detect the air pressure in the parking brake piping thereby detecting a parking brake application or release which will then be displayed on the operator display.

2.5.8. SAND VALVES

The sand valves and cut out cock for the #1 and #2 end trucks/bogies are located behind the door in front side of #1and #2 end of Cabs.

2.5.9. SEAT

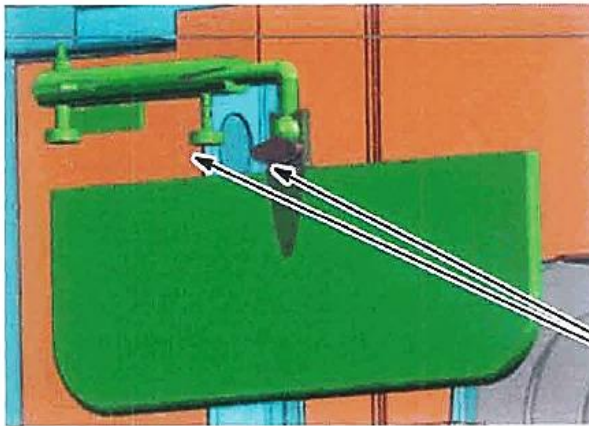
Following are the various adjustments in the seat.

- Back rest
- Back rest adjustment lever. Forward / backward adjustment lever - Pull the lever to allow forward and backward adjustment in a seated position.
- Height adjustment lever - In seated condition, pull the lever lower the height. In unseated condition, (no weight on seat) pull the lever to move the seat up. Force rotation adjustment.
- Rotate the seat, it has four locking positions: 0'. 90°, 180°, 270'.
- Foot lever - Press the foot lever and make necessary lateral adjustment. Release the lever and engage in the slot based on the required lateral movement. Applying

the foot lever, seat can be pushed to left or right.

2.5.10. SUN VISORS

To adjust the visor, loosen the knob behind the visor and tighten the knob after positioning.



KNOBS CAN BE USED FOR ADJUSTMENT OF SUN VISOR, TIGHTEN AFTER REQUIRED ADJUSTMENT

2.5.11. FIRE EXTINGUISHER

Two CO₂ type fire extinguishers are provided, one in the driver cab and one in the Radiator Cab.

2.6. OTHER DEVICES AND EQUIPMENT

2.6.1. AIR BRAKE SYSTEM

The air brake equipment consists of the Electronic Brake Valve (EBV), Pneumatic Operating Unit (POU), trainline brake pipes, and electronic devices for loco pilots' control. The brake system is an electro-pneumatic system that needs locomotive battery power to function.

Electronic microprocessor based electro-pneumatic brake equipment is provided for control of the air brakes on locomotives and wagons coupled together in trains. This application supports for freight and passenger operation.

The EBV is an operator-actuated selector for Automatic Brake or Independent Brake operation. The movement of the brake handle corresponds to appropriate brake application.

The air brake compartment, containing the POU, is located on the B-side of the locomotive in the Radiator Cab. The POU consists of the control components (pneumatic, electrical, mechanical, and electronic) for air pressure regulation in the trainline air pipes.

The Dead Engine cut out on the POU allows the loco pilot to set up a locomotive to be towed with a dead diesel engine. The setting of the valve, for a Dead (in tow) locomotive, is the IN position. The normal setting of the valve for a functioning locomotive, is the OUT position.

The trainline brake piping is connected at the end of the locomotive.

Operating Pressure Range for the Air Brake System

Pressure	Value psi (kgf/cm ²)
Main Reservoir Pressure	114-142.2 psi (8-10 kgf/cm ²)
Brake Pipe Pressure	71+/-1.4 psi (5.0 +/- 0.1 kgf/cm ²)
Maximum Independent Brake Cylinder Pressure	74+0/-1.4 psi (5.2 +0/-0.1 kgf/cm ²)
Minimum Service Automatic Brake Cylinder Pressure	16+0/-1.4 psi (1.1 +0/-0.1 kgf/cm ²)
Maximum Service Automatic Brake Cylinder Pressure	26+0/-1.4 psi (1.8 +0/-0.1 kgf/cm ²)
Emergency Brake Cylinder Pressure	26+0/-1.4 psi (1.8 +0/-0.1 kgf/cm ²)
Maximum Pneumatic Backup Mode Brake Cylinder Pressure	51+0/-3 psi (3.6 +0/-0.2 kgf/cm ²)

Main Reservoir Drain Valves

The main reservoir drain valves allow accumulated moisture to be removed from the main reservoirs. These drain valves are automatic and controlled by the drain valve magnet valve (DVMV). The valve shall operate when the main engine is operating and during the AESS shutdown when the APU engine and air compressor operates.

The valves shall only shutdown during the main diesel engine shutdown and APU engine shutdown. The drain valves are mounted on the drain boss of the two main air reservoirs and is pilot air actuated.

Pneumatic Backup

The electronic air brake includes a backup system that controls the brake cylinder pressures if the EAB power is interrupted. When cut-in the backup brake system allows the driver to control the locomotive brake pipe (BP). The pneumatic backup valves included in the primary brake system shall develop Locomotive brake cylinder (BC) pressure based on the BP reduction. When cut out the backup brake system shall not affect the normal operation of the primary locomotive brake system operating in either lead or trail mode.

The brake system can be setup for Pneumatic backup by using three switches:

1. Pneumatic backup brake switch located on the pneumatic rack.
2. Backup active console handle switch (PCSS) located in radiator cab in C12 compartment.
3. Goods/Passenger switch located on the pneumatic rack.

Before switching to pneumatic backup brake mode, it should be ensured that the primary air brake handle is in Full Service position and pneumatic backup brake handle in the active console is in Apply position.

Pneumatic backup brake switch activates the pneumatic gauges in the cab and cuts in the air brake for backup brake operation. Active Console handle switch in C12 compartment activates the respective air brake handle in the operator cab. When pneumatic backup brake switch is operated to switch on backup brake, active console handle must be operated to select the correct handle.

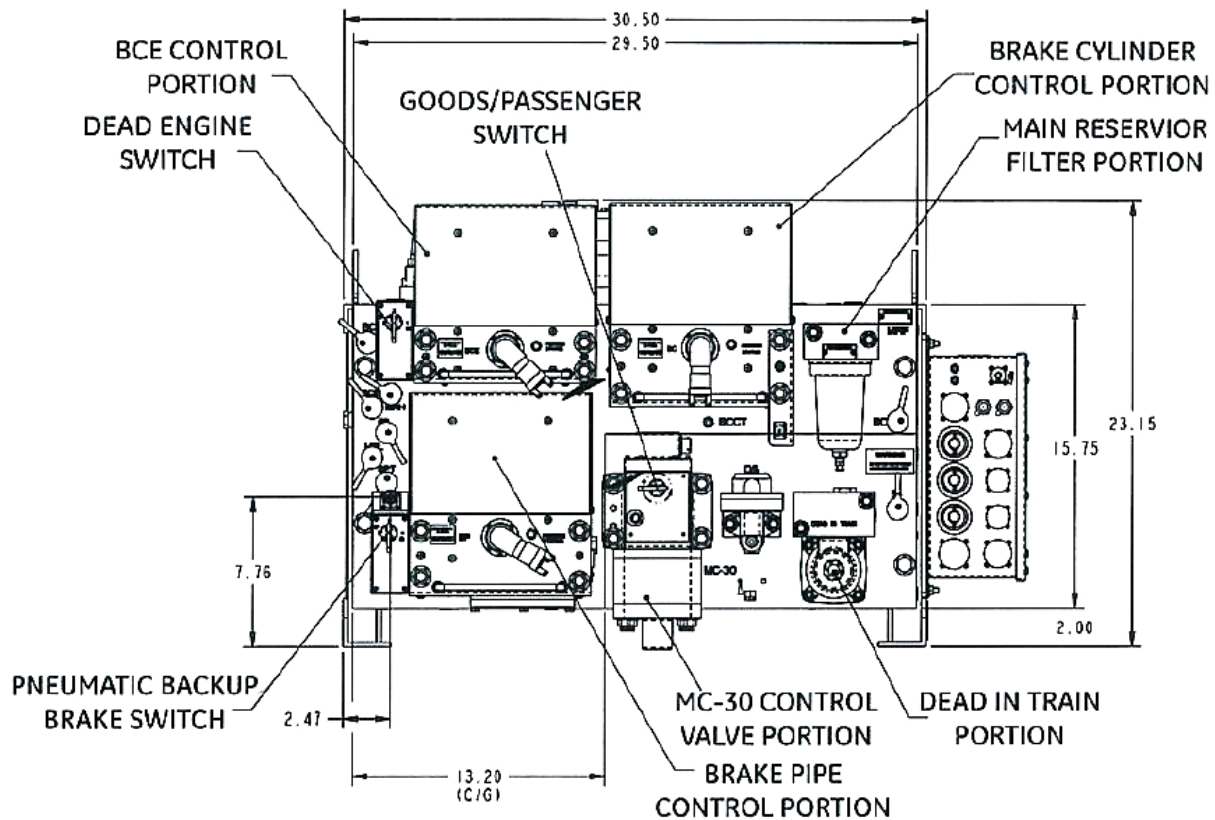
If Short Hood Console is in operation, active console handle switch should be moved to Handle 1 position.

If Long Hood Console is in operation, active console handle switch should be moved to Handle 2 position.

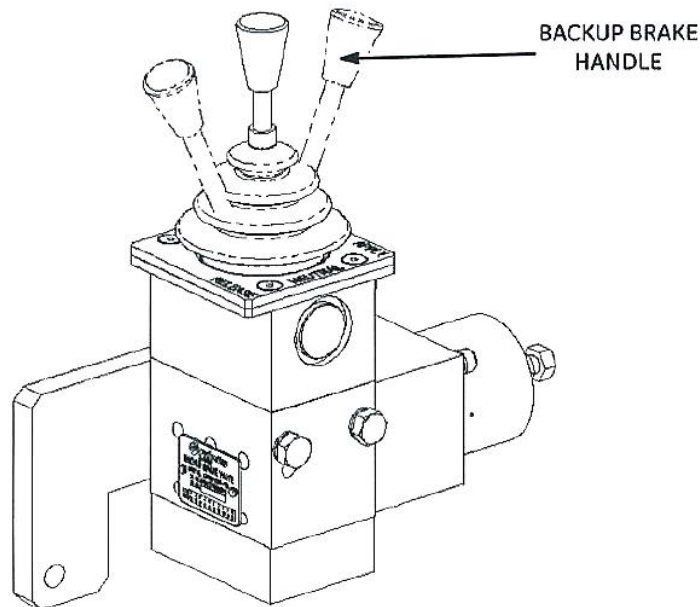
WARNING: *If active console handle is not selected correctly during backup mode, backup brake handles may not work.*

Goods/Passenger switch selects the goods or passenger timings on the air brake. When setting up the brake system. Goods/Passenger switch shall be selected based on the respective trailing stock.

Once the respective switch positions are set, verify on the HMI display that Pneumatic backup alarm is displayed on the HMI screen. Goods or Passenger is visible on the main operating screen according to the switch position on the air brake rack.



Pneumatic Backup Switch Location



Backup Brake Handle

Brake Pipe Leakage Test

GUIDELINES :

- I. *Ensure that the reverser handle is centered, throttle notch is in idle position, and independent brakes are applied on the locomotive.*
- II. *Ensure that the locomotive (and/or rake if conducting test with train formation) is secured against motion and parking brakes are applied on the locomotive.*
- III. *Ensure engine is running and EC switch is in ISOLATE position.*
- IV. *Ensure that the main reservoir is charged between 8-10 kg/cm², before proceeding for the test.*

1. Ensure that all the angle cocks on both ends of the locomotive are closed.
2. Move the automatic brake handle to RUN position and charge the brake pipe to 5.0 +/- 0.1 kg/cm².
3. Wait for 5 minutes for pressures to stabilize.
4. Move the rotary switch on brake handle to TEST.
5. Move the automatic brake handle to MIN position and ensure that equalizing reservoir pressure is reduced to 4.6 +/- 0.1 kg/cm² and verify brake pipe pressure is maintained at 5.0 +/- 0.1 kg/cm².
6. Wait for 5 minutes. Verify that the amount of brake pipe drop in these 5 minutes should not be more than 0.7 kg/cm².

NOTE: *If leakage observed in step 6 is not within limits, check the locomotive for any leakages in the brake pipe and correct them.*

7. In order to restore the system, move the automatic brake handle to FULL position and rotary switch to LEAD position.
8. Recharge the brake pipe by moving the automatic handle to RUN position.

Checking the Capability of Locomotive Charging / Releasing of Train Brake

GUIDELINES :

- I. *Ensure that the reverser handle is centered, throttle notch is in Idle position, and independent brakes are applied on the locomotive.*
 - II. *Ensure that the locomotive (and/or rake if conducting test with train formation) is secured against motion and parking brakes are applied on the locomotive.*
 - III. *Ensure engine is running and EC switch is in ISOLATE position.*
 - IV. *Ensure that the main reservoir is charged between 8-10 kg/cm², before proceeding for the test.*
1. Ensure that all the angle cocks on both ends of the locomotive are closed.
 2. Ensure that the rotary switch on brake handle to LEAD.
 3. Move the Distributor Valve knob position to Passenger Mode on the Air Brake rack (POU).
 4. Ensure Independent brake handle to REL position.
 5. Move the automatic brake handle to EMERGENCY position.
 6. Secure the #1 end brake pipe hose and Install a 7.5 mm test orifice at #1 end of brake pipe hose
 7. Open the angle cock at the #1 end of the locomotive.
 8. Follow on screen instructions and Move the automatic brake handle to RUN position after 60 secs are over
 9. Verify the following parameters after approx. 1 minute, when the parameters stabilize.
 - a. BP Pressure range is between 4.2 to 4.6 kg/cm²
 - b. ER Pressure range is between 4.8 to 5.1 kg/cm²
 - c. BC pressure goes to 0 kg/cm²

NOTE: *The message may appear on the HMI screen that indicating "HIGH FLOW DETECTED. CHECK BRAKE PIPE CONTINUITY".*

NOTE: *If Brake Pipe pressure is not within limits as mentioned in step 9, verify 7.5 mm test orifice is used for the test.*

10. Restore the system after the test is complete.

2.6.2. AIR DRYER

Air Dryer removes moisture from the compressed air system. It is installed in a mounting bracket on the locomotive platform. This arrangement allows easily removal for servicing.

A humidity indicator provides information on the operational status.

- Blue color indicates that the dryer is operating correctly.
- Any other color such as lavender, white, yellow or brown indicates that further inspection is required.

The air dryer can be bypassed in case of malfunction/defect by closing the cut outs in the input air pipe and the output air pipe and opening the bypass valve.

For normal operation of the Air Dryer:

- a. Close the bypass valve (handle parallel to pipe).

b. Open both isolation valves (handle perpendicular to pipe).

Bypass operation of Air Dryer:

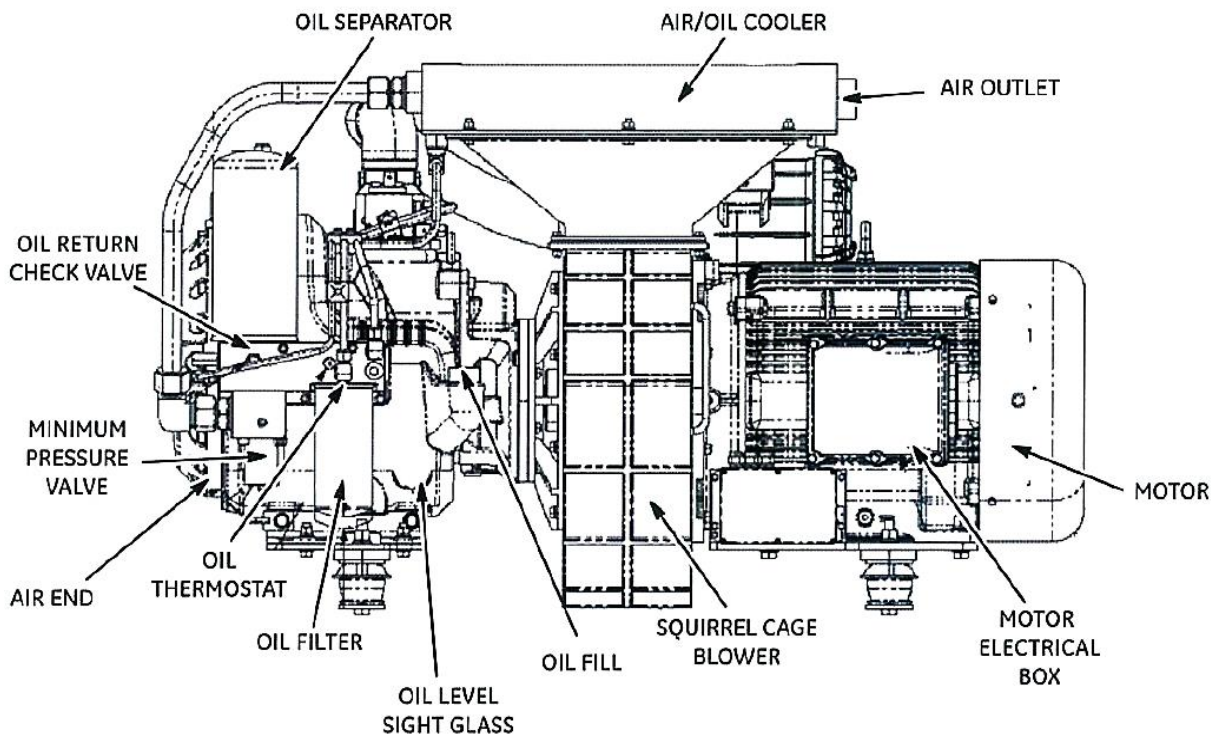
- a. Close both isolation valves (handle parallel to pipe).
- b. Open the bypass valve (handle perpendicular to pipe).

2.6.3. AIR COMPRESSOR

The locomotive Air Compressor supplies compressed air used for the locomotive and train air brake systems. The electric motor driven, single-stage compressor is located in the Radiator Cab

The Air compressor Magnet Valve (CMV) cutout cock is on integral part of the air compressor. Air compressor can be forced to run loaded upon closing the main reservoir sensor cutout cock on the C12 panel.

WARNING : While servicing the air compressor, open LCCB on the EC panel to prevent the air compressor motor from starting. The motor-driven air compressor has hot surfaces and may operate at any time with the diesel engine running. Do not service the air compressor while hot and/or diesel engine running as personal injury may occur.

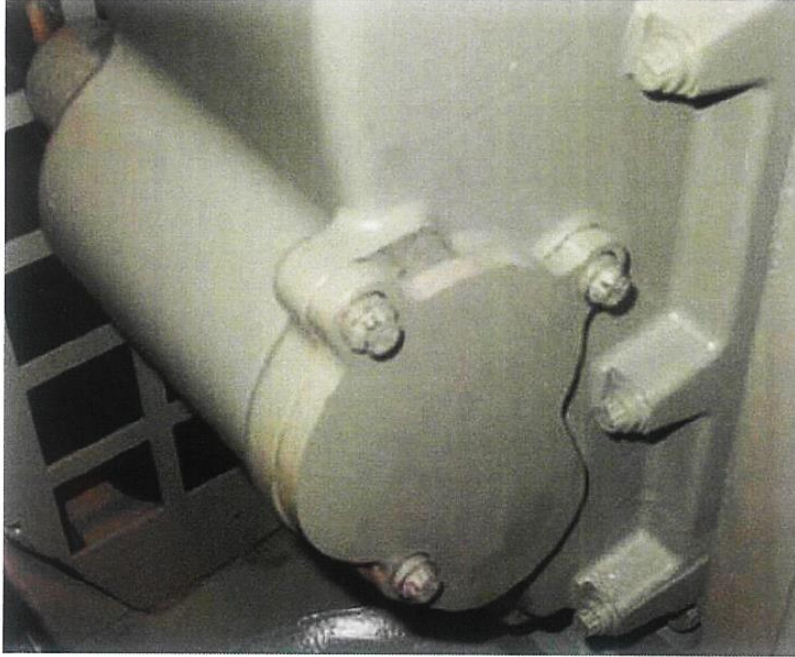


Air Compressor Unit

2.6.4. BARRING-OVER COVER

A barring-over cover is located on the diesel engine on the B side of the locomotive. The barring-over function is typically used in maintenance operations.

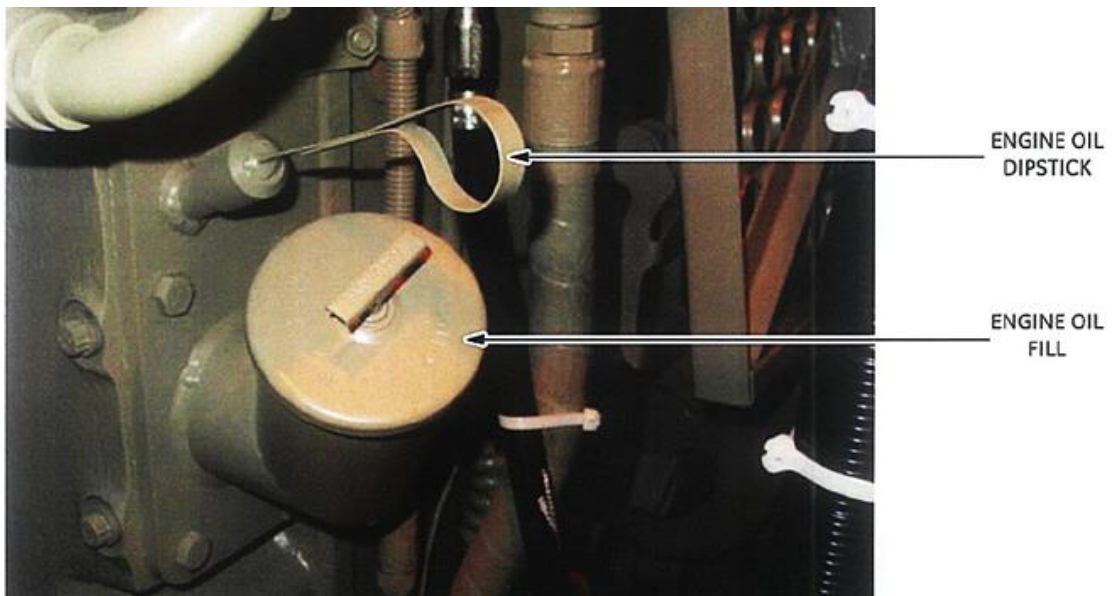
WARNING : Before starting the engine, verify that the barring-over cover is in place and the barring-over tool has been removed. Failure to do so could result in serious personal injury and/or damage to the engine.



Barring Over Cover

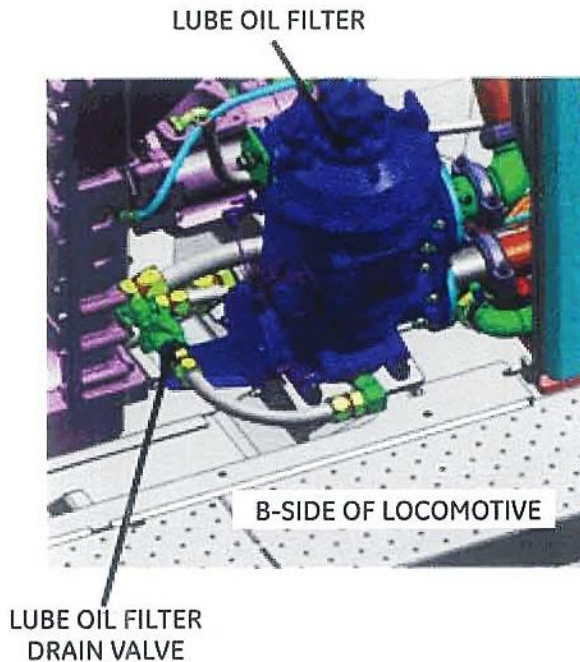
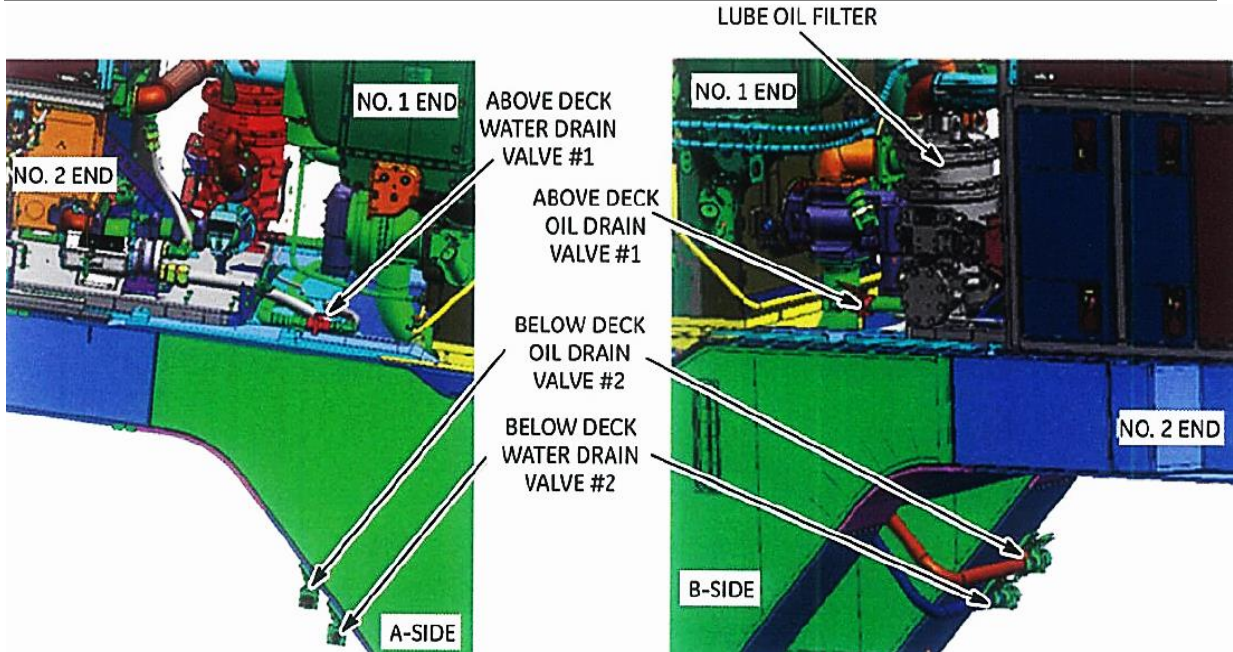
2.6.5. ENGINE OIL

Engine oil dipstick and fill locations can be found on both the A side and B side of the locomotive at the Integrated Front End (opposite the main alternator). The dipstick is marked FULL and ADD. Proper level with the engine idling is between FULL and ADD.



Engine Oil Fill & Dipstick Arrangement

Engine Oil drain locations can be found on the A side and B side of locomotive.



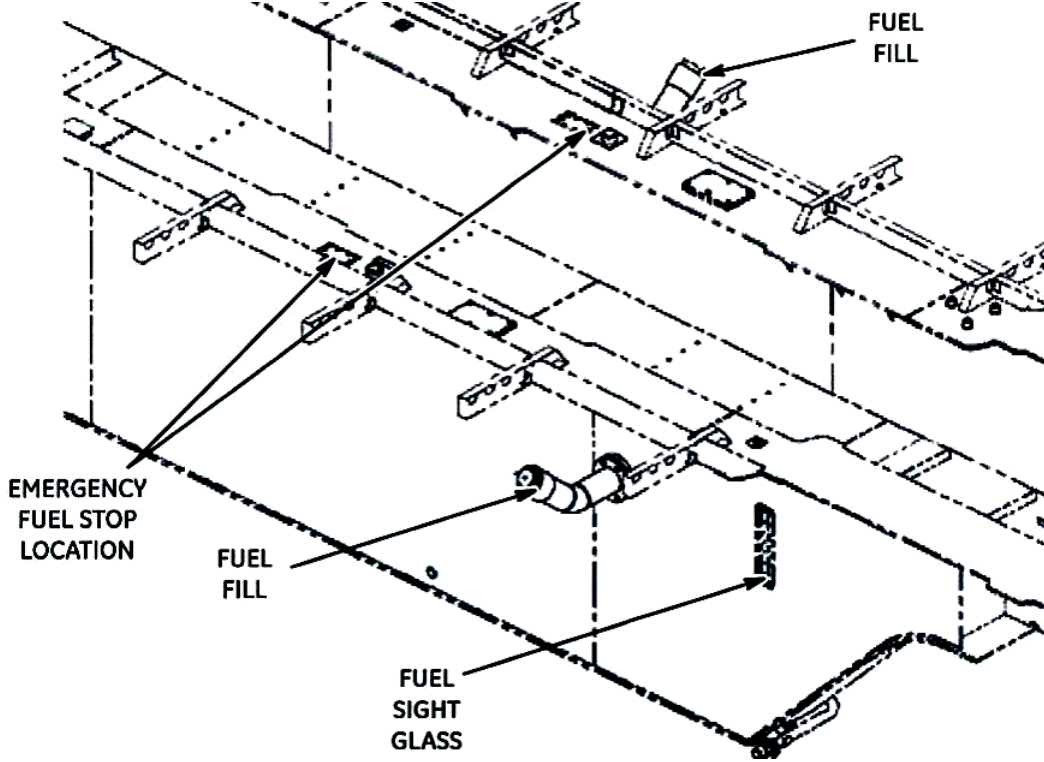
Engine Oil Drain Arrangement

2.6.6. FUEL FILL AND EMERGENCY FUEL STOP

A Fuel Fill and Emergency Fuel Stop button are located at approximately the middle of the locomotive on either side. Pressing the Emergency Stop push button will shut down the APU as well.

Emergency Stop pushbutton are located at

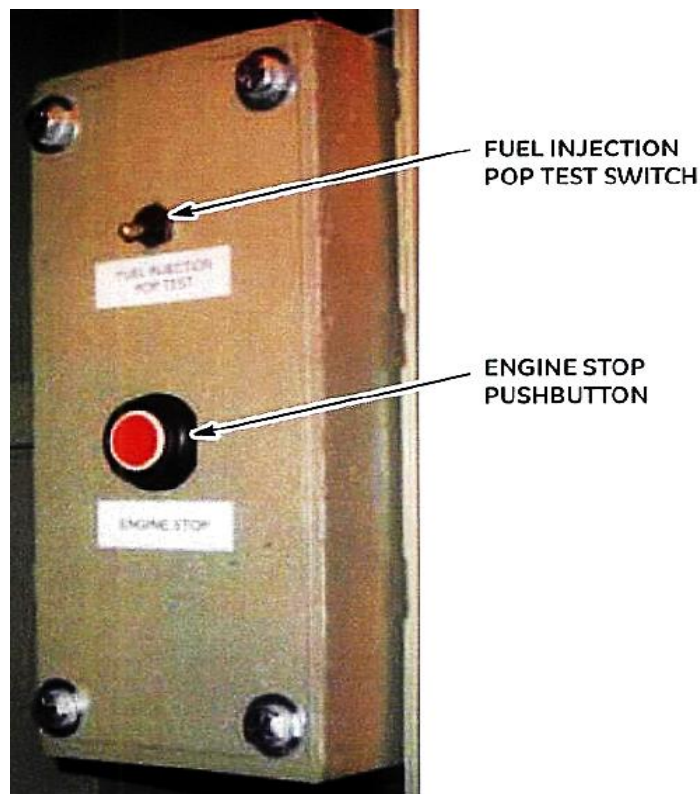
- Engine Control (EC) Panel
- Locomotive Platform
- Near Alternator (A Side)



Fuel Tank Arrangement

2.6.7. FUEL INJECTION POP TEST

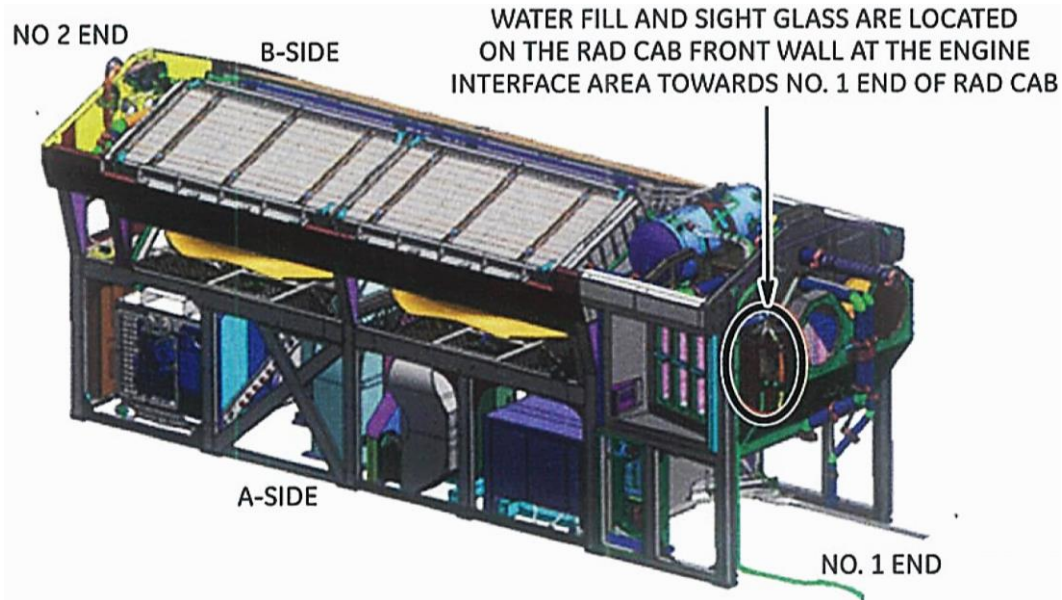
A Fuel Injection Pop Test switch is located near the alternator on the A side of the locomotive. After toggling the switch, the engine speed goes to 330 RPM and the test sequence is initiated.



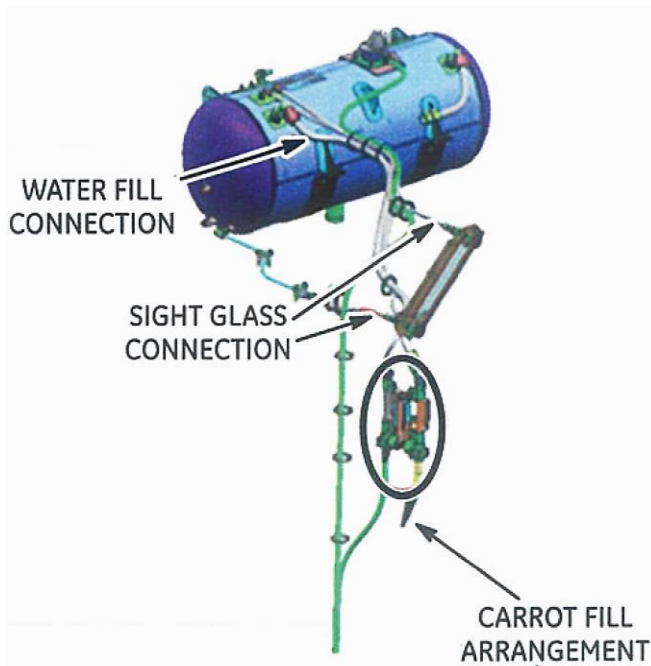
Fuel Injection Pop Test Switch

2.6.8. ENGINE COOLING WATER

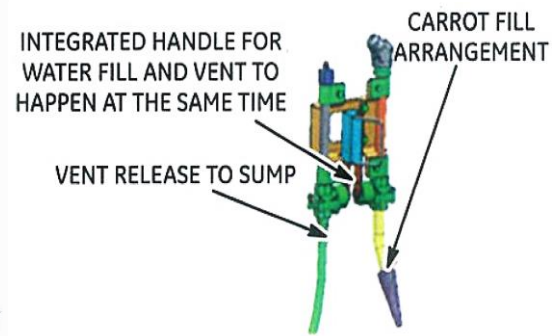
The engine cooling water level can be checked by viewing the water sight glass located on the A side of rad cab near the engine cab interface. A hinged door is located engine cab on A side of the locomotive to access water fill valve and carrot fill. The sight glass has two markings, one for when the engine is running and one for when the engine is shut down.



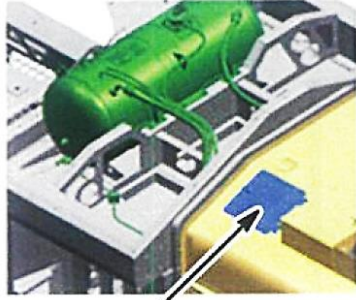
Engine Cooling Water System



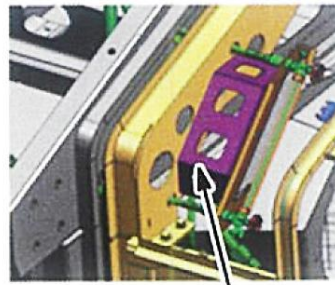
Engine Cooling Water Tank



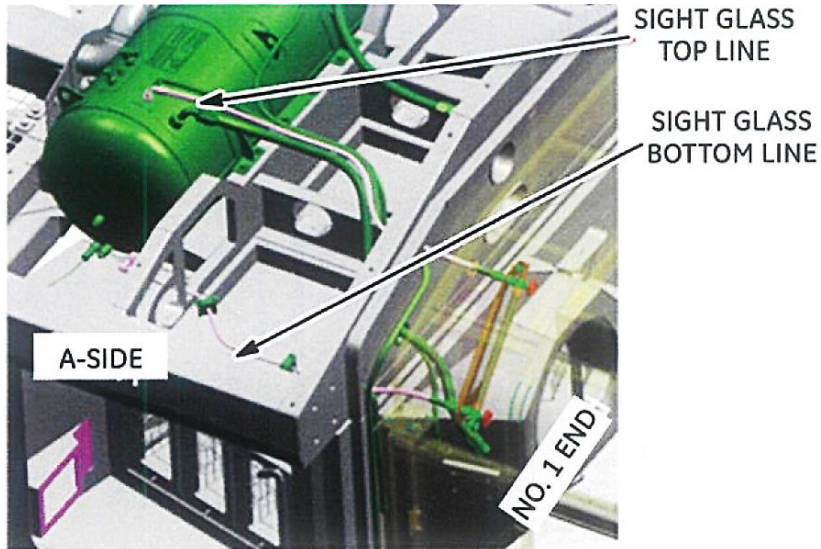
Carrot Fill Arrangement



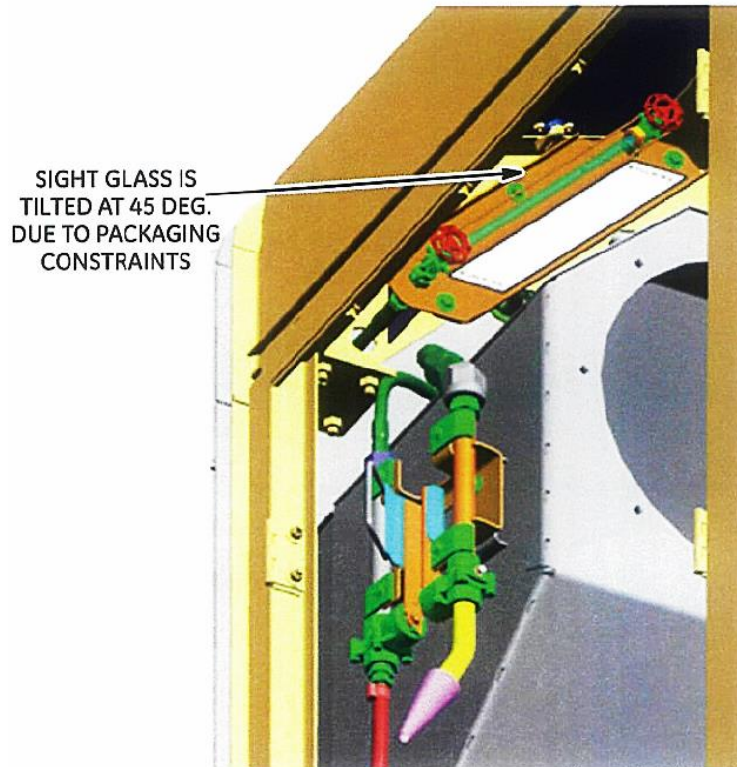
HATCH DOOR ON TOP OF ENGINE CAP TO FACILITATE INSTALLATION



SIGHT GLASS BOLTED ON TO A SUPPORT BRACKET WICH IS WELDED TO ENGINE CAB



Engine Cooling Water Tank and Sight Glass Arrangement



Sight Glass Arrangement

Filling Cooling Water

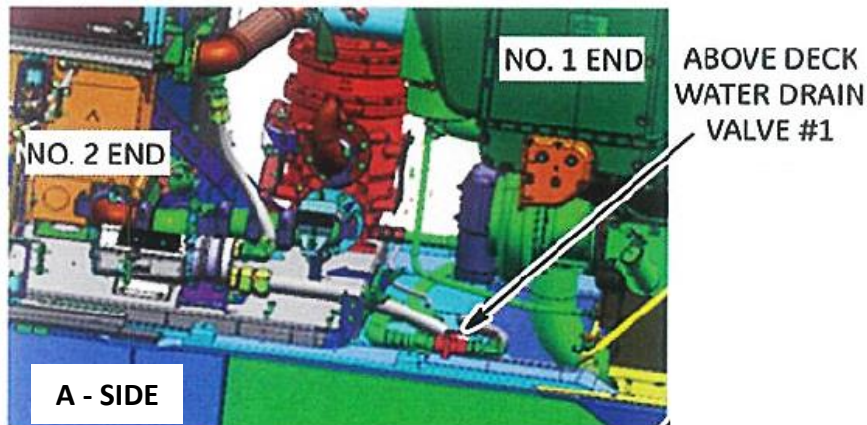
NOTE: When filling the system or adding water treatment compound, proceed according to instructions. Do not overfill the cooling water system.

Fill the system with treated water and recommended anti corrosion using carrot fill when the engine is not running till full mark on the sight glass. Start the locomotive, keep it in idle for some time. This procedure is needed when the loco is filled with water from empty.

Monitor water level on the sight glass it may drop due to air venting from the system. While engine is in idle fill the water again till fill mark level on the sight glass.

Draining Cooling Water

The engine cooling water system may be manually drained by opening the main water drain valve. This valve is located on the A-side of the locomotive.



Coolant Water Drain Arrangement

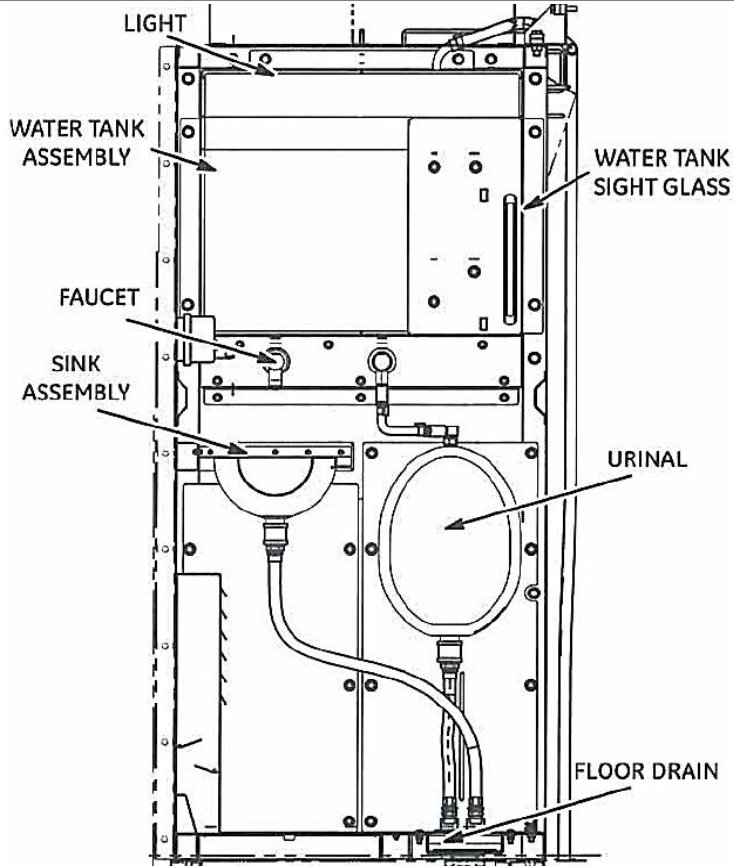
2.6.9. TOILET COMPARTMENT

The toilet compartment is located on the A side of the locomotive at the #1 end of the locomotive adjacent to the Driver Cab.

This compartment is provided with

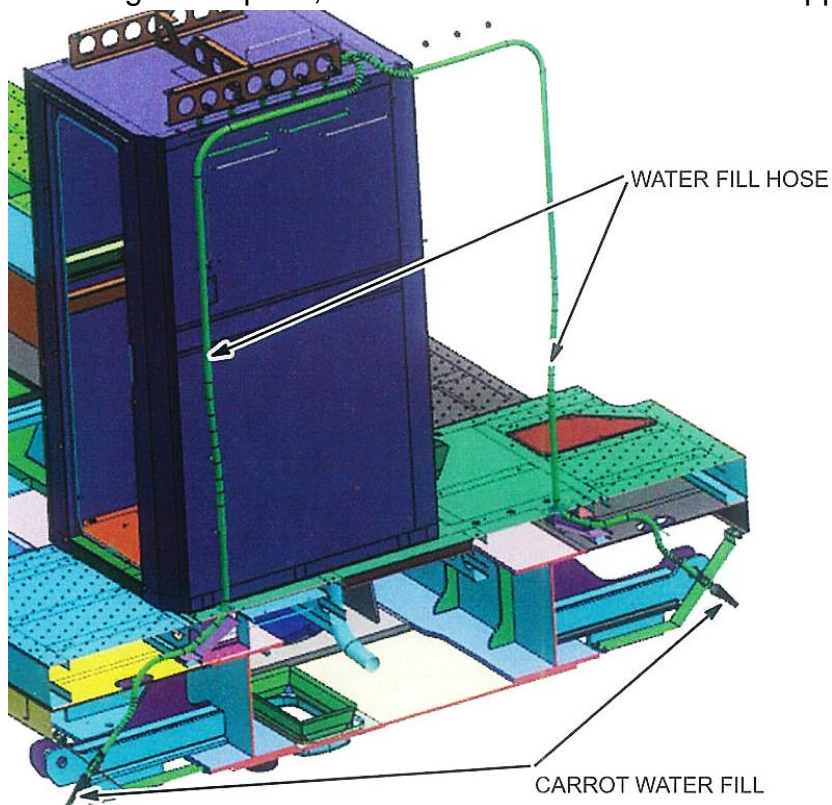
- Light
- Water tank & plumbing
- An exhaust fan (operates when Light is turned on)

A water tank with capacity 45 l and gauge (for water level measurement) is provided for the vacuum toilet and wash.



Toilet Compartment Schematic

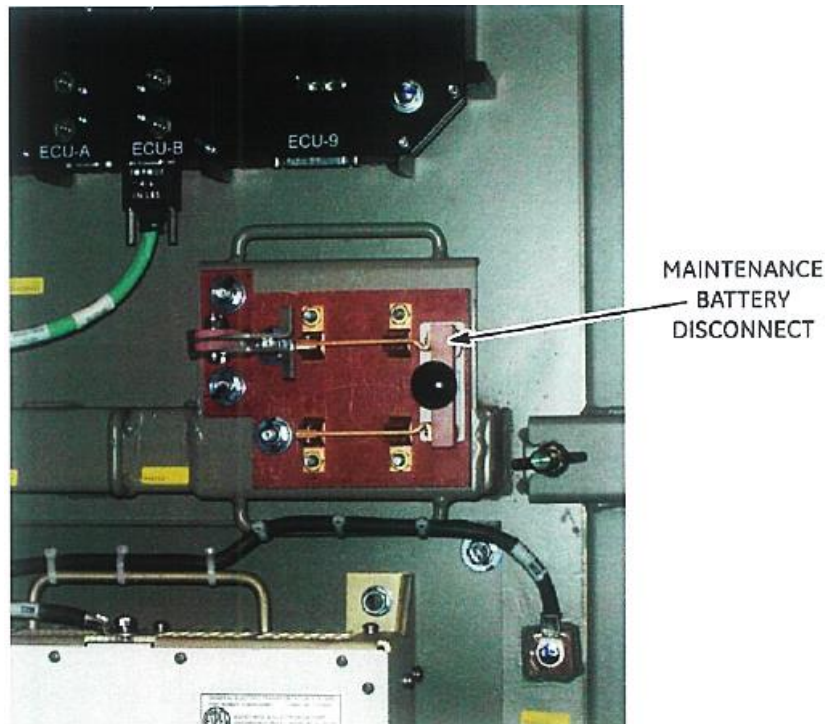
The tank is filled from carrot fills located below deck, one on each side of the locomotive and configured to carry water through hoses. Tank shall be filled through any of the two hoses. When filling is complete, excess water will drain from the opposite hose.



Piping Arrangement – Toilet Compartment

2.6.10. MAINTENANCE BATTERY DISCONNECT

The Maintenance Battery Disconnect is mounted in the Auxiliary Cab on the A side of the locomotive. It may be noted that if the MBD is left open, devices connected after the MBD will not function.



Maintenance Battery Disconnect

2.6.11. CONTROL AREA EQUIPMENT

The computers, relays, contactors, and control panels which make up the locomotive control system are located in control areas throughout the locomotive.

Control Area 1 (CA1) is located behind the rear wall of the driver Cab. It contains the Consolidated Input / Output Panel, terminal boards, switches, and relays required for locomotive operation.

DANGER : *Lethal voltages may be present on some circuits in the Control Areas. When working on Auxiliary Cab or Blower Cab devices, high voltages can be removed by shutting down the diesel engine, isolating and applying lock-out tag-out (LOTO) on battery knife switch located inside CA1 in Operator cab. Wait for the four Capacitor Charge Lights (CCL) to go out prior to opening any doors and reaching into the Auxiliary Cab or Blower Cab.*

DANGER : *Lethal voltages may be present on some circuits within the Auxiliary Cab. High voltages can be removed by shutting down the diesel engine, isolating and applying lockout tag-out (LOTO) on battery knife switch located inside CA1 in driver cab 1. When working on Auxiliary Cab devices, opening any door in the Auxiliary Cab will activate the discharging of the capacitor banks. Verify that the Capacitor Charge Lights (located at the top of each control box) are off out prior to reaching into any control box. Failure to*

observe this precaution may result in serious personal injury or death. Only trained personnel should access the equipment in the Control Areas.

Control Areas 2,3,4, and 5 are located on either side of the Auxiliary Cab. The Auxiliary Cab is a high-voltage cabinet with four indicating lights to warn of high voltage. When the CCL is illuminated, voltage levels higher than 50 volts are present. Each of the access doors to the high-voltage cabinet have a limit switch and viewing window to view capacitor discharge lights.



Capacitor Charge Lights

The Auxiliary cab also contains the electronic drive systems for the Traction Alternator Controller (TAC), Auxiliary Alternator Controller (AAC), Traction Motor Controller (TMC), Inverters (Inverters 1 through 6), Engine Control Unit (ECU), and other components for locomotive operation.

Control Area 9 is located on the B-side of the Radiator Cab. It contains the Compressor contactors and the Exhauster Motor Breaker.

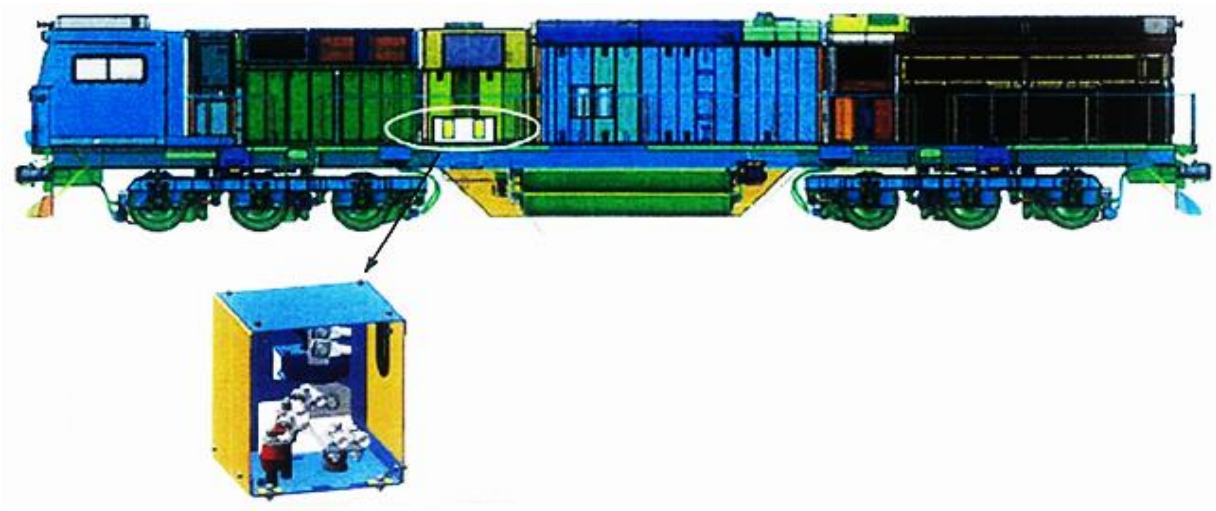
Control Area 12, also known as the Transducer Box, is mounted to the platform in the middle of the A Side of the Radiator Cab. It contains transducers for measuring fuel, water and air pressures.

Control Area 13, also known as the Magnetic Valve Panel, is located under the platform near to the Radiator Cab. The C13 control box contains magnetic valves for controlling the parking brake and the drain mag valves.

2.6.12. EXTERNAL LOAD BOX CONNECTIONS

This locomotive has onboard self-load capability of 4500 HP, if full self-load is required

you need to use any external grid of 1500 HP and make necessary connections to terminal box connections provide on the B-side of the loco.



External Load Box Connection

2.6.13. BATTERY SWITCH

The Battery switch is located in the cabinet below the Engine Control (EC) panel. The Battery switch shuts down most major locomotive functions. However, some key locomotive functions remain active after the Battery switch (BS) is opened.



Battery Switch

2.6.14. AUXILIARY POWER UNIT (APU)

The Auxiliary Power Unit (APU) located in Radiator Cab is a generator set that keeps locomotive battery and main reservoir charged to support prolonged main engine shutdown. Following are the details of APU.

- AESS shuts down the main engine and starts the APU automatically.
- APU DC power is used for locomotive loads such as battery charging, control system operation, HVAC and lighting loads.

- APU Compressor will be loaded based on the main reservoir pressure settings command by the locomotive control system.
- APU has its own microprocessor-controlled system which governs APU activity, monitors conditions for starting and stopping the APU diesel engine, detects and displays APU faults. The faults and the parameters can be seen through a self-contained display inside APU.
- The APU have a local warning bell that warns loco pilot that the APU is about to start and informs the loco pilot through the display in the event of an internal fault.



Auxiliary Power Unit

3. LOCOMOTIVE OPERATION

Operator Messages

Operator messages inform the operator of events that have occurred within the locomotive control system or within other locomotives in a formation. The messages may be accompanied by an audible alarm. The highest priority message will be displayed on the Main Operation screen in the operator message box just above the softkey indicators.

If more messages exist than can be displayed in the message box, the list of messages can be viewed on the Display Operator Messages screen.

Alarms

An alarm bell sounds in the Driver Cab when the locomotive control system detects an abnormal operating condition or fault.

Faults may be initiated by the CCA system or by other systems on the locomotive. When the CCA system detects a fault, a message describing the fault will appear in the message area of the Display screen. A Display visual alarm box below the gauges may flash or stay solidly lit if it is related to the operator message.

Depending on the fault, the alarm bell may ring for 30 seconds, ring continuously, or not ring at all (some computer detected faults do not ring the bell). The Silence alarm screen is displayed on the Display when the bell is ringing. Pressing softkey F4 (Silence Alarm) cancels the ringing of the bell, cancels the Alarm Silence screen, and returns the Display to the screen that was displayed prior to the alarm message. Thirty-second faults may be allowed to time out, in which case the bell stops ringing and the alarm silence screen disappears.

NOTE: *Some faults ring the bell continuously and the alarm silence screen is not displayed. In these cases, the bell can be cancelled only by correcting the condition. Check the locomotive for locked axles or a dead engine.*

The bell may ring in response to certain faults (such as a trainline alarm from a trail unit) that are not initiated by the CCA system. The Silence Alarm screen does not appear in these cases. The bell can be silenced by resolving the cause of the alarm or by pressing the Alarm Silence pushbutton on the Operator Control Stand.

The alarm bell rings continuously when the diesel engine is shut down. The Engine Control (EC) switch must be placed in the START position to cancel the ringing of the bell.

Alerter / VCD

It is a vigilance system to monitor various operator control movements to ensure alertness of crew. Lack of operator movement for 60 seconds after activation will trigger a visual alarm on the display with a countdown timer of 20 seconds along with vigilance indication light provided on operator and helper desk. If further operator input is still not received, the visual alarm accompanied by an audible alarm will be triggered. Further

Lack of operator movement will trigger alerter penalty application.

Alerter will be Reset with following:

- Activate manual reset switch
- Change in state of Horn switch
- EAB Handle activity
- Movement of Reverser handle
- Movement of Throttle handle
- Movement of Dynamic Brake handle > 12.5%
- Softkey press on one of operator displays
- Change in state of Manual Sand switch
- Change in state of Lead Axle Sand switch

3.1. BEFORE BOARDING LOCOMOTIVE

1. Inspect for broken, worn, loose, or dragging parts (brake rigging, brake shoes, wheels, covers, etc.)
2. Check for leaks from outside piping.
3. Properly position all drain and air cut out cocks.
4. Ensure the Brake Pipe cocks are properly positioned.
5. Check for proper connections of the air hoses and MU jumper cables (if unit is in a formation).
6. Check the fuel supply on the fuel sight glass on the platform on both A and B sides of the locomotive.
7. Ensure that the fuel level is sufficient to begin the trip.
8. Ensure the Dead engine/Dead (in tow) cutout cock on the Electro-pneumatic Operating Unit (EPCU) is in the correct position on each locomotive (OUT for regular operation. IN for dead engine / Dead (in tow) operation).

3.2. AFTER BOARDING LOCOMOTIVE

1. With the engine shutdown, remove rags, tools, etc. from moving parts and electrical equipment of all consist locomotives.
2. Ensure that the exhaust stack cover has been removed (if applied).
3. Check the diesel engine lubricating-oil supply in all formation locomotives. Oil level should indicate FULL on the dipstick with the engine at idle. The dipstick is located on the side of the engine and is marked LOW and FULL.
4. Check the air compressor lubricating-oil level.
5. Check the cooling water supply. Ensure the water drain valve is closed.
6. Ensure the MR1 sensor cutout cock on the C12 box is open.
7. Ensure the air brakes are set up properly.
8. Move the Engine Control (EC) switch to ISOLATE.
9. Properly position the MU headlight selector switch.
10. Check that the Master Controller handle is in IDLE and the Reverser handle is in the center position.

3.3. STARTING THE ENGINE

1. Perform operations” *Before Boarding Locomotive*” and” *After Boarding Locomotive*”.
2. Verify the Maintenance Battery Disconnect located in the Auxiliary Cab on the A

side of the locomotive is closed. If necessary, close the MBD switch.

3. Close the Battery Switch (BS) located in Control Area 1 (CA1).
4. Set all applicable to ON.

NOTE: *On power up, ensure the air broke computer circuit breaker is ON. A power up penalty might occur. Simply move the automatic brake handle to FULL position, move the rotary switch to Lead if not in Lead and hold the handle in FULL position for 34 seconds, then return handle to RUN.*

5. Check the Display screens for any status messages. When the message line displays "Engine Can't Crank" or "Engine Won't Start", a maintenance issue has arisen.
6. Verify the EC switch is in the ISOLATE position.

NOTE: *When starting engines of several locomotives in a multiple-unit consist, start engines one at a time. Set the Control circuit breaker (COB) to ON in one unit at a time. When all engines are running, set the Control circuit breaker (COB) to ON in the Lead unit only, set to OFF in other units.*

7. Press the Engine Start pushbutton and hold until "engine start in progress" appears on the Display screen. This screen will disappear automatically once the engine is running. The following events take place during engine starting:
 - The fuel pump starts immediately when the Engine Start pushbutton is pressed. A crank warning bell (located in the Auxiliary Cab) will sound.
 - There will be a delay of five to ten seconds between the time the Engine Start pushbutton is pressed and the pre-lube pump starts to rotate (if a pre-lube cycle is required by the control system).
 - If the BCCB has been cycled, or if the locomotive has been shut down for 30 minutes or more, the diesel engine will receive a pre-lube cycle. Loco pilot may see the message "AESS Prohibited" displayed if sufficient oil pressure does not develop during the pre-lube cycle. The diesel engine will still crank if this message is displayed. Typical time for an engine pre-lube cycle is two to four minutes.
 - The diesel engine will crank upon completion of the engine pre-lube cycle.
 - If proper engine lubricating-oil pressure does not build within approximately 40 to 60 seconds, the control system will log a restrictive fault and the engine will not crank. A maintenance issue has arisen.

NOTE: *Do not discharge the battery excessively by repeated attempts to start. If the locomotive does not crank, check the Display for fault messages. If the first two or three tries are unsuccessful, recheck the starting procedure.*

8. With the engine running, re-check the lubricating oil supply. Oil level should indicate FULL on the dipstick with the engine at Idle.

3.4. COLD WEATHER ENGINE STARTING/WARM-UP

During cold weather conditions when a locomotive has been shut down for a period of time, locomotive horsepower will automatically be de-rated until the lubricating oil temperature reaches a predetermined level. This special warming period is required to avoid equipment failure from thermal or overload strain.

3.5. LOCOMOTIVE AIR RESERVOIR CHARGING

The air reservoir will be charged during normal locomotive start up and operation. To charge the air reservoir. Follow normal starting procedures as in “**Starting the Engine**”. The computer system will automatically adjust the engine speed to optimize reservoir charging.

NOTE: *Increasing engine RPM will not charge the air reservoir to a higher operating level.*

3.6. LOCOMOTIVE SETUP FOR OPERATION

Each locomotive must be set up for operation before attempting to move the formation. The locomotive will be set as the Lead. Single. Trail, or Dead (in tow).

NOTE: *The active console is selected by moving the Isolate switch located on the EC panel of the desired operating console to the ISOLATE position.*

The Console Selection screen displays the conditions necessary to allow the loco pilot to change consoles and the status of those conditions. The active console position is also identified.

Press soft key 7 (Screen Controls) on the Main Operating screen or the Main Operating More Menu screen to display the Screen Controls Setup screen. Then, press soft key 5 (Console Selection) to display the Console Selection screen. Press soft key F8 (Exit) to return to the Main Operating screen or the Main Operating Menu screen.

Initial Console Select Strategy

1. Ensure that the display shows a message that says "No Driver's Console Is Selected", and there is an "inactive console" indication present
2. Ensure that the Isolate switch in the EC panel of both operating cabs are in the OFF position.
3. Select on operating console by changing only the isolate switch located on the EC panel of the cab with the desired console of operation from the OFF position to ISOLATE position.

Console Selection (Changing Cabs)

1. Move the throttle handle to the idle position, and the reverser to the centered position.
2. Ensure the locomotive is fully stopped, and the display shows the throttle handle is in idle, and the reverser is centered.
3. Ensure the locomotive air brakes are applied.
4. Remove the reverser handle from the master controller and move the Isolate switch to the OFF position. A penalty brake application will be requested.
5. In the desired operating cab, move the isolate switch to the ISOLATE position and insert the reverser handle into the master controller.
6. Ensure that the display shows that the console selected is activated

While changing cabs in Backup Brake mode:

1. Follow the above steps, except the Step 3
2. Go to the Radiator cab and engage the backup brake

3. Move the backup brake cab selection switch to primary OR secondary based on the desired active console

If the above conditions are not satisfied, then the screen below shall be visible with the non-highlighted condition not met by the loco pilot. For example. The Throttle is not in Idle condition is shown to not be met in the screen.

On ensuring that the required conditions are achieved, all the conditions on the console selection screen will be high-lighted with green check boxes.

Engine Start

1. Ensure you have selected the desired console for operation by moving the Isolate switch to the ISOLATE position.
2. Confirm that the display shows that the system is in the "ISOLATE" state.
3. Push the engine start switch.
4. Ensure that the display shows the crank pop-up screen, and that the display indicates the system is in the "START" state.
5. Release the engine start switch
6. Ensure that engine speed increases, and the engine starts running.

NOTE: It should take 2-3 mins for engine to prime and to get into run mode.

Air System Cut Out Cock Position

S.N	Cut Out Cock Name	Cut Out Cock Location	Handle Orientation Relative to Air Flow	Normal Position for Single Unit Operation	Normal Position for Multiple Unit Operation
1	Main Reservoir	A cut-out cock is located next to the filter between the filter and the main reservoirs.	Open if perpendicular to pipe.	Open	Open
2	Air Filter Drain.	Located on the main reservoir and auxiliary air filters.	Not Applicable	Closed	Closed
3	Parking Brake and Brake Cylinder	Located on the A-side beneath platform level by each truck/bogie.	Open if parallel to pipe.	Open	Open
4	Horn, #1 End	Located on Mag Valve Panel behind access door in front end of #1 Driver Cab.	Open if parallel to pipe	Open	Open
5	Horn, #2 End	Located on Mag Valve Panel in Rad Cab area on B-side.	Open if perpendicular to pipe.	Open	Open

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6	Aux Air COC	Located on Mag Valve Panel in Rad Cab area on B-side.	Open if perpendicular to pipe.	Open	Open
7	Sanding, Rear (#2 End) below deck	Located on the below deck B-Side closer to MR tank.	Open if perpendicular to pipe.	Open	Open
8	Sanding, Front (#1 End - Below Deck)	Located on the below deck B-Side closer to Air Dryer.	Open if perpendicular to pipe.	Open	Open
9	Sanding, Front (#1 End)	Located in Nose Cab Mag Valve Panel.	Open if perpendicular to pipe.	Open	Open
10	Brake Pipe (BP)	Angle cock located on the #1 end of A side and #2 end of B side.	Open if parallel to pipe.	Open on trailing car end. Closed if no cars.	Open between locos. Closed on end of consist (unless trailing cars).
11	Brake Pipe (BP)	Cutout cock located behind the end plate on the #1 end of A side and #2 end of B side with the handle open if parallel to the pipe.	Open if parallel to pipe.	Open on trailing car end. Closed if no cars.	Open between locos. Closed on end of consist (unless trailing cars).
12	Main Reservoir Equalizing (MRE)	Located behind end plate on both A and B sides for #1 and #2 ends.	Closed if parallel to pipe.	Closed	Open between locos. Closed on end of formation.
13	Brake Cylinder Equalizing (BCE)	Located behind end plate on both A and B sides for #1 and #2 ends.	Closed if parallel to pipe.	Closed	Open between locos. Closed on end of formation.
14	Feed Pipe (FP)	Angle cock located on the #1 end of A side of the end plate and #2 end of B side of the end plate.	Open if parallel to pipe.	Open on trailing car end. Closed if no cars.	Open between locos. Closed on end of consist (unless trailing cars).
15	Feed Pipe (FP)	Cutout cock located behind the end plate on the #1 end of A side and #2 end of B side.	Closed if parallel to pipe.	Closed if no cars.	Open between locos. Closed on end of consist (unless trailing cars).

16	Air Dryer Isolation	Two cocks - one inlet to AD P168 and outlet	Closed if parallel to pipe.	Open	Open
17	Compressor Governor Switch/main Reservoir Sensor (CGS/MR1)	Located on C12 box in the Rad Cab A side on equipment support skid.	Closed if parallel to pipe.	Open. Close to force compressor to load.	Open. Close to force compressor to load.
18	Air Dryer Bypass	Two cocks - one inlet to AD P168 and one MR1 outlet B side close to the Filter Tee #P34.	P168 - Closed if parallel to pipe. P34 - Open if handle is parallel to pipe.	P168 - Closed P34 - Open during air dryer failure.	P168 - Closed P34 - Open during air dryer failure.

3.6.1. LOCOMOTIVE SETUP AS THE LEAD OR SINGLE UNIT LOCOMOTIVE

The locomotive that the loco pilot will run the train from is called the Lead locomotive. The controls operated from the Lead locomotive will result in actions from the Trail locomotives.

1. Set all applicable circuit breakers on the Engine Control (EC) panel ON or OFF for Lead or Trail. All circuit breakers should be ON for Lead operation.
2. Verify the Master Controller handles are in the following positions in the Lead locomotive:
 - Combined Power handle is in neutral (N) position.
 - Reverser is in the centered or (N) position.
3. Verify that the Display shows Throttle/Dynamic Braking Status is Idle.
4. Verify the Electronic Air Brake (EAB) system is properly set up for Lead operation.
5. The Lead locomotive is identified on the Display for EAB operation. Set up all Trail locomotives in the consist before identifying and setting up the Lead locomotive.
6. The Engine Run circuit breaker, Generator Field circuit breaker, Control circuit breaker, and the Dynamic Braking Control circuit breaker are set to ON in the Lead locomotive. Start all locomotive engines in the consist and ensure the MU lines are connected before setting the circuit breakers to OFF in the Trail units.

3.6.2. LOCOMOTIVE SETUP AS A TRAIL LOCOMOTIVE

1. The breakers on the Engine Control (EC) panel are labeled to be ON or OFF for Lead or Trail position. In a Trail configuration.
2. Move the Reverser handle to the center (N) position. Ensure the Combined Power handle is in neutral (N) and the Display indicates Throttle/Dynamic Braking Status as Idle.
3. Verify the electronic air brake system is properly setup for Trail operation.
4. Move the automatic handle to FULL position and Independent brake handle to REL position for Trail operation.
5. The Lead locomotive is identified on the Display for EAB operation. Set up all Trail locomotives in the consist before identifying the Lead locomotive in Display.
6. Generator Field circuit breaker and Control circuit breaker are OFF in the Trail

locomotives. Start all locomotive engines in the consist and ensure the MU lines are connected before setting the circuit breakers to OFF in the Trail units.

Circuit Breaker Configuration for Various Positions

	LEAD	TRAIL 1	TRAIL 2
GEN FIELD	ON	ON	ON
EC SWITCH	RUN	RUN	RUN
COB	ON	OFF	OFF
DBC B	ON	OFF	OFF
BRAKE	LEAD	TRAIL	TRAIL

3.6.3. LOCOMOTIVE SETUP AS A DEAD (IN TOW) LOCOMOTIVE

1. Set the Air Brake Computer circuit breaker to OFF
2. Ensure the Dead Engine cut out cock is set to the IN position.
3. Connect the MU Brake Pipe hoses on either end of the locomotive.
4. If functional, set the Display Air Brake Setup screen to Trail/Cut Out position.
5. Set the Electronic Brake Valve (EBV) Independent handle in the RUN (RUN) position and the Automatic handle in the NEUTRAL (NEUT) position.
6. Drain the Main Air Reservoir to less than 25 psi (1.75 kgf/cm²).

CAUTION: *To avoid wheel flats when operating Dead (in tow), drain the main reservoir of the unit to less than 25 psi (1.75 kgf/cm²). Failure to do so may result in equipment damage.*

3.6.4. CHANGING OPERATING CONTROL TO ANOTHER UNIT WITHIN THE FORMATION

To change operating control from the cab of one locomotive unit to the cab of another refer to LOCOMOTIVE SETUP FOR OPERATION.

3.7. BEFORE MOVING LOCOMOTIVE

1. Set the Engine Control (EC) switch (located on the EC panel) to RUN.
2. Check the Main Reservoir air pressure according to Railroad Operating Procedures.
3. Make an Independent Air Brake application.
4. Remove any blocking of the wheels.

WARNING : *The loco pilot must verify the proper release or setting of the Parking Brake before moving or leaving the locomotive (this includes all locomotives in the formation). Keep clear of active brake rigging. Disable the Parking Brake prior to maintenance.*

5. Release the Parking Brake
6. Allow time for the engine cooling water to warm.
7. Check the Display screens for any fault messages. Message line should state "Ready".

WARNING : *Prior to train movement, brake application/release and leakage tests*

must be performed at the railroad-specified Brake Pipe pressure for the entire train.

8. Perform an Air Brake Departure Test.
9. After the Main Air Reservoir is recharged to operating pressure, the locomotive is ready for operation.

3.8. MOVING A TRAIN

1. Ensure the Parking Brake is released according to the instructions

NOTE: *If motoring is attempted with parking brakes set on any of the locomotive in the MU formation, or from a DP remote formation, traction is prevented until the parking brakes are released and throttle handle brought to idle.*

2. Move the Reverser handle to the desired direction of movement. Ensure train motion is stopped before reversing direction.
3. Operate the pneumatic brakes accordingly.

NOTE: *If motoring is attempted with the independent brake application level more than 46.37 psi (3.26 kgf/cm²), traction will be limited to Notch 2 until the independent brake level is reduced to below 40.5 psi (2.85 kgf/cm²).*

CAUTION : *When moving the train, wait at least four minutes after moving the Reverser handle before moving the Throttle handle. This pause allows units that may have been shut down by AESS to start the diesel engine. Failure to do so may result in alarms and faults and will prevent the consist from loading.*

4. Advance the Combined Power handle to the desired motoring power position. The CCA control system will begin to ramp up the motoring power command.

NOTE: *The engine will operate at a power deration determined by the control system to maintain a cooler temperature. If it cannot maintain the temperature and derates to zero for five minutes, the system will shut down the engine.*

WARNING : *Under no circumstances should a train be permitted to continue in operation if the Brake Pipe air pressure falls below 45 psi (3.16 kgf/cm²). If this situation occurs, the train must be stopped and the Brake Pipe recharged to the recommended setting.*

3.8.1. LIMITING TE

To limit the TE whenever there is a requirement, such as driving over bridges etc.

1. Go to 'Tractive Effort Toggle' Switch located on EC panel.
2. Remove the locking pin and move the toggle switch from 'Normal' to 'Limited' position.
3. Place the locking pin back in the slot
4. Observe 'TE Limited' message on the screen (Display on control desk) and reduced tractive effort can be achieved.

To remove the TE limit and run the locomotive in normal mode

1. Go to 'Tractive Effort Toggle Switch' located on EC panel.
2. Remove the locking pin and move the toggle switch from 'Limited' to 'Normal' position.
3. Place the locking pin back in the slot.
4. Observe 'TE Limited' message disappear from the screen (Display on control desk) and normal tractive effort can be achieved.

NOTE:

1. *When locos are coupled and running as MU (Multiple Unit) then TE limit switch of Lead loco is only considered, Trail loco TE limit switch input is ignored.*
2. *While in motoring, if the switch is in "Limited" position and "TE LIMIT" HMI label is not displayed it indicates problem with TE Limit function.*

CAUTION:

1. *In case of any problem with TE Limit function, Loco Pilot has to depend on combined power handle to reduce notch and keep TE limited as required.*
2. *Maintenance Unit need to be informed about the situation later, this does not require to stop the journey.*

3.8.2. OPERATING WITH OTHER TYPES OF UNITS

If the units in the locomotive consist are geared for differing maximum speeds, do not run at speeds in excess of that recommended for the unit having the lowest maximum permissible speed.

Similarly, do not operate at low speeds long enough to exceed the specified traction motor ratings on any of the units in the locomotive consist. A locomotive with high horsepower per axle will develop more tractive effort at any given speed than will units of lower horsepower per axle and will, therefore, tend to overload sooner at lower speed.

This locomotive will reduce output as required when traction motor temperature rises above a given temperature. This condition will continue until traction motor temperature returns to the acceptable range.

3.9. STOPPING A TRAIN

1. Ensure the Dynamic Brake circuit breaker is set to ON and the Display Dynamic Brake Cut Out switch is set to IN.
2. Move the Combined Power handle to neutral (N).
3. Apply the Dynamic or Electronic Air Brakes according to procedure.

CAUTION: *If however, other locomotives in the formation do not have this feature, to prevent equipment damage when changing from power to Dynamic Braking or from Dynamic Braking to power, pause ten seconds with the Combined Power handle at neutral (N).*

3.9.1. DYNAMIC BRAKE APPLICATION

1. Ensure the Dynamic Brake circuit breaker is set to ON and the Display Dynamic Brake Cut Out switch is set to In.

2. Move the Combined Power handle to neutral (N).
3. Pause as required. then advance the Combined Power handle into the BRAKING sector as desired.
4. After the slack is compressed, manipulate the Combined power handle until the desired braking effort is obtained. Observe and correct braking effort during the initial period of Dynamic Braking application.
5. The amount of braking effort obtainable varies with the position of the Dynamic Braking handle for various speeds. Maximum braking effort is obtained in the FULL BRAKING position. This locomotive allows full Dynamic Braking down to zero kmph.
6. Release Dynamic Braking by moving the Combined Power handle to the OFF position.

NOTE: *Wheel slip warning may occur while in Dynamic Braking. This indicates wheels are sliding. Sand is applied automatically to the wheels of the sliding unit. If the warning continues, reduce the Combined Power handle position.*

3.9.2. USE OF AIR BRAKES DURING DYNAMIC BRAKING

When necessary, the Automatic Air Brakes may be used in conjunction with the Dynamic Brake. Automatic Air Brakes will apply on the entire train (including the locomotives) until they are released or bailed off.

NOTE: *If the locomotive Independent Brake is applied while in Dynamic Braking, Dynamic Braking effort is decreased when brake cylinder pressure rises above a pre-set maximum. The amount of Dynamic Brake reduction depends on locomotive speed.*

3.9.3. AIR BRAKE APPLICATION

1. Move the Automatic Brake handle from the RUN (RUN) position to the MINIMUM position.
2. If additional braking is desired, move the Automatic Brake handle through the Full Service range. Increasing brake effort will occur as the Automatic Brake handle moves through the service range.
3. Return the Automatic Brake handle to RUN (RUN) position after the train has slowed to the desired speed. If stopping and leaving the train, leave the Automatic Brake handle in the FULL position and follow the procedures.

3.9.4. AIR BRAKE APPLICATION WITH BLENDED BRAKE

NOTE: *Blended Braking is a function of locomotives only, not rail wagons. Blending will be available under the following conditions: Air Brake is Lead, Throttle is in Idle, Independent Brake is released, Brake Pipe is greater than 1.41 kg/cm² (20 psi), no dynamic brake faults. Blended Braking is enabled for Passenger mode as well as Freight mode.*

1. Ensure the Display Dynamic Brake Cut Out Switch is set to In and Blended Brake Cutout switch is in Cut In position.
2. Move the Automatic Brake handle from the RUN position to the MINIMUM

position. If the Throttle handle is in IDLE and locomotive is in motion, blended braking will automatically be applied. Traction motors will be re-configured to generate braking energy into the dynamic braking grids. A visual braking effort bar graph will be displayed on the Display, along with a digital readout. As blended braking effort increases, the brake cylinder pressure will be reduced.

3. If additional braking is desired, move the Automatic Brake handle through the FULL SERVICE (FULL) range. Increasing brake effort will occur as the Automatic Brake handle moves through the service range. Follow all Railroad Operating Procedures for any additional air brake processes.
4. Return the Automatic Brake handle to the RUN position after the train has slowed to the desired speed. If stopping and leaving the train, leave the Automatic Brake handle in the FULL position and apply the independent brake. Follow the procedures BEFORE LEAVING A LOCOMOTIVE UNATTENDED.
5. When in Blending Braking mode and the Dynamic Brake Handle is moved to Brake position, Brake Cylinder pressure of the locomotive will be reduced to 0.37 kg/cm² (5.3 psi).
6. When in Blending and the Dynamic Brake Handle is moved to Braking position, Dynamic Brake will take precedence.
7. When in Blending and the Throttle handle is moved to N1-N8 motoring position, Stop Blending, Locomotive transition to Motoring State, and Air brake remains applied.
8. When the Auto Handle is released and the Dynamic Brake Handle is moved to the Braking position, Blending will be disabled and Dynamic Brake will take precedence.
9. No Dynamic Braking in emergency.

3.10. MANUALLY STOPPING THE ENGINE

1. Move the Combined Power handle to Neutral (N) and ensure the Throttle/Dynamic Braking Status shows Idle.

CAUTION : *After a locomotive diesel engine has operated at full load, allow the engine to run at IDLE for at least five minutes before shutting down. Immediate shut down after operation could be harmful to some engine components.*

2. Set the Generator Field circuit breaker to OFF.
3. Move the Engine Control (EC) switch to START.
4. Press the Engine Stop pushbutton on the EC panel.
5. To shut down all diesel engines when in multiple-unit (formation) operation, the MU shutdown switch must be toggled on the crew console.
6. Secure the locomotive in accordance with Railroad Operating Procedures.

3.11. BEFORE LEAVING A LOCOMOTIVE UNATTENDED

WARNING : *The loco pilot must verify the proper release or setting of the Parking Brake before moving or leaving the locomotive (this includes all locomotives in the formation). Keep clear of active brake rigging. Disable the Parking Brake prior to maintenance.*

1. Apply the Parking Brake and release the Automatic Brakes after uncoupling from the train:
 - a. Make a full Independent Brake application.
 - b. Apply Parking Brake.

CAUTION: *An illuminated indicator light does not guarantee that the Parking Brake is fully applied. The loco pilot must verify that the brake is properly applied prior to leaving the locomotive unattended.*

2. Leave the Combined Power and the Reverser handles in the neutral (N) positions and unplug the reverser handle from the master controller. Ensure the Throttle/Dynamic Braking Status shows (Idle).
3. Close the windows and doors.
4. Ensure that the locomotive is set for AESS operation.

3.12. LOCOMOTIVE MECHANICAL AND ELECTRICAL SHUTDOWN

1. Shut down the engine.
2. Set all appropriate switches and circuit breakers to OFF.
3. Open the Battery switch (BS) located in Control Area 1 (CA1) behind the door below the Engine Control (EC) panel.
4. If the Locomotive will be shut down for more than 24 hours, open the Maintenance Battery Disconnect (MBD) located in the Auxiliary Cab on the A side of the locomotive.
5. In freezing weather, take precautions to ensure the cooling water does not freeze.

CAUTION: *Upon performing a locomotive manual shut down, failure to open the Battery Switch (BS) and/or Maintenance Battery Disconnect (MBD) may result in the draining of the locomotive batteries and locomotive equipment damage.*

3.13. LOCOMOTIVE RECOVERY WITH LOCKED AXLES

In the event of locked axles with no movement of the wheel or traction motor, the Locomotive shall be moved to the nearest repair facility without causing additional damage to the wheel, motor, or track.

In case an Axle gets locked due to Traction Motor Roller Bearing seizure, Axle Roller Bearing Seizure, Traction Motor Suspension Bearing Seizure, Wheel Flat or Heavy Skidding of Wheels, the affected axle should be floated/lifted after electrically isolating the affected traction motor. / all traction motors of affected bogie.

Before attempting the lifting of locked axle of the locomotive, the steps given below should be strictly followed to avoid damage to equipment or any mishap:

- Apply wheel chokes/ wooden wedges at wheels to prevent rolling of locomotive.
- Release all TBUs (brakes) and Parking brake of the affected bogie, which requires lifting.
- Before application of jacks for lifting, ensure that the ground below the lifting jacks is firm and leveled. Due care must be taken to avoid slipping of the jacks.
- Isolate all the traction motors of the affected bogie.
- Remove all primary vertical dampers of the affected bogie to avoid their damage.
- For using Wheel Set trolley, sand pipes/brackets may be required to be removed.

The locomotive should be worked as a light engine/ locomotive on its own power with a maximum restricted speed of 15 km/h under escort by authorized maintenance personnel. In such case, a close watch is necessary while passing over curves and turnouts.

3.14. COUPLING LOCOMOTIVE WITH TRAIN

1. Ensure that the angle cocks for brake pipe connections are in cut-out position before proceeding for coupling the locomotive to train.
2. Slowly move the locomotive closer to the train for coupling.
3. Couple the locomotive to the train using couplers.
4. Ensure that the couplers are locked securely.
5. Ensure locomotive parking brakes and independent brakes are applied after coupling.
6. Connect the brake pipe connections (and feed pipe, if equipped) between the locomotive and train.
7. Ensure that the pneumatic connections are locked securely.
8. Open the brake pipe (and feed pipe, if equipped) angle cock between the locomotive and train.
9. Charge the brake pipe by moving the automatic brake handle to release position.
10. Ensure that the main reservoir pressure is between 8-10 kg/cm² after the train is fully charged, before starting the trip.

3.15. SETTING UP LOCOMOTIVE FOR BANKER (OR HELPER) OPERATION

1. Ensure that the parking brakes and automatic full-service brakes are applied on the are applied on the LEAD locomotive with train.
2. Ensure that the rotary switch on the HELPER locomotive is in LEAD position.
3. Using radio, keep in contact with the loco pilot of the LEAD locomotive.
4. Ensure that the brake pipe angle cock (and feed pipe, if equipped) is closed on the train and the HELPER locomotive.
5. Slowly move the HELPER locomotive closer to the train for coupling.
6. Couple the HELPER locomotive to the train using couplers.
7. Ensure that the couplers are locked securely.
8. Connect the brake pipe connections (and feed pipe, if equipped) between the HELPER locomotive and train.
9. Ensure that the pneumatic connections between HELPER locomotive and train are locked securely.
10. Ensure that independent brakes and parking brakes are not applied on the HELPER locomotive.
11. Move the automatic brake handle to full-service position on the HELPER locomotive.
12. Move the rotary switch on the air brake handle on HELPER locomotive to HELPER position.
13. Open the brake pipe (and feed pipe, if equipped) angle cock between the locomotive and train.
14. Release the brakes from LEAD locomotive by moving the automatic brake handle to Release position.

3.16. STARTING LOCOMOTIVE UP HILL

1. Ensure that the sanding system is working properly.
2. Actuate the sanding manually and check for adequate sanding.
3. Gradually have the Engine notch up while monitoring the actual speed.

3.17. RUNNING LOCOMOTIVES THROUGH WATER

1. Assess the flood or water level situation.
2. Ensure based on visual inspection that the track condition is safe for locomotive to run.
3. If the level of water above the track is greater than 102 mm (14.01 in.) the locomotive shall be stopped/remain stopped.
4. If the level of water above the rail level is less than 102 mm (14.01 in.) then the locomotive may be started/ advanced.
5. For running under the above condition, the locomotive may be powered to move at slow speeds up to 10 kmph, all the while monitoring the water level.

3.18. STARTING LOCOMOTIVE ON A BRIDGE

1. Crank the engine.
2. Remove the seal wire on the TE Limiter Switch (if applied) after getting necessary approvals.
3. Move "TE Limiter" switch to "ON" position to limit the tractive effort.
4. Ensure all brakes are released including independent and parking.
5. Move the reverse to Forward/ Reverse position as applicable.
6. Slowly move to N1 and confirm the loco movement.
7. Then gradually increase to higher notches. It should be noted that Tractive effort will not exceed 294 kN (30 t) when the TE Limit switch is enabled.
8. Maintain the speed and follow the restrictions as per railway guidelines and caution order.
9. Restore the TE Limit switch by moving to "OFF" position after crossing the bridge

3.19. LOCOMOTIVE CONTROLLER RECYCLING PROCEDURE

The locomotive control system may be recycled if so advised by the display messages during clearing of certain fault incident codes. The recycle procedure involves cycling the BCCB (Battery and Control Circuit Breaker).

1. Push the engine stop push-button or operate any operating elements that can command an engine stop.
2. Ensure that engine speed starts to decrease, and the engine stops running.
3. Release the engine stop push-button.
4. Open all the essential circuit breakers as listed below
 - LCCB
 - BCCB
 - GFB
 - COB
 - DBCB
 - FPB
 - MTB
 - ABCB1
 - ABCB2

5. Ensure the SDIS screens are not operational.
6. Close all essential circuit breakers, opened in the above step.
7. Ensure the SDIS screens are fully operational.
8. Ensure the SDIS screens indicate that the locomotive system is in the ISOLATE state.
9. Ensure that independent and automatic brakes are fully applied, reverser is in centered, master controller notch is in IDLE.
10. Ensure that the SDIS shows a message which indicates that no driving cab is selected, and there is an INACTIVE CONSOLE indication present.

4. LOCOMOTIVE TROUBLESHOOTING

4.1. ENGINE NOT CRANKING

- Check the Display screens for any status messages. If the message line displays "*Engine Can't Crank*" or "*Engine Won't Start*", a maintenance issue has arisen that will prevent the locomotive from moving.
- The ambient temperature must be over 1 deg C in order for the engine to crank.

4.2. ENGINE CRANKING BUT NOT STARTING

- Verify the battery voltage is above 55 volts when cranking.
- If display screens are also unable to power up, verify BCCB, MTB and LCCB are ON.
- Verify if the Battery switch is ON (cabinet below EC panel, #1 end driver cabin).
- Verify the Aux cab doors are closed (doors for CA1, CA3, CA4, CA5)
- Verify all the necessary Circuit Breakers are ON - (HN1 Gen field breaker, LCCB, BCCB, MTB, ABCB1, ABCB2, FPB).
- The reverser handle must be inserted in the master controller and be in the neutral position.
- The EC switch is in the ISOLATE position.
- Verify sufficient fuel is available by checking the fuel level in sight glass provided on the fuel tank.

4.3. ENGINE STARTED BUT UNABLE TO LOAD

- Check the Display screens for any status messages or fault messages referring to restriction to load and take appropriate action to clear the fault.
- Verify the Parking Brake is released.
- Verify EC rotary switch is in "Run" position.
- Verify all the necessary Circuit Breakers are ON - (HN1 Gen field breaker, LCCB, BCCB, MTB, ABCB1, ABCB2, FPB).
- Verify the engine has completed warm up. The control system prevents loading unless engine warming is complete. Display screens indicate when engine warming in progress
- If AESS is active, wait at least four minutes after moving the Reverser handle and before moving the Throttle handle. This pause allows units that were shut down by AESS to restart.

4.4. TRAIL UNITS NOT LOADING

- Verify the MU cable/connection and the air pipe connections are correct and intact.
- Verify the Electronic Air Brake (EAB) system is properly set up for Lead/ Trail operation.
- Ensure all applicable circuit breakers on the Engine Control (EC) panel are ON or OFF for Lead or Trail.
- Ensure the engine in the trail unit is started and running.

4.5. ENGINE DERATED / TRACTIVE POWER RESTRICTED

The Locomotive can go into a restricted load state based on various key parameters of the engine, such as to protect a hot or cold engine, or if operation in a tunnel is detected.

- If the system is unable to maintain optimal temperature the engine is derated automatically. Failure to resolve the issue can result in engine shutdown.

- If low oil or water pressure is detected, the engine speed and power will be derated automatically until the pressure recovers.
- When more than one traction motor is cut-out (manual or automatic), the Locomotive will not be able to achieve full tractive effort.

4.6. LOAD LIMITED DUE TO LOW LUBE OIL PRESSURE

- Verify the loco lube oil drain is closed.
- Verify the oil filter drain valve is in closed position.
- Look for obvious leaks in engine or radiator cab.
- Check the engine oil level using the dipstick. Oil level must be above "low" mark while the engine is idling.
- Verify connections to the pressure sensor are and tight and intact.

4.7. LOAD LIMITED DUE TO LOW WATER PRESSURE

- Verify the loco coolant drain valve is closed
- Look for any obvious water leaks in the engine or radiator cab.
- Check the water level at the sight glass. The water level should be between the MIN and MAX marks at idle.
- Verify connections to the pressure sensor are and tight and intact.

4.8. DISPLAY/ KEYBOARD NOT RESPONDING

Before troubleshooting a blank display, locked-up display, or keyboard not responding the Locomotive must be stopped and secure.

- Cycle the display circuit breaker. The breaker is located on the side of EC panel when EC panel is open.
- Cycle the BCCB to reset the system.

4.9. EAB COMMUNICATION LOST

Before troubleshooting EAB Communication issues, reduce power and allow Locomotive to stop.

- Center the Reverser and apply a service brake application.
- Cycle the BCCB, MTB, ABCB1 and ABCB2 to reset the system.

4.10. BRAKE PRESSURE NOT BUILDING

- Check for any compressor related incidents on the display screen.
- Verify all the cut-out cocks in the air brake system are in the correct position.
- Check for active leaks in the air piping circuit. Focus attention on piping/joints, air dryer, air filter drain, stuck relief valve, etc.

4.11. HORN NOT ACTIVE OR NOT AUDIBLE

- Check if problem affects one or both horn switches.
- Verify the horn cut-out cock is open.
- Check for any compressor related incidents on the display screen.

4.12. LOCKED AXLE / TRACTION MOTOR CUT OUT

Before troubleshooting a locked axle or cut-out traction motor, the Locomotive must be stopped and secure.

- Physically verify the affected/indicated wheel/axle for obvious signatures of a locked axle. If no issues identified, contact maintenance unit / OEM to manually cut-out speed sensor of the affected axle.

4.13. HVAC NOT WORKING

- Check that the Air Conditioning or Heater Rotary Switch on Operator Console is in the desired mode setting
- If the HVAC still does not work, then check if the Heater/Air conditioner Circuit Breaker in CB panel is ON.
- If the Heater/ Air conditioner Circuit Breaker is in OFF position, first turn OFF the HVAC Rotary Switch, turn ON the Circuit Breaker and turn the HVAC rotary switch back ON. If the circuit breaker does not turn on, or the HVAC does not operate, contact maintenance unit / OEM for assistance.

4.14. SANDING NOT WORKING

- Ensure that the locomotive is stationary. Actuate sanding manually and check for sanding, with reverser in Forward/Reverse. If sanding is inadequate check if the mag valves for forward sand control and reverse sand control actuates (typically for 10 seconds).
- Check that the cut-out cocks are in open (cut-in) position.
- Check the sand valves by pushing button on the mag valves. If any valve does not actuate, check electrical wiring for any loose connections.

NOTE: *The sand valves and cut out cock for the #1 and #2 end trucks/bogies are located behind the door in front side of #1 and #2 end driver Cabs.*

- Check for any leaks in the air pipeline connecting to sand magnet valve and from sand magnet valve to sand trap.
- Check for any blockages in the sand hose.

4.15. COMPRESSOR NOT WORKING

- Check if there are any compressor related messages on the display screen, and attend accordingly.
- If there is an incident on the screen stating that compressor is not available OR if the compressor does not run (when Main Reservoir pressure > 113 psig). check if the compressor drive contactor(s) located in the B-side of the Radiator cab, has engaged / actuated. To determine if specific contactor(s) are not engaged observe the state of the button in front of the drive contactor and the markings on the contactors.
 - a. If Engine speed is less than or equal to 440 rpm, compressor drive contactors 2A and 2 should be engaged and compressor should operate.
 - b. If Engine speed is greater than or equal to 580 rpm. compressor drive contactor 1 should be engaged and compressor should operate.
- If contactor is not actuated, check for any loose wiring connections for the 74 V DC input to contactor circuit.
- Look for any loose connection in the speed sensor connection cable.
- If the compressor runs, but is not able to build pressure, then check Compressor magnet valve operation. Check for any loose wiring and fix the wiring issue.

4.16. APU DOES NOT START

- Check on the display screen for any APU health related fault message. If there's an APU related fault message, check APU.
- Check if the APU circuit breaker is OFF. Turn ON the circuit breaker.
- APU will be disabled if there's main engine start request. or a safety request from the loco pilot.
- APU may not start automatically, if the locomotive was manually shut down (using the Engine Stop Pushbutton). In such a case, Manual restart of the Engine will be needed.

- APU may not start if AESS system is deactivated.
 - a. One or more of the following actions may deactivate the AESS
 - Opening any of the Auxiliary Cab or Blower Cab doors.
 - Entering self-test mode.
 - Pressing an Engine Stop switch while an AESS automatic shutdown is in process.
 - Setting the BCCB Breaker to OFF on the EC panel.

4.17. CONTINUOUS ALARM

Continuous Alarm and Alarm Silence Screen is not Displayed

- A fault condition exists. Check the locomotive for locked axles or a dead engine.

Continuous Alarm Upon Manual Engine Shutdown

- The Engine Control (EC) switch must be placed in the ISOLATE position.

Trainline Alarm from a Trail Unit

- Reset the trainline fault from the unit that initiated the alarm.

Alerter Cut-Off Not Responding

- Reset the alerter from the active cab.

4.18. AIR BRAKE SYSTEM POWER LOSS

When an air brake system power loss occurs, the locomotive must be brought to a full stop before moving the train again. The air brake system power loss must be addressed before the locomotive operation. When power is restored to the air brake system move the train.

When power is lost to the air brake system, the following will occur:

- The alarm bell will ring. The bell may be silenced by pressing the softkey F4 (Silence Alarm) on the Silence Alarm screen.
- The locomotive control system will stop/prevent any further power applications. Dynamic brake operation will be affected.
- The locomotive will go into a Penalty Brake situation and the Brake Cylinder pressure will develop 1.6 to 1.8 kg/cm².
- Independent Brake control will not function. Bail-off of the locomotive will be affected

Toggling the Air Brake circuit breaker on the Engine Control (EC) panel may restore power to the air brake system.

If the unit is a Trail unit, also note the following:

- Bail off is permitted when commanded from Lead unit (limited to BCE pipe pressure).
- There will be no change in air brake, power, or dynamic brake conditions.
- Independent Brake will apply and release when commanded by the Lead unit (limited to the BP and BCE pipe pressure).

5. REFERENCES

1. Operating Manual, ES57ACi (WDG6G) – Wabtec Corporation
Document No. GEJ-7228, Rev. D
2. WDG6G Locomotives Technical Description - Wabtec Corporation

DISCLAIMER

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