Rail Operating Code

Code Supplement CS 4.7

Operating Instructions for Refreshed EF Locomotives

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Fig. 1 Refreshed EF locomotive.

The protype refreshed locomotives, EF30163 and EF30226, may have some minor differences in the layout of equipment.

EF locomotives are also known as Class 30 locomotives.

1.0 Training and Certification

To operate an EF locomotive the operator is required to hold a current license to operate (LTO) and has completed a conversion training course. Refer Rail Operating Rules and Procedures Section 10.3 Training and Certification.

Learning and Development manage training modules that cover:

- Second person duties on an EF locomotive.
- Operate an EF locomotive within a depot.
- Haul a train with an EF locomotive.

Rolling Stock Asset Services manage the repair and maintenance training modules.

2.0 Commonly Used Abbreviations

Abbreviation	Meaning
ABV	Automatic Brake Valve
APC	Automatic Power Control
BIS	Battery Isolation Switch
BV LCD	Small LCD screen on each brake valve.
CB	Circuit Breaker
CCG	Control Circuit Governor
HSCB	High Speed Circuit Breaker
IBV	Independent Brake Valve
ILD	Integrated Locomotive Display (VDU screen in each cab)
MA	Motor Alternator
MCB	Miniature Circuit Breaker
NYAB	New York Air Brake
RSAS	Rolling Stock Asset Services
TM	Traction Motor
TMB	Traction Motor Blower
VCB	Vacuum Circuit Breaker

3.0 General Data

Wheel Arrangement	Bo-Bo-Bo
Power Input	25 kV, 50 Hz, nominal
Transmission	6 DC traction motors
Dimensions:	
Length	19.61 metres
Height - Pantograph down	3.95 metres
Overall width	2.70 metres
Bogie centres	5.80 metres
Wheel Tread Diameter (new)	1.10 metres
Weight:	
Full Working Order	108 Tonne
Axle Load	18 Tonne
Performance:	
Continuous Rating	3,000 kW @ 43 km/h
Starting Tractive Effort	300 kN
Maximum Speed	105 km/h
Brakes	Compressed air and regenerative

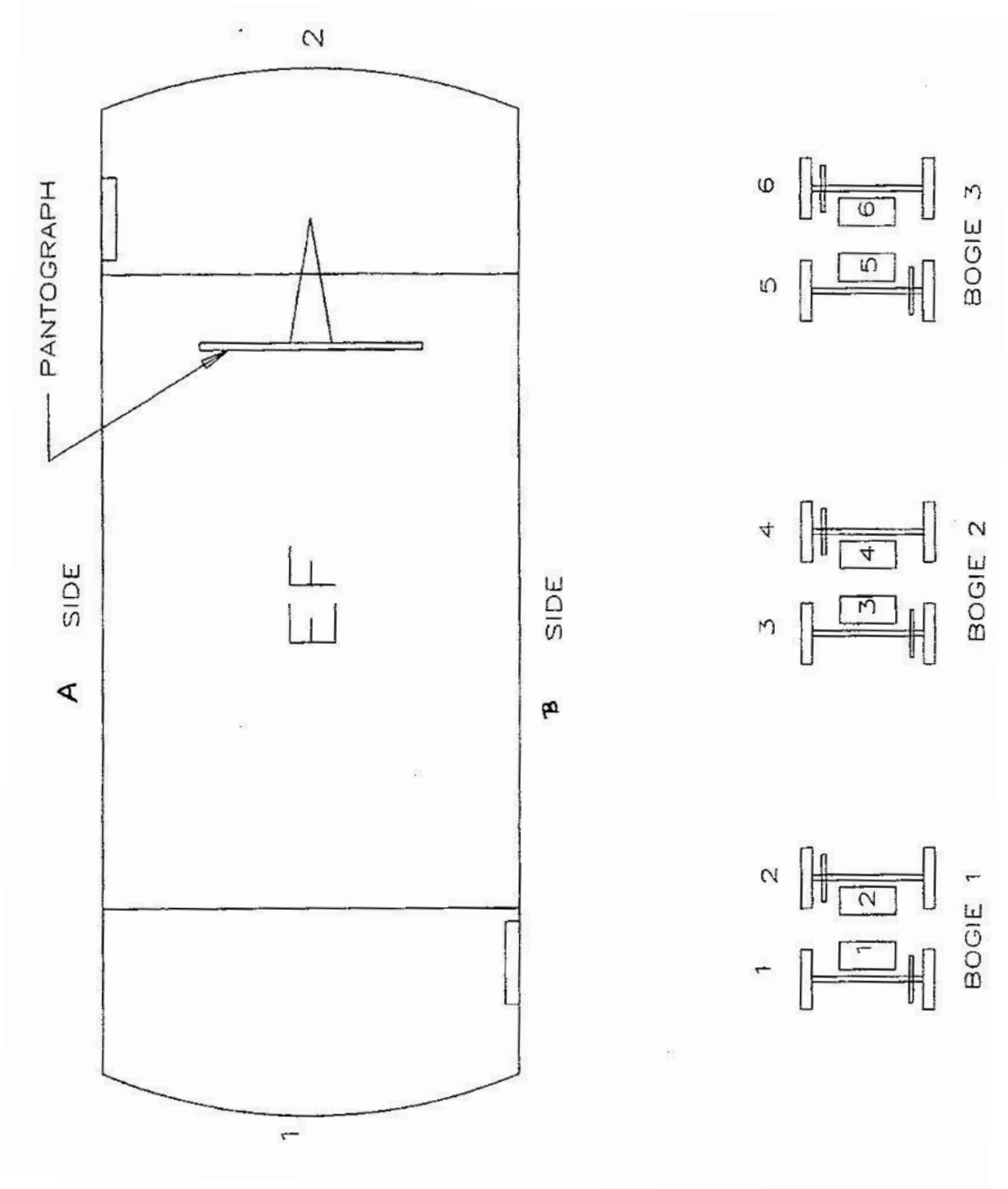
3.1 Compatibility between original and life extended EF locomotive.

Both types are compatible with the other.

It is planned to have all original EF locos out of service by late 2024.

4.0 Operating Equipment Locations

4.1 Numbering logic of sides, ends, bogies and traction motors.



4.2 Locomotive equipment location diagrams

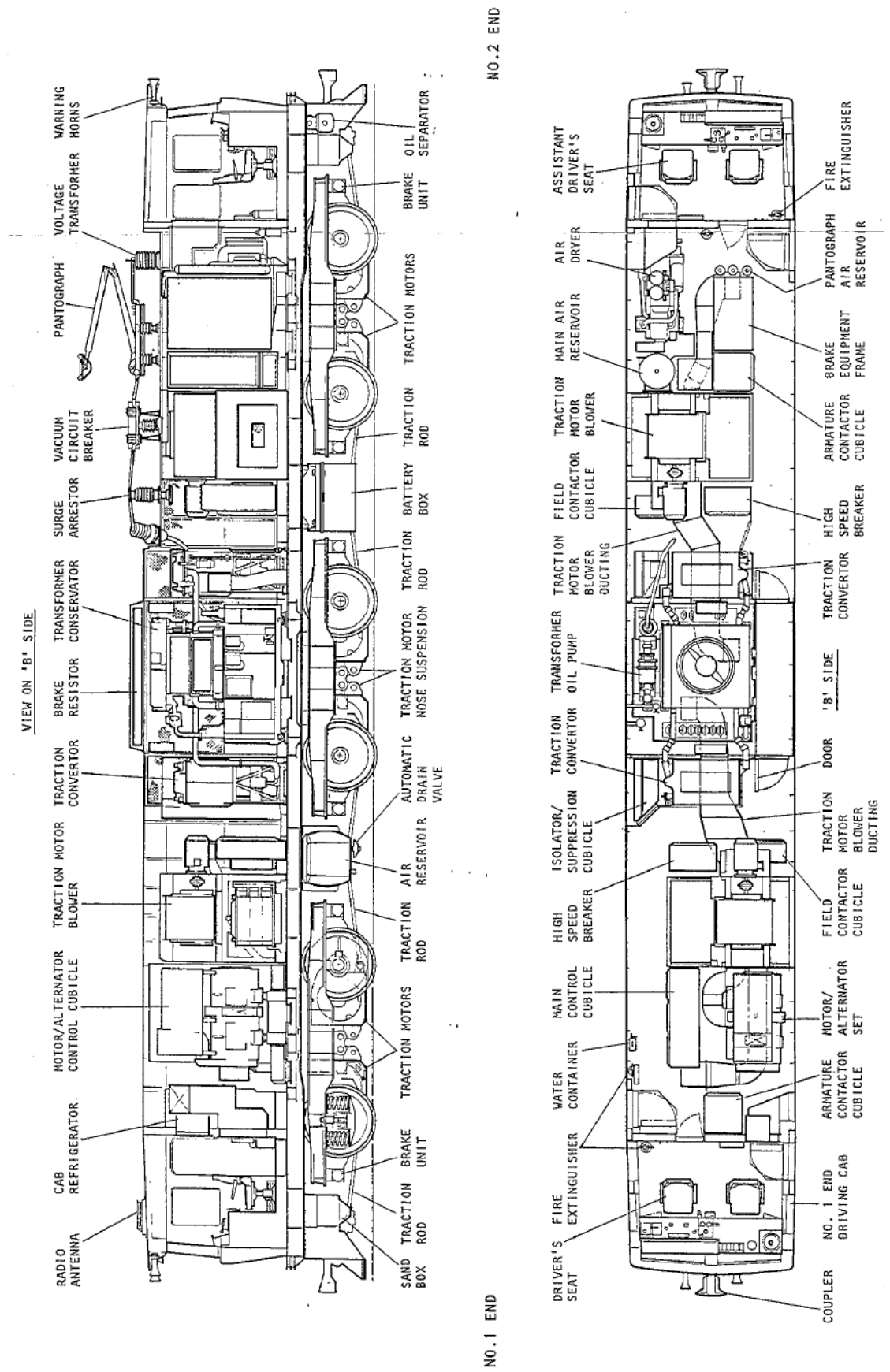


Fig. 2 Equipment layout

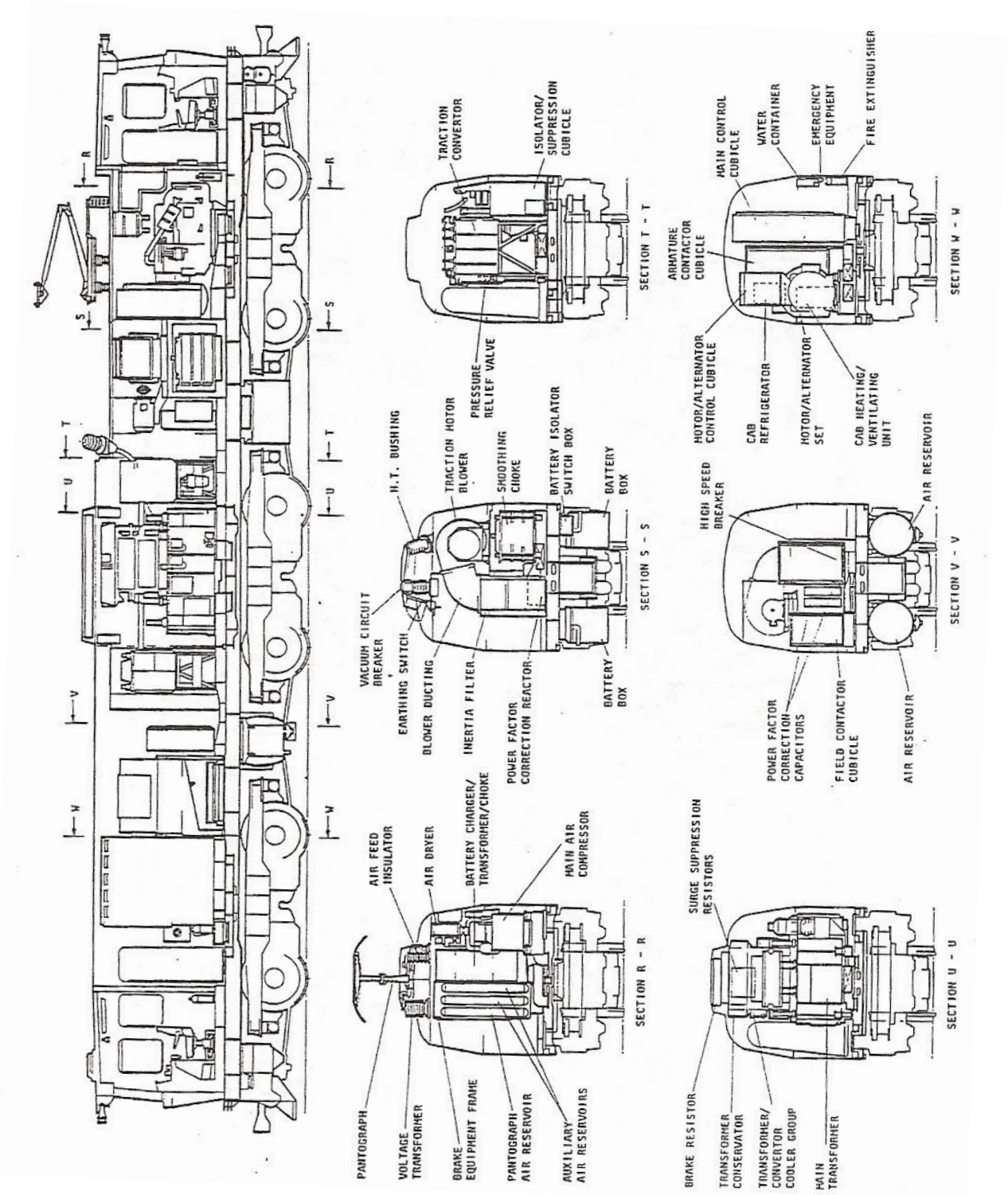


Fig. 3 Equipment layout

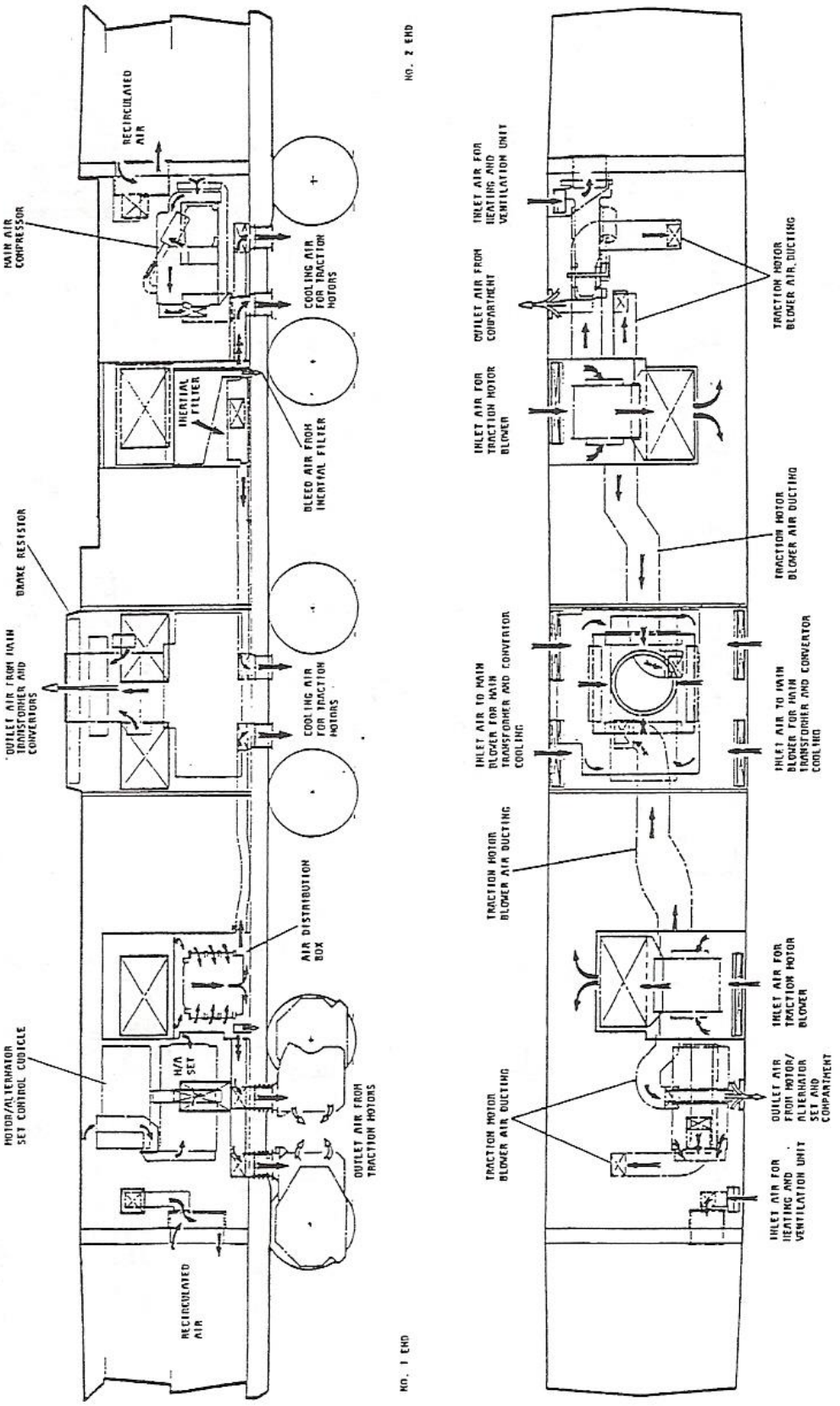


Fig. 4 Air Circulation diagram

4.3 Spare equipment locations

Equipment	Location
Chock bag	No.1 end alongside the start-up panel.
Detonators	In the lockable cabinet adjacent to the sink in No.1 end, locked with 100 padlock.
Handheld fire extinguishers	Four in each loco. One in each cab at floor level, one at the start-up panel and one by Cab 2 doorway. See location diagram below.
Kidney link	B side about halfway along the locomotive, kept closed with cable tie.
Jumper cable	Inside the loco No.2 end.
Spare hooks	B side about halfway along the locomotive, kept closed with cable tie.
Spare kit bag	No.1 end alongside the start-up panel.
Towing Chain	B side about halfway along the locomotive, kept closed with cable tie.

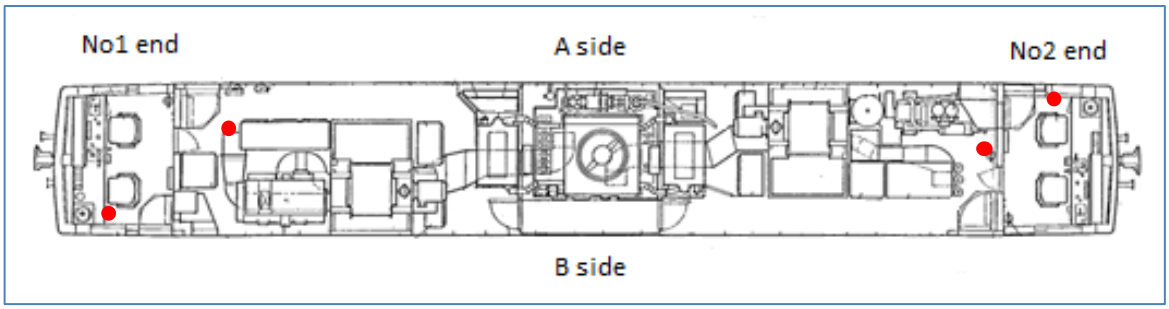


Fig. 5 Handheld Fire Extinguisher Location

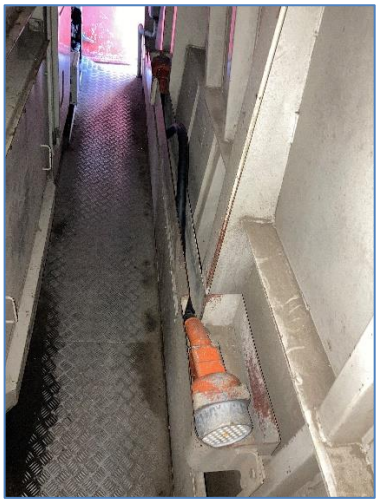
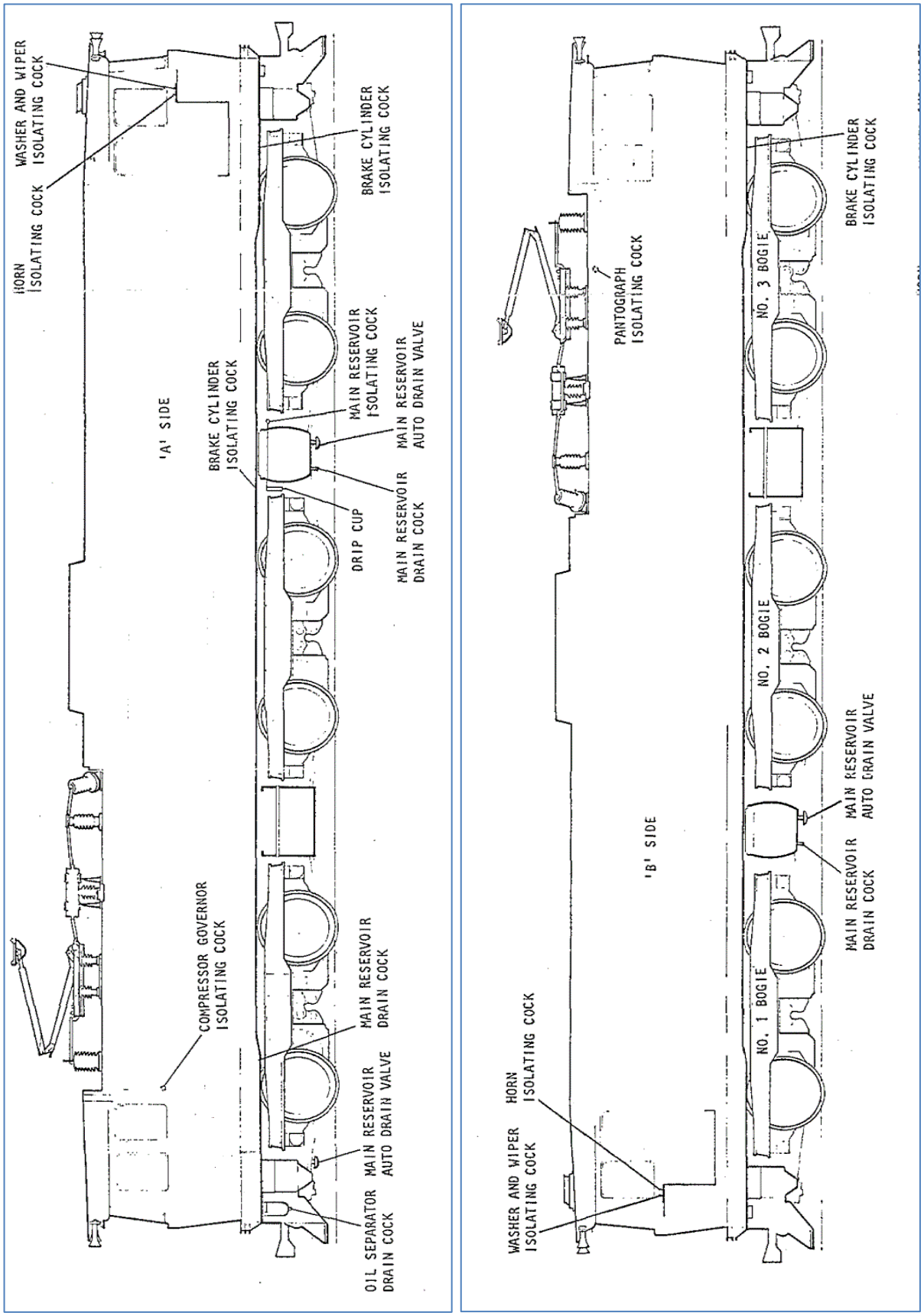


Fig.6 Jumper cable storage

Fig.7 Spare equipment location on B side

4.4 Cut Out valve location Diagram.



4.5 Cut out valves in the Cab.

In each cab 3 cut out valves are located on the driver's desk below the brake valve.

Fig. 8 Cab cut out valves.

4.5.1 Seat cut out valve.

This isolates the air to the seats in the cab.
When operated the seats will have no air suspension.

4.5.2 Horn cut out valve.

This isolates the air supply to the horn at that end of the loco.
Restrictions may apply when this has been operated.

4.5.3 Wiper cut out valve.

This isolates the air supply to the wipers and windscreen washers.

4.5.4 Main Reservoir Cut Out valve for the above

This isolates the main reservoir air supply to the other 3 valves for maintenance purposes.

This is located on the inside behind the cover.

The cover is secured with screws and is not easily removed.

4.6 Cut out valves on the Brake Rack

4.6.1 Park Brake cut out valve.

The park brake cut out valve prevents air being supplied to the park brake system. This would be used if a bogie hose or a park brake unit developed a leak.

When this valve is isolated, the park brake can only be released by manual operation of each park brake unit. The park brake cannot be reapplied until this valve is cut back in.

The loco will be inoperative as the control system will not detect the park brake being in the release position, therefore it will not develop driving amps.

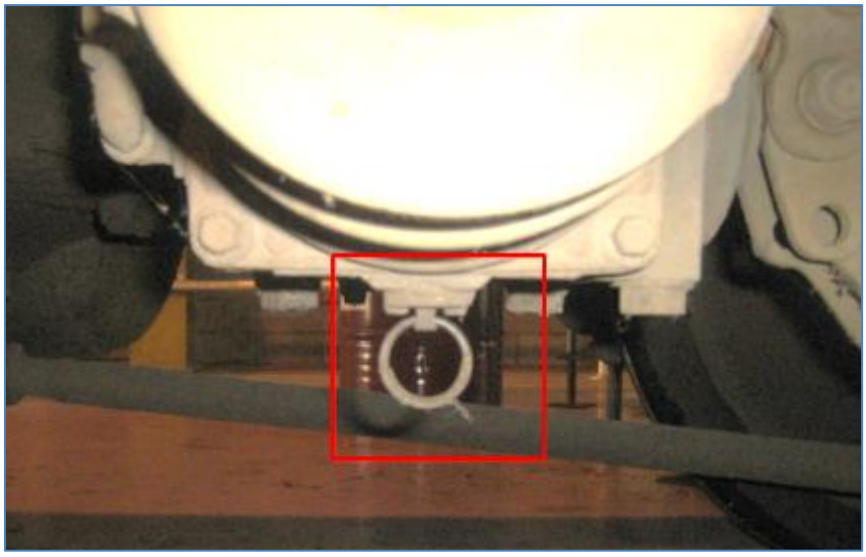


Fig. 9 Park brake release at axle

Fig. 10 Brake rack isolation valve for the Park Brake

Pull ring downwards, it may take some force to operate.

1. The park brake will click and retract the brake block off the wheel approximately 10mm when it releases.
2. If the independent brake is applied, the park brakes will click but the brake blocks will not release from the wheels.
3. The 4 Park Brake units are located only on bogie No 2, B side of the loco.

After manually releasing the park brakes, they must be reset to allow them to function correctly.

To reset the park brake units, apply and release the park brakes at least 2 times.

IMPORTANT:
Always visually check the park brakes have released correctly.
Dragged park brakes will overheat the wheels and destroy them.

4.7 Sanding cut out valves.

The sanding cut out valves prevent air being supplied to the sanding valves. This would be used if a valve failed in the open position and would not stop sanding.

The valves are operated during some maintenance procedures. There is one for each end of the locomotive.

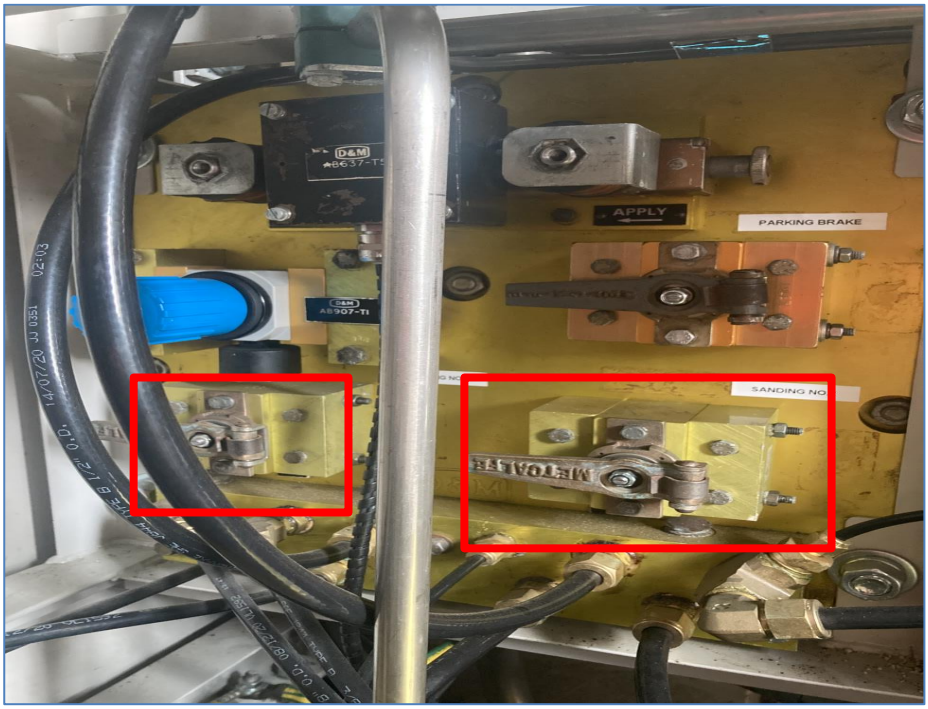


Fig. 11 Sanding cut out valves.

4.8 Control Reservoir cut out valve.

The control reservoir cut out valve will prevent air being supplied to the control system, this includes air for motor contactors, power brake switches, etc.

This valve would be used if an air leak developed in the control system. The loco will be inoperative when this is cut out.

Fig. 12 Control reservoir cut out valve.

4.9 Bogie cut out valves.

Each bogie has a cut out valve mounted on the underframe above the bogie.

They are operated by RSAS persons when working on bogies.

They would be operated if a bogie hose leaked or broke, brake cylinder leaked or when changing brake blocks.

The Brake Cylinder warning on ILD will not come on if a bogie is cut out while the independent brake is applied.

NOTE: These valves do not affect the park brake units.

When these are operated, the cut-out bogie has no functioning air brake.

The bogie air pressure exhausts out the cut-out valve elbow with a sudden blast of compressed air, keep your body clear of this.

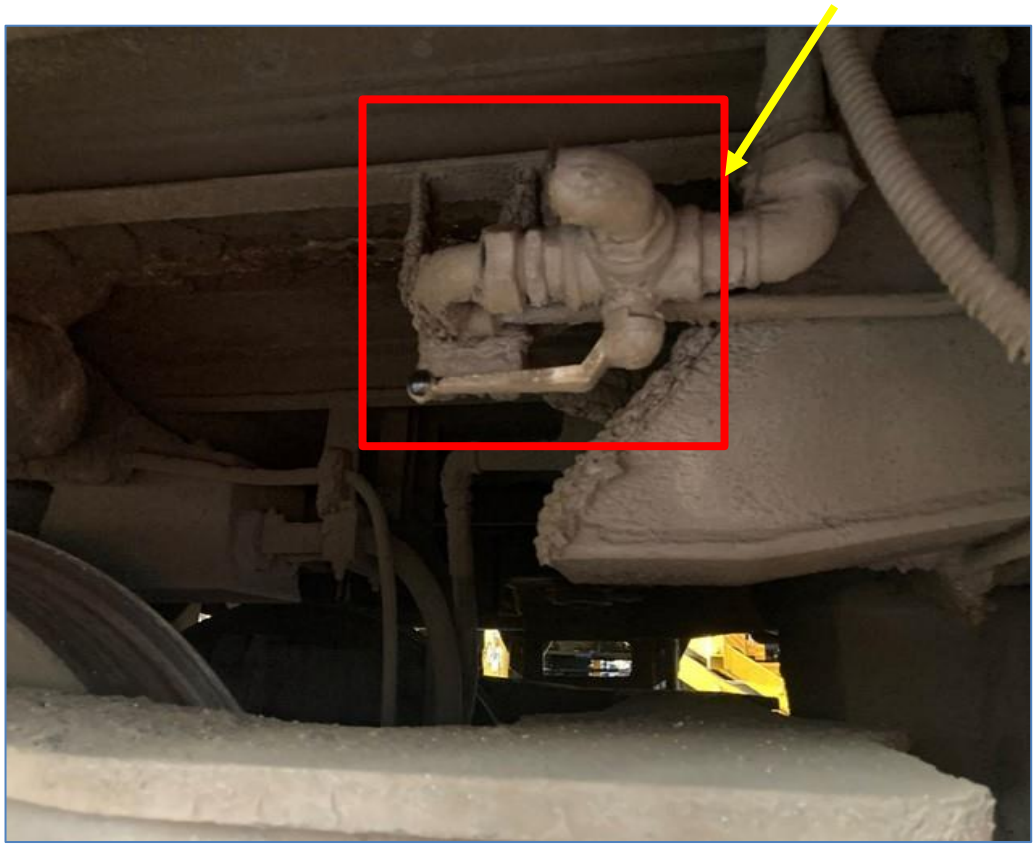
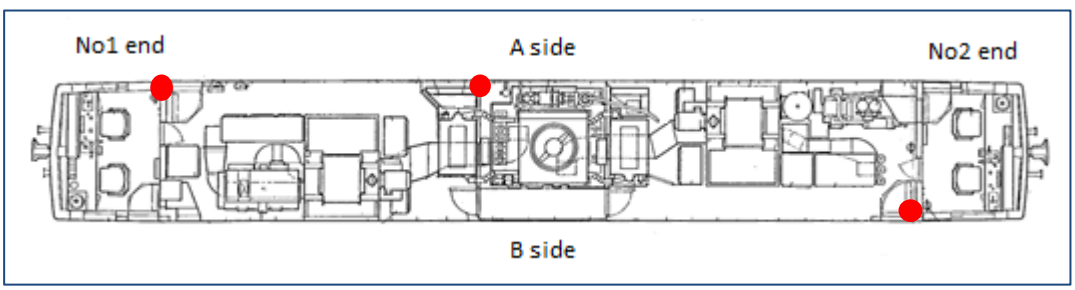


Fig.13 Bogie cut out valve and location diagram.



4.10 Brake Rack layout

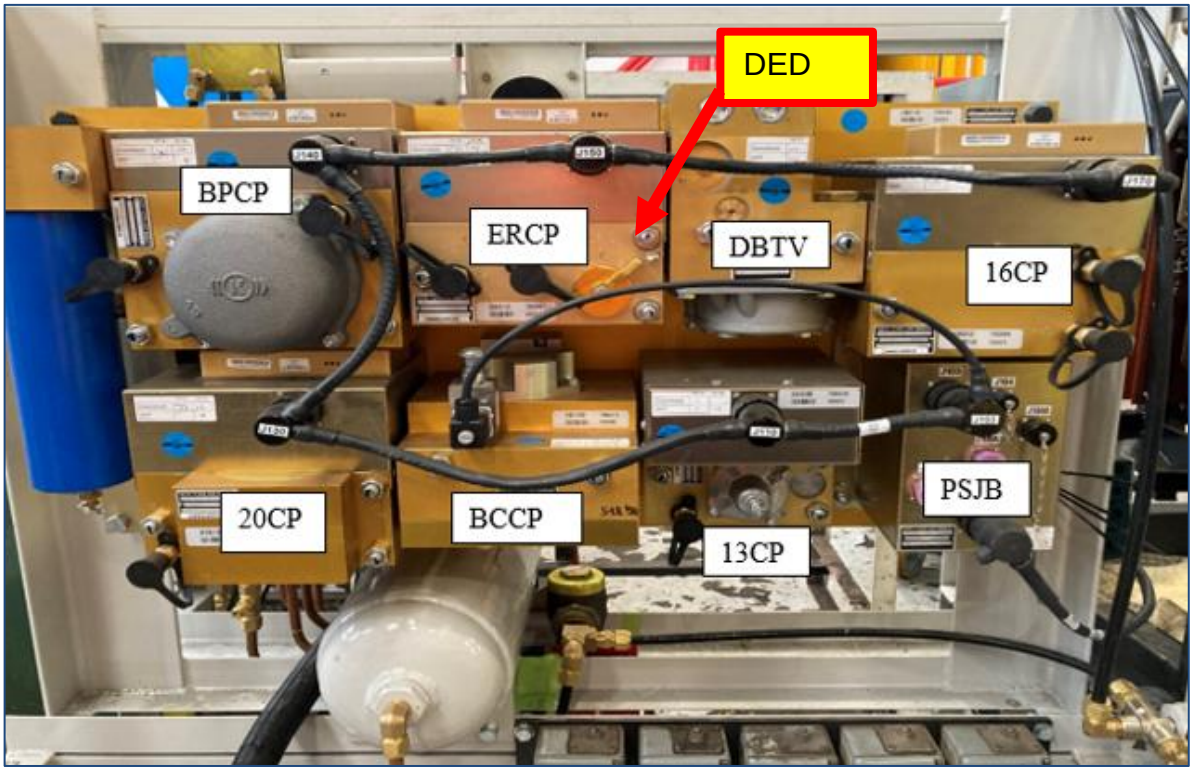


Fig. 14 New York Air Brake (NYAB) Manifold

Symbol	Meaning
BPCP	Brake Pipe Control Portion
ERCP	Equalising Reservoir Control Portion
DBTV	Pneumatic Brake Triple Valve Portion
PSJB	Power Supply & Junction Box
13CP	13 Pipe Control Portion (ER pipe)
16CP	16 Pipe Control Portion (BC application pipe)
20CP	20 Pipe Control Portion (BP pipe)
DED	Dead Engine Device (used when towing BP coupled only)

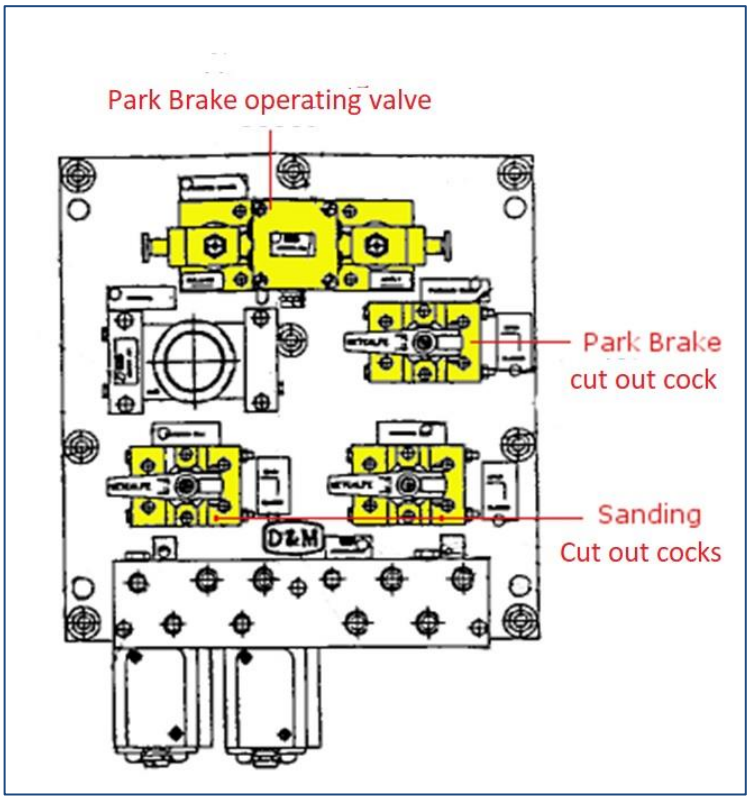


Fig. 15 Manifold 1 Park Brake and Sanding cut out valve's location diagram.

Fig. 16 Manifold 2 Control Reservoir cut out valve.

4.11 Air Systems

4.11.1 Compressors

The locomotive is fitted with one Atlas Copco GAR 30 Main Air Compressor.

A second, smaller, battery driven Auxiliary Air Compressor is fitted to supply air pressure to raise the pantograph and charge the control air system at initial start-up.

Both compressors are air cooled.

4.11.2 Main Reservoirs

The locomotive has three main reservoirs (MR).

The compressor supplies air directly through the check valve to the No1 main reservoir and then via the oil separator and air drier to the two No2 main reservoirs.

All three main reservoirs are fitted with manually operated drain valves and automatic drain valves.

No1 MR is mounted beside the compressor, the No.2 MRs are mounted on the underframe between bogies 1 and 2.

4.11.3 Air blowers

Three electric motor-driven blowers are provided: a main blower and two traction motor blowers.

The main blower forms part of the main transformer, located at the top of the transformer. The blower cools the transformer and convertor radiators by drawing air through the filters in the body sides, through the radiators, the air then being expelled through the regen resistors on the roof.

All blower motors will run at full speed immediately the reverser is placed into direction. They will run at half speed three minutes after the reverser has been placed in neutral. The delay in going to half speed is to prevent the motors continually going between high and low speeds whilst shunting.

A traction motor blower is located at each end of the locomotive to supply cooling air for the adjacent group of three traction motors.

4.11.4 Sanding equipment

Standard Salem sand traps are fitted to the sandboxes in each corner of the locomotive.

When the sanding switch, sanding pedal, or emergency brake is operated, the electro-pneumatic valve fitted on the brake frame supplies air to the sand traps at the leading end of the locomotive which then applies sand to the front of the leading pair of wheels via the hoses and delivery pipe fitted to the bogie.

The application of sand is therefore restricted to the leading wheelset in the direction of travel.

Deflectors are fitted to the traction motor vents to prevent the sand being blown off the rails by the forced draught.

4.12 Electrical systems

All the lights on the EF locomotive, including head and ditch lights, are LED units operated by battery voltage.

4.12.1 Battery supply

Gel Lead Acid batteries for supplying 100 volts to the essential circuits are contained in two boxes slung underneath the locomotive, between bogies 2 and 3. The locomotive's battery charger charges the batteries.

An external charging socket is fitted on B side of the loco in the charging case.

Fig. 17 Battery location

4.12.2 Battery life

- A minimum of two hours battery life if loco battery charger fails.
- Battery is 80Ah hour rating.
- If battery fuse blows everything shuts down, the pantograph lowers automatically.
- If the external battery charger switch is in external charge position (switches on CB panel) battery will appear to be dead.
- As a dead lead locomotive, with the jumper cable coupled to a second running locomotive, the dead leading locomotive can carry on controlling as normal. Therefore, the dead locomotive can lead for as long as required without discharging the batteries.

- Battery voltage is 100 volts.
- Battery charge voltage is 110 volts.
- If more than 120 volts, shut locomotive down.
- If below 78 volts, no traction amps but auxiliaries will work.

4.13 Pantograph manual controls

4.13.1 Pantograph Auto-drop and height limit

If a collector carbon is lost or damaged, the pantograph automatically drops away from the overhead wire. This auto-drop can be overridden after first visually checking pantograph shows no observable damage.

This can be carried out by viewing the pantograph from the external door of cab No.2.

As shown below, the override is operated by removing the cable tie and turning the valve.

The valve is located on the roof of the locomotive car body above the compressor.

When the valve has been isolated, a close watch should be kept of the overhead wire whilst the loco is moving.

If the wire starts shaking the pantograph should be dropped and a tow home sought. The carbon collectors may be damaged and may cause damage to the overhead wire.

If the pantograph rises too high, as would happen if there was no overhead wire, a height limit valve mounted on the pantograph operates to automatically drop the pantograph. The Locomotive Engineer CANNOT reset this valve as it is mounted on the pantograph.

Fig. 18 Pantograph auto drop override cut out valve.

4.13.2 Manually Lower Pantograph

If the pantograph cannot be lowered via any of the push buttons, it may be lowered manually.

Step	Action
1	On the protection valve turn the blue key and remove from lock. (This will vent pantograph raise piston.)
2	Visually check by looking through the Pantograph viewing window that the Pantograph has dropped.
3	If the Pantograph has not dropped, call Train Control to advise Traction Control of the situation.

Opening the battery switch will cause the pantograph to lower itself after a short delay.

Protection Valve Blue barrel key switch

Fig. 19 Blue key used to lower Pantograph manually

5.0 Cab Controls / Layout

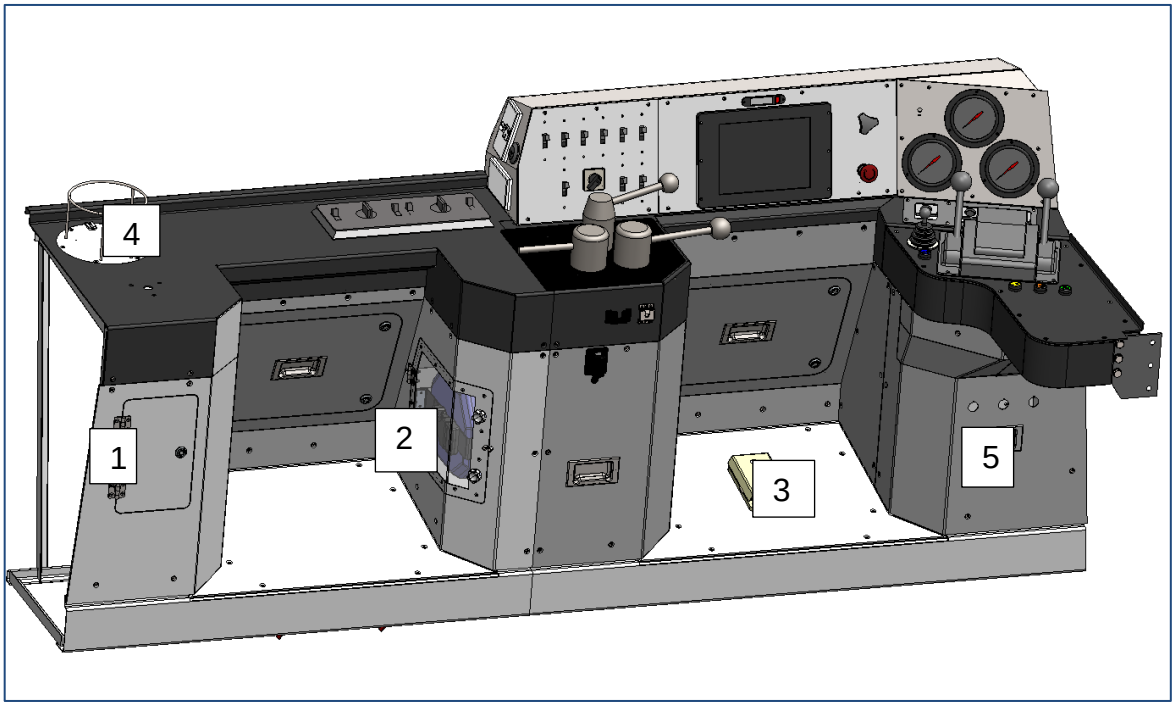


Fig. 20 Cab Desk layout

Number	Description
1	Access door to windscreen washer bottle.
2	Self-Contained Self Rescue (SRSR) container.
3	Pedal for operating sanders.
4	Jug for hot water.
5	3 air isolation valves for seats, horns, wipers, and washers (on front of cover).

Fig. 21 Brake gauges, Park brake controls, VD cancel and head light buttons.

Number	Description
1	Gauge light dimmer, works only for the three air gauges.
2	Flow meter air gauge.
3	MR / ER air pressure gauge.
4	BP / BC air pressure gauge.
5	Reset press button.
6	Park brake release press button.
7	Park brake indicator (only shows correct indication when power is on).
8	Park brake apply press button.
9	Horn operating valve
10	Sand press button (located adjacent to the horn valve on EF30163)

Number	Description
11	Vigilance press button
12	Ditch light flasher press button
13	Head & ditch light dim latching button
14	Electronic brake valve
15	Brake Valve LCD Display

Fig. 22 Integrated Locomotive Display, Emergency Pan down button.

Number	Description
1	Vigilance light with dimmer switch
2	Windscreen wiper & washer control
3	Emergency pantograph down button (latches in when operated, small clockwise twist to unlatch)
4	Integrated Locomotive Display (ILD)

5.1 Cab door lock

The standard cab key is used to lock/unlock from the outside. Doors can be locked from the inside without a key.

5.2 Headlight controls

Fig. 23 Headlight control switch

Position	Function
OFF	All head & ditch lamps OFF
HL	Headlamps only operating
ALL	Head & Ditch lamps operating
DL	Ditch lamps only operating
TRAIL	All cabs except the leading cab.

The headlight switch must be placed in Trail in all cabs in a consist except the lead cab.

- In the lead cab, the headlight switch position controls the head and ditch lights (OFF, HL, ALL or DL).
- In cabs set to TRAIL, the headlights automatically turn on dim in the direction of the reverser of the leading loco.

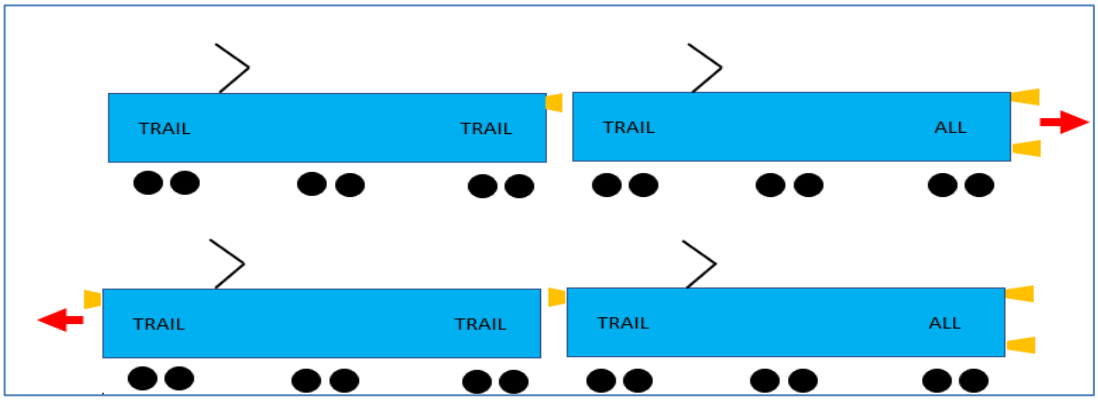


Fig. 24 Headlight control diagram

Headlight Button	Action when pressed
Head and Ditch Lights Dim	Toggles between bright and dim. The button lights up **green** for dim.
Ditch Lights Flash	Flashes the ditch lights for 15 seconds. Operating the horn has the same effect. The button lights up **orange** while the ditch lights are flashing.

Fig. 25 Headlight push buttons

5.2.1 Headlight Alert

EF locomotives are equipped with Tranzlog headlight alert system.
If the loco is moving with the headlamps not correctly switched **on.**

The **blue** alert lamp will flash off and on to remind the driver, the beeper will also pulse off and on.

Pressing the blue alert button will cause the lamp to stay on and the beeper to stop for 5 minutes. After 5 minutes the flashing lamp and pulsing beeper will begin again.

5.3 Signal Alert

EF locomotives are equipped with a Tranzlog Signal Alert system.

Press the red button, it will stay lit for approximately 400 meters. The red lamp and warning beeper will then begin to pulse for 6 seconds then cease.

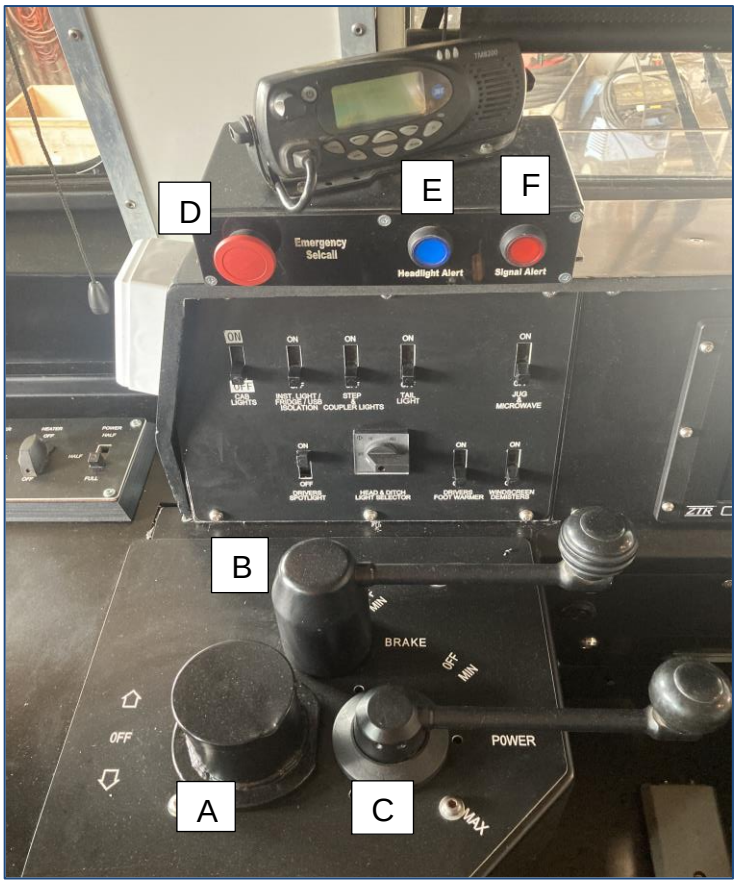


Fig. 26 Throttle and brake levers, Headlight and Signal Alert buttons

Alpha	Control
A	Forward/reverse lever
B	Regen brake control handle
C	Power control handle
D	Radio Emergency push button
E	Headlight alert push button
F	Signal alert push button

5.4 Auxiliary switches

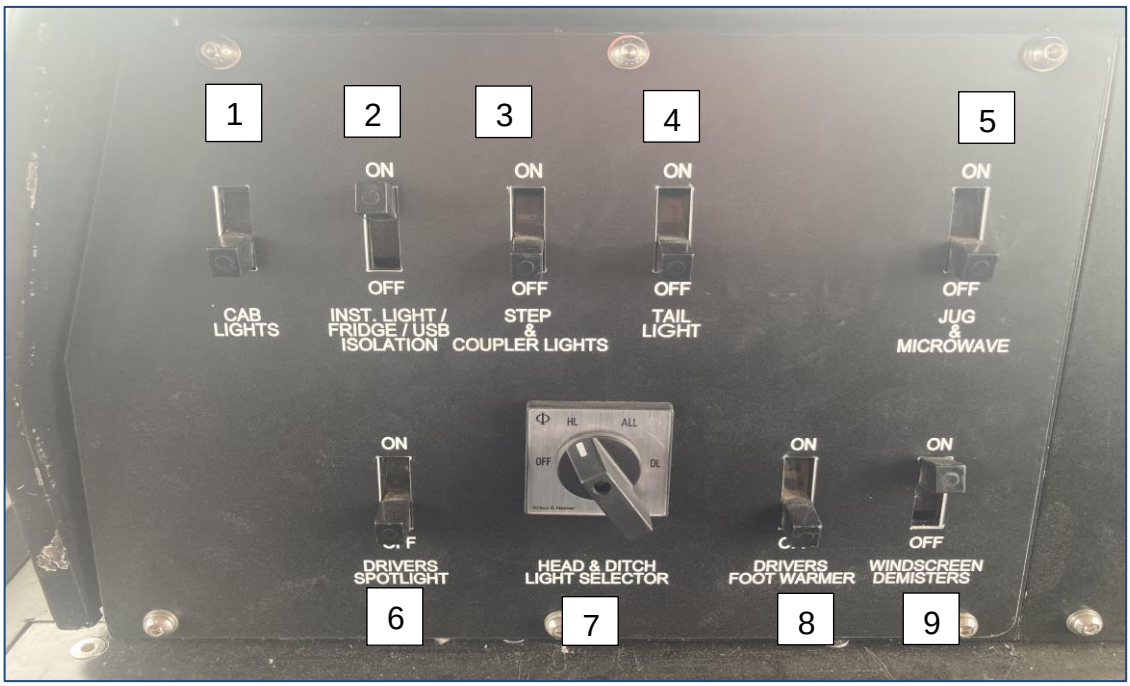


Fig. 27 Cab switches identification

Number	Switch
1	Cab Light Switch – Fluro lamps only.
2	Instrument, Fridge & USB Switch
3	Step & Coupler Lights Switch
4	Taillight Switch
5	Jug & Microwave Switch
6	Drivers Spotlight Switch – on for spotlight to operate.
7	Head & Ditch Light Selector Switch
8	Drivers Foot Warmer Switch
9	Windscreen Demister Switch

The roof spotlights are dimmable and switched on the mounting plate.

Fig. 28 Dimmer control for cab spotlights

Fig. 29 Microwave, Portable Radio charger, Masks and Filters

Number	Description
1	Slide out drawer beneath both seats, see next page for contents.
2	Microwave.
3	Cooler.
4	Portable radio charger.

The slide out drawers beneath each cab seat are sealed to indicate they are complete. Each cab contains the same equipment in the drawers.

When using any of the equipment, details must be entered in the repair book to ensure the equipment is replenished.

Fig. 30 LE seat drawer contents

Contained in this drawer are.

- 1 First Aid kit, sealed to indicate it is complete.
- 1 Gas Mask.
- 2 Gas Mask filters.

Fig. 31 Assistants seat drawer contents

Contained in this drawer are.

- 1 Gas Mask.
- 2 Gas Mask filters.
- 1 LED Head Torch & spare batteries.
- 4 Thermal Blankets.

Fig. 32 Assistant side features

Number	Description
1	Hand wipes dispenser
2	Electric jug
3	Emergency Stop push button (dumps brake pipe only)
4	Spotlight and heating controls

On the dash:

- 240V AC socket for running small items only, such as laptop chargers. It contains an internal earth leakage detector.
- USB socket with earth leakage protection for the jug and the microwave.

Fig. 33 230v power and USB charger

5.4.1 Kitchen / Heating Power – fault finding.

To prevent the motor alternator being overloaded by the new cab equipment the loco is fitted with load shedding.

The refurbished EF can only power the kitchen and heating circuits in one cab at a time.
The cab with the brake valve active (OUT, FRT, or PASS) will be powered.

When both brake valves are in TRL, cab 1 will be powered.

If kitchen/heating appliances are not working, check the following:

1. Locomotive is running (VCB closed)
2. All circuit breakers on the start panel are closed.
3. Brake valve in the cab to be powered is in OUT, FRT or PASS.
4. Jug / microwave RCD is not tripped (press the green “RESET” button and check that the amber power indicator is illuminated).

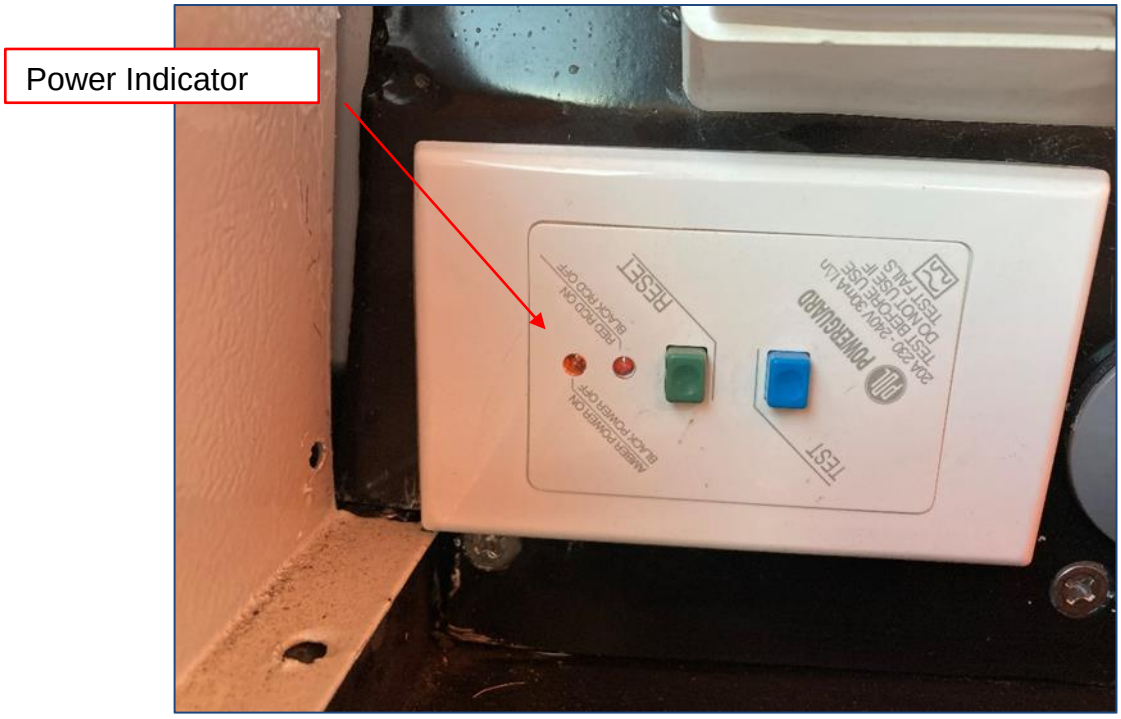


Fig. 34 230v power indicator light

5. The desk switch for the kitchen/heating appliance is on.

5.5 Train Control radio

- Tait 8260 radio with two roof mounted speakers
- Standard crossband link portable radio.

5.6 Emergency Pushbuttons

Two emergency pushbuttons are provided in each cab, one on the driver's desk and the other on the assistant's desk.

5.6.1 Emergency Stop – Assistant side

The emergency pushbutton (aluminium mushroom headed) on the assistant's desk only dumps the brake pipe, and consequently applies the brakes on the train and locomotive. This button may take force to operate and will latch in either position.

Fig. 35 Assistant Emergency Stop pushbutton

5.6.2 Down Pantograph

When depressed, the red pushbutton on the driver's desk opens the VCB and lowers the pantograph.

The button remains in the down position until it is reset.

To reset, turn the button clockwise to unlatch it.

Fig. 36 Down Pantograph button

5.7 Fire suppression system

The fire detection and extinguisher systems are described below.

The FirePro FP-08451KR Fire Control Panel is a combined detection and extinguishant system that is compliant for vehicle and mobile plant installations (AS5062).

Upon activation, the solid compound in the 4 generator units is transformed into a rapidly expanding, highly efficient gas, based on Potassium salts.

NOTE It does not deplete oxygen levels.

Its built-in fail-safe activation system ensures operation of the generators when required, even if everything else fails.

The system:

- The system is self-monitoring and does not require pre-service testing.
- Is self - testing, any errors will show as the Fault LED
- Has an internal battery to ensure it will operate if the loco battery power is lost.

5.7.1 Cab equipment

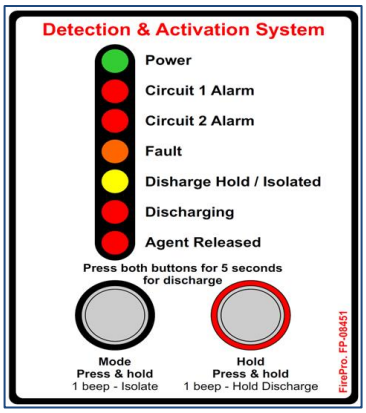


Fig. 37 Cab fire panel image

Fig. 38 Cab fire warning strobe light/siren

Each cab contains:

- 1 display panel.
- 1 combined warning siren / strobe lamp.
- No.1 cab has a key isolation switch to disconnect the generator units from the display panel. When in the Isolated position, the display will show Fault LED.

When locomotive power is disconnected from the fire system it will continue to monitor the locomotive for fires for a least two hours.

The system will not indicate loss of locomotive power, it will continue running on its internal battery.

When the battery is going flat, the system will warn by beeping for a short time, then it will go silent, and all LED lights will extinguish.

When the locomotive power is reconnected, the fire system will power up and the battery will recharge.

5.7.2 Panel indications

Panel	Strobe	Condition
	Off	Power LED is green, and all other LEDs are extinguished. • System on and 'normal'.
	Off	Power LED is green Fault LED is yellow. • Ensure the key isolation switch is not in the isolated position. • Call depot for advice.
	Off	Power LED is green Isolate LED is yellow. • System is isolated. • Call depot for advice as the Locomotive may need to go to depot for repair.
	**On**	Agent released LED on: • Locomotive shut down. • Beeper sounding • Fire extinguisher discharged. • Beeper will sound until maintenance staff reset the system. • Locomotive will need to go to depot for repair

5.7.3 Re start checks.

Each time the locomotive is started both cabs should be checked to ensure:

1. The green LED is illuminated.
2. No other LED is illuminated.

5.7.4 Sequence of operation

60 seconds from first alarm sounding to extinguisher activation.

Step	Action
1	System detects fire.
2	a. The alarm siren / strobe will operate continuously in each cab. b. The panel will light the **red** LED for Circuit 1 Alarm
3	There is time delay of 30 seconds to the activation of the suppression system to allow the Loco Engineer time to hold/prevent discharge of the system.
4	At 30 seconds the VCB will open, and the pantograph will drop automatically to allow all the blowers to come to a complete stop.
5	At 60 seconds the system will activate and extinguish the fire.

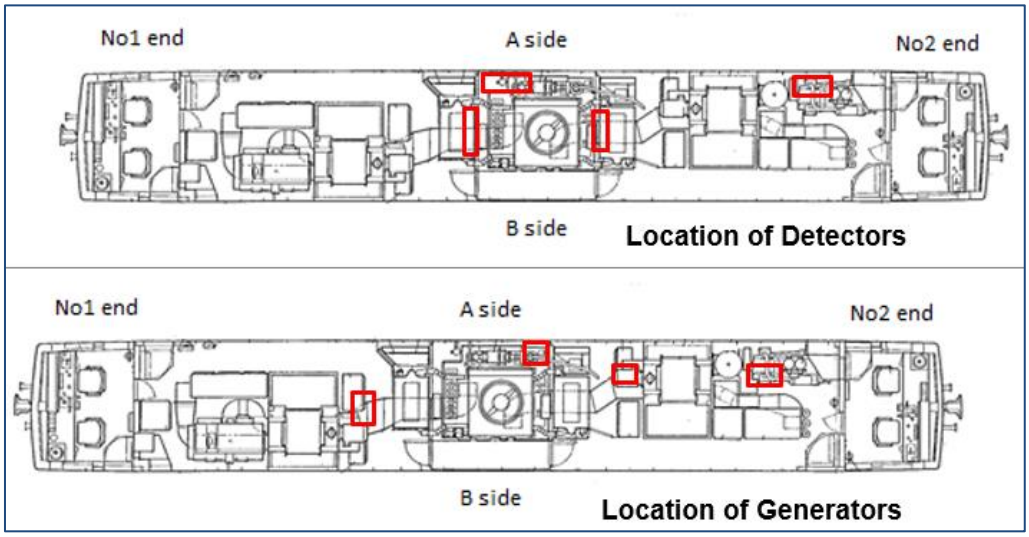
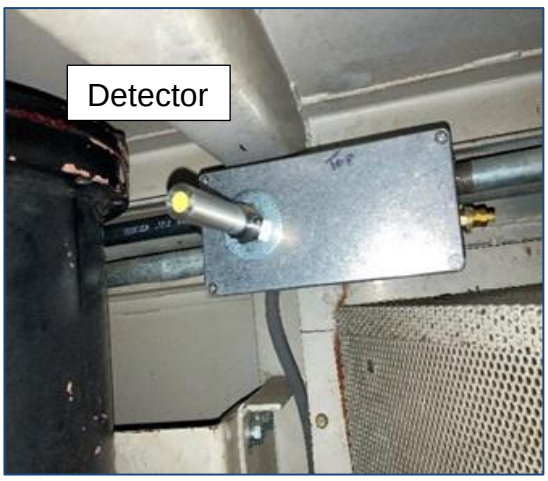


Fig. 39 Location & illustration of Fire System Detectors & Generators



5.7.5 To Manually activate the fire system.

To manually discharge the fire system.

Step	Action
1	Press and hold both the Hold and Mode buttons until Discharge LED lights.
2	The siren / strobes will operate, the loco will shut down before activation.

5.7.6 To Silence Alarms

To silence the internal sounder and any installed siren/strobes that have operated due to an alarm condition.

Step	Action
1	Press and hold the Mode button until 1 beep is heard.
2	The Isolated LED will light on the panel.
3	This will also override any installed shutdown relays and allow for operation of the equipment.

Equipment should not be operated until it has been rendered safe RSAS.
The control panel will remain in an alarm/fault condition until serviced and reset.

5.7.7 To Pause fire system activation.

To STOP / HOLD the discharge of the suppression system during activation, this must be completed within 30 seconds of the alarm first sounding.

Step	Action
1	Press the Hold button until 1 beep is heard.
2	The Hold LED will illuminate.

5.7.8 To return the fire system to activation.

Step	Action
1	Press the Hold switch and ensure the Hold LED turns off.
2	The system will continue automatic activation.

Holding discharge disables automatic activation.
Manual Activation will remain operational.

- When in Hold, the control panel continues to monitor for alarm and fault, and show the alarm and fault indications, but will not operate the siren and the automatic discharge.
- The Hold function will also silence the siren/strobe and the internal sounder but will not cancel the alarm or fault indication.

5.7.9 To Isolate the Control Panel

Step	Action
1	Press and hold the hold Switch until 1 beep is heard.
2	The Isolated LED will be illuminated.
	To restore the control panel to normal operation, press the Mode Switch and ensure the Isolated LED turns off.

Isolating disables automatic activation.
Manual Activation will remain operational.

- When isolated, the control panel continues to monitor for alarm and fault, and show the alarm and fault indications, but will not operate the siren and the automatic discharge.
- When isolated, any change in the detector status, will cause the panel sounder to operate for 1 second as an alert of the status change, but the panel will remain isolated.
- The isolate function will also silence the siren/strobe and the internal sounder but will not cancel the alarm or fault indication.

5.7.10 Safety Data sheet

This datasheet is for the compound contained in the 4 generator units.

Safety Data Sheet (SDS) - FirePro

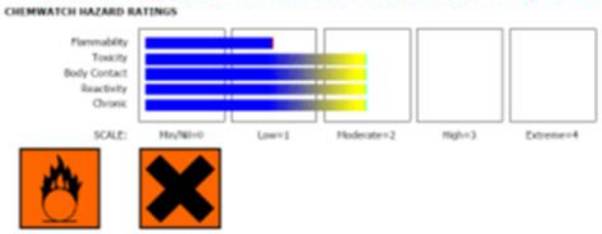
This is an EXTRACT ONLY from the full SDS. To view the full SDS go to **www.chemwatch.com.au**.

CHEMWATCH

PRODUCT NAME CELANOVA FIREPRO

PRODUCT USE Fire extinguishing agent.

HAZARDOUS SUBSTANCE. DANGEROUS GOODS.
According to NOHSC Criteria, and ADG Code.



POISONS SCHEDULE - None

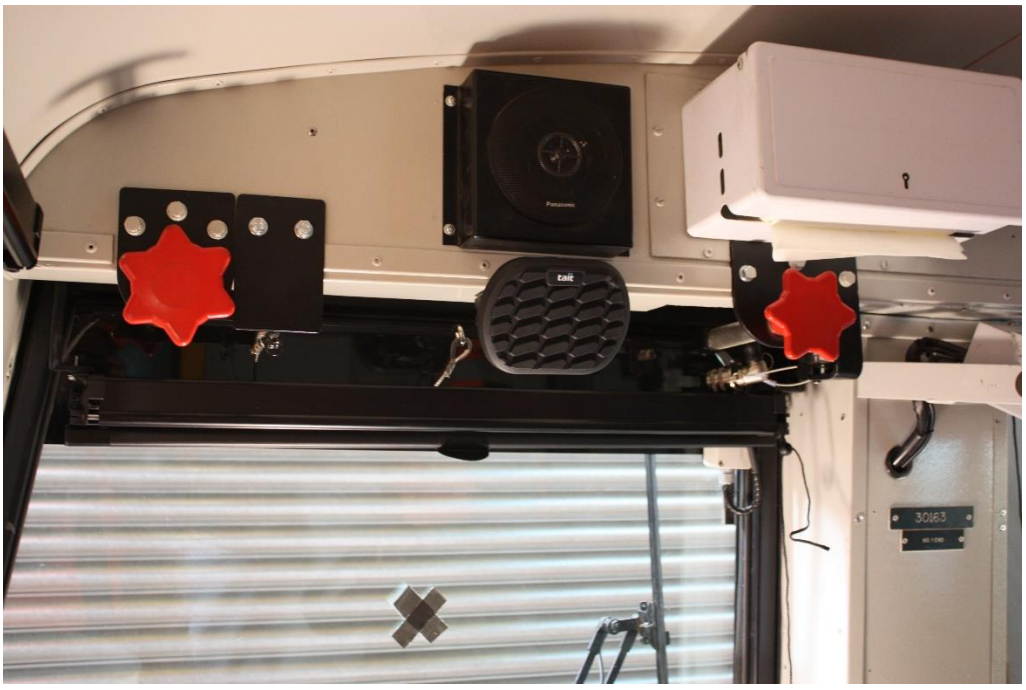
RISK	SAFETY
• Contact with combustible material may cause fire. • Harmful if swallowed • Irritating to eyes and skin. • May cause SENSITISATION by skin contact. • Harmful to aquatic organisms may cause long- adverse effects in the aquatic environment. • Cumulative effects may result following exposure • May produce discomfort of the respiratory. system* • Possible respiratory sensitiser*. • May possibly affect fertility* (limited evidence).	• Keep away from combustible material • Avoid exposure - obtain special instructions before use. • To clean the floor and all objects contaminated by this material use water and detergent. • Keep away from food drink and animal feeding stuffs. • In case of contact with eyes rinse with plenty term of water and contact Doctor or Poisons Information Centre. • If swallowed IMMEDIATELY contact Doctor or. Poisons Information Centre (show this container or label). • This material and its container must be disposed of as hazardous waste.

FIRST AID MEASURES	
SWALLOWED	• If swallowed do NOT induce vomiting. • If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration. Observe the patient carefully. • Never give liquid to a person showing signs of being sleepy or with reduced awareness. • Give water to rinse out mouth, then provide liquid slowly and as much as casualty can comfortably drink. • Seek medical advice.
EYE	• If this product comes in contact with the eyes: • Wash out immediately with fresh running water. • Ensure complete irrigation of the eye. • Seek medical attention without delay; if pain persists or recurs seek medical attention. • Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
SKIN	• If skin contact occurs: • Immediately remove all contaminated clothing, including footwear. • Flush skin and hair with running water (and soap if available). • Seek medical attention in event of irritation.
INHALED	• If dust is inhaled, remove from contaminated area. • Encourage patient to blow nose to ensure clear passage of breathing. • If irritation or discomfort persists, seek medical attention.

Fig. 40 Extinguisher Safety Data Sheet

5.8 Cab window exit

Crew can evacuate through the left-hand windscreen of either cab if there is no way to leave the locomotive through the side doors.

Step	Action
1	Confirm with Train Control that the overhead is isolated – **you will be closer than the Minimum Approach Distance of 2 metres.**
2	 **Fig. 41 Screws to release the windscreen.** Unscrew (anti-clockwise) the two screw handles that hold the front windscreen in place. This will “jack” the top of the window out, pivoting on the bottom edge.
3	Push out the window, it will pivot from the bottom edge.
4	The window will drop to the ground allowing escape via the front of the locomotive.

Step	Action
5	 **Fig. 42 Left foot first** Face the back wall of the cab and put your left leg out first. With your left hand, hold onto the hand grab between the windscreens. Put your left foot on the footstep above the taillight.
6	 **Fig. 43 Right foot to handrail** Swing your right leg out of the window. Put your right foot on the horizontal treadplate.

Step	Action
7	 **Fig. 44 Left foot to buffer** With your right-hand hold onto the horizontal handrail. Step with your left foot down to the buffer.
8	 **Fig. 45 Right foot to cowcatcher** Hold on with both hands to the middle handrail. Step down with your right foot to the cowcatcher.
9	Watch the sequence in this short clip .

6.0 Integrated Locomotive Display (ILD)

The ILD displays a range of information for the Locomotive Engineer.

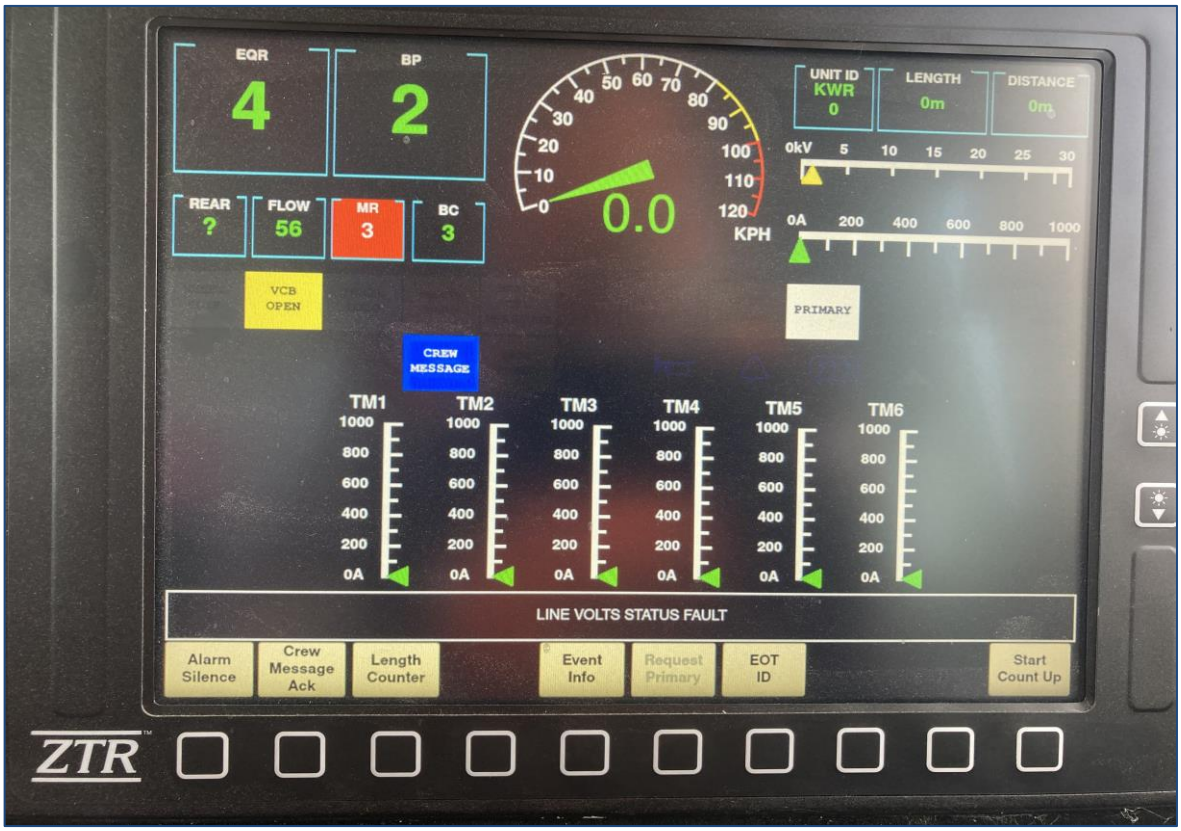


Fig. 46 ILD display

6.1 Main menu

Item	Function
Alarm Silence	Use this button to silence the bell on the display from sounding when there is an End of Train alarm.
Crew Message Ack	Crew messages are on-screen prompts intended to notify the locomotive engineer of a fault condition or situation requiring action. For example, that a fault has occurred, and the controls need to be placed into a certain setup to clear the fault. This button will be visible only on the main screen when crew message is active. In normal operation the crew message button is hidden.
Length Counter	Use this button to go to the Length counter menu.
Event Info	Use this button to go to the Event Info menu.

Item	Function
Request Primary	If the ILD is currently set as the primary unit, this button will be greyed out. If the ILD is the secondary unit, the primary request button will be active, and when pressed a request will be sent for primary control. When this request is accepted, the ILD which requested the primary and their button will then be greyed out.
EOT ID	Use this button to go to the EOT ID menu.
Start Count Up	Start Length Counter.

6.1.1 Display items

- Equalising Reservoir pressure
- Brake Pipe pressure
- Main Reservoir pressure
- Brake Cylinder Pressure
- Flowmeter
- Rear vehicle brake pipe pressure
- Brake Cylinder Pressure
- Speedometer digital and numerical – gets its signal from 1A axle.

Bar gauges for:

- Line voltage
- Average traction motor current
- Six traction motor currents

6.1.2 Alarms

- Vigilance
- Wheel Slip
- Half Power
- VCB Open
- Trail Loco
- Unit Alarm
- End of Train motion
- End of Train alarms

6.1.3 Diagnostics

The Diagnostics function is used to help problem solve or troubleshoot issues with the normal operation of the locomotive. View active faults, crew messages, and fault history information.

6.1.4 Head of Train Display (HOTD)

The HOTD function provides a communication link between the HOTD and End of Train (EOT) devices. The HOTD relays important information from the end of train to the ILD.

6.1.5 Overspeed warning

The Overspeed function is a safety feature that monitors when the locomotive road speed is approaching the overspeed set point. The digital speed read out will change to yellow as a warning when approaching the overspeed set point. The speed read out will turn red and an audible tone will sound when overspeed is occurring.

6.1.6 Train Length counter

The Train Length Counter function is normally used to help the locomotive engineer determine the position of the last vehicle.

The countdown feature preloads a counter with the accepted train length and an audible tone will sound when the counter reaches zero.

The Train Length Counter can also be used to measure the train length. See Section 6.2 Length counter menu.

6.1.7 Line Voltage gauge

The line voltage gauge will change based on the line voltage passed to the ILD from the Loop Tech Data Logging Unit.

- When the line voltage is within the acceptable range, the line on the gauge will be green.
- When the line voltage is outside of the acceptable range, but lower than the maximum line voltage, the line on the gauge will be yellow.
- When the line voltage is above the maximum line voltage, the line will be red and will remain at the maximum value.

If the line voltage is flagged as invalid by the Loop Tech Data Logging Unit, the line voltage gauge will be set to zero.

6.1.8 Average Traction Motor Current gauge

- This gauge is an average, based on the six traction motor currents passed to the ILD from the Loop Tech Data Logging Unit.
- The line on the gauge will be green if the average is lower than the maximum traction motor current, and red if it is larger than the maximum.
- If any of the traction motor currents is flagged as invalid, the gauge will be set to zero.

6.1.9 Traction Motor Current gauges (six)

- These gauges are based on the six traction motor currents passed to the ILD from the Loop Tech Data Logging Unit.
- The line on the gauges will be green if the current is lower than the maximum traction motor current, and red if it is larger than the maximum.
- If the traction motor current is flagged as invalid, the gauge will be set to zero.

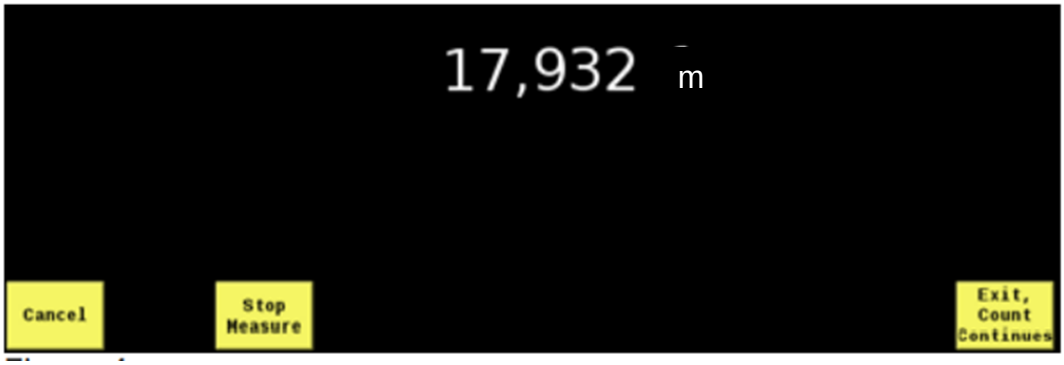
6.2. Length Counter menu

Item	Function
Change Length	Use this button to open the Change Length Menu and to enter or modify the train length.
Countdown Length	Use this button to open the train length countdown counter.
Counting Toggle	Use this button to change between counting up or counting down.
Measured Kilometre	Use this button to measure average speed of the locomotive over one Kilometre.
Exit	Return to the Main Menu

6.2.1 Change Length menu

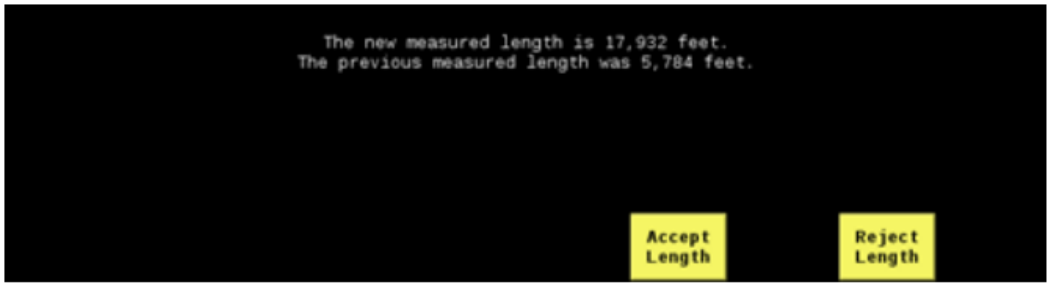
Item	Function
Measure	Use this function to measure the train length.
Enter Length	Use this function to enter the train length if it is known.
Exit	Return to Length Counter Menu

6.2.2 Measure Length



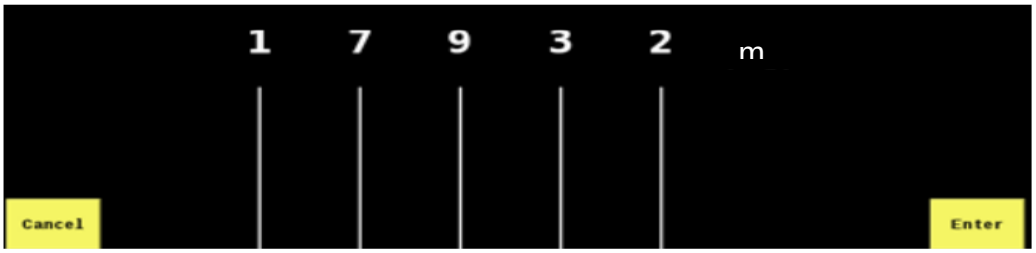
The locomotive length is measured in metres as the locomotive is in motion. Begin to measure the length as the locomotive passes a landmark and press the Stop Measure button as the last vehicle passes the same landmark.

Item	Function
Cancel	Use this button to stop and reset the measured length counter. Return to Change Length menu.
Stop Measure	Use this button to stop and hold the new measured length.
Exit	Count Continues Return to the Main Menu and continue counting the length
Accept Length	Use this button to save the new measured length as the train length. The measured length must be between 50 and 7000 metres to be saved as the train length.
Reject Length	Use this button to keep the existing train length. The new measured length is saved as the previous measured length.



6.2.3 Enter Length

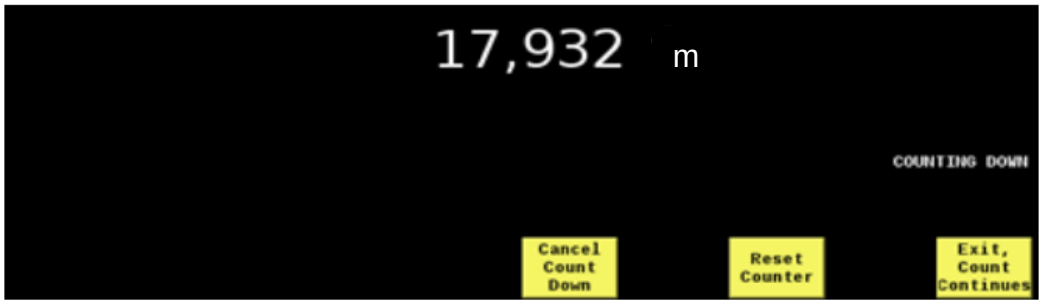
If you know the train length it can be manually entered or changed using this screen. Press the appropriate key below each digit to raise the number until the correct value is displayed. If you pass the desired number keep pressing the key and the number will loop back to zero. Hold down the key to scroll quickly through the numbers.



Item	Function
Cancel	Use this button to discard the value on the screen and return to the Change Length menu.
Enter	Use this button to save the manually entered value as the new train length. The length must be between 50 and 7000 metres to be saved as the train length.

6.2.4 Countdown Length

The countdown length function preloads the train length into the countdown counter. The counter value is decreased as the locomotive moves. When the counter reaches zero an audible tone is given to alert the locomotive engineer.



Item	Function
Cancel Count Down	Use this button to cancel the countdown length function and return to the Change Length menu.
Reset Counter	Use this button to cancel the countdown length function and return to the Change Length menu.
Exit	Count Continues Return to the Main Menu and continue counting down.

6.2.5 Measured kilometre

The Measured kilometre function is a timer that is used to calculate the average speed of the locomotive between two-kilometre posts.

Item	Function
Start Timer	Use this button to start the timer as you pass the first kilometre post. Maintain a constant speed until you reach the second kilometre post.
Exit	Stop the Timer and return the Length Counter Menu

Item	Function
Stop Timer	This button appears when the Measured kilometre function is active. Use it to stop the timer as you pass the second kilometre post.
Reset Timer	Use this to reset the timer to 00:00. The timer will immediately continue tracking time in order to measure a new average speed.

When the timer is stopped the screen will display the average speed of the locomotive in KPH. Compare the calculated average speed to the speed you were trying to maintain. If there is a significant discrepancy it may be that the wheel diameter needs to be modified in the STANDALONE ILD system settings.

6.2.6 Event Info Menu

Item	Function
Active Faults	Use this button to view any faults that may exist in the STANDALONE ILD control system.
Fault History	Use this button to view a history of faults that have occurred on the STANDALONE ILD and see the date and time when each fault happened.
AESS Events	Use this button to view the date and time when AESS events occurred.
Exit	Use this button to return to the Main Menu

6.3 Active Faults

This screen displays any active faults that may exist in the STANDALONE ILD control system.

When the control system is clear of active faults the screen will display the message “No Active Faults Found”. This screen can be used to help troubleshoot problems.

- One fault can be viewed at a time.
- A list of up to ten active faults is available.
- The fault name and details of that fault is displayed.
- The screen shows the total number of active faults that are in the list and the place where the fault is in the list, i.e., 3 of 5 would be the third of five active faults.
- The active faults are sorted by their respective priority prior to being displayed on the ILD.
- Only ten active faults are displayed at a time, being the ten faults with the highest priority of all the faults currently active.
- If the active fault rectifies itself, the fault will be removed from the screen.

Item	Function
Next	Use this button to scroll to the next active fault.
Previous	Use this button to scroll back to the previous active fault.
Exit	Use this button to return to the Event Info Menu

6.3.1 Fault History

Item	Function
Next	Use this button to scroll to the next fault history page.
Previous	Use this button to scroll back to the previous fault history page.
Exit	Use this button to return to the Event Info Menu
Most Recent	Use this button to go to the first fault history page.
>>	Use this button to select which fault is highlighted.
Details	Use this button to see more information about the highlighted fault.
Exit	Use this button to return to the Event Info Menu.

6.4 End of Train Device (EOT)

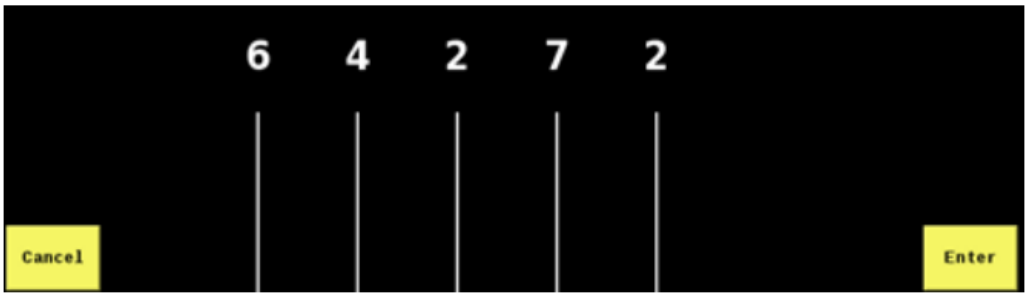
There are two constant buttons and four dynamic buttons on the EOT screen.

Item	Function
Change EOT ID	Use this button to open the EOT ID configuration screen.
EOT ID 00000	Use this button to cancel and existing ID and set ID to 00000
Arm EOT	This dynamic button appears only when the Arm button on the EOT is pressed and the HOTD has communication with the EOT Device. It is active on the screen for a short period. Press this button to complete the arming process of the EOT. The Arm state will change to Armed.
Disarm EOT	This dynamic button appears only when the EOT is in the Armed state. Press this button to disarm the EOT. EOT 00000 This dynamic button appears only when the EOT is in the Disarmed state. Use this button to automatically send a zero EOT ID to the HOTD and clear the EOT ID being displayed on the screen.
Comm Test	Once the EOT ID is set, use this button to test the communication link between the HOTD and EOT. The status window will show In Progress followed by the test result. The result will show a moment and then return to the default.
Exit	Use this button to return to the Main Menu.

Some Head of Train Devices enter a dormant state when an EOT ID of zero is entered. Refer to the operation instructions of the equipped device for more information.

6.4.1 Change EOT ID

Press the appropriate key below each digit to raise the number until the correct EOT ID is displayed. If you pass the desired number keep pressing the key and the number will loop back to zero. Hold down the key to scroll quickly through the numbers.



Item	Function
Cancel	Use this button to return to the EOT screen and discard any changes to the EOT ID.
Enter	Use this button to set the new EOT ID.

If the EOT ID and the Arm State both have questions marks, book it up in the loco repair book.

7.0 Braking Systems

7.1 Electronic Brake Valve (EBV)

The refurbished EF locomotives have a new air brake system.

The CCBII Passenger Brake System, (CCBII-P), is a, electro-pneumatic air brake system designed for AAR compliant main line freight and passenger locomotives.

The system is, except for some minor differences, identical to that fitted to the DL 2.3 model.

The brake valve is a desktop type.

The Electronic Brake Valve (EBV) contains handles for operation of the automatic and independent brakes.

The EBV also contains a cam-actuated pneumatic valve which will create an emergency rate reduction in brake pipe when the automatic brake handle is moved to the Emergency position, regardless of the presence of electrical power.

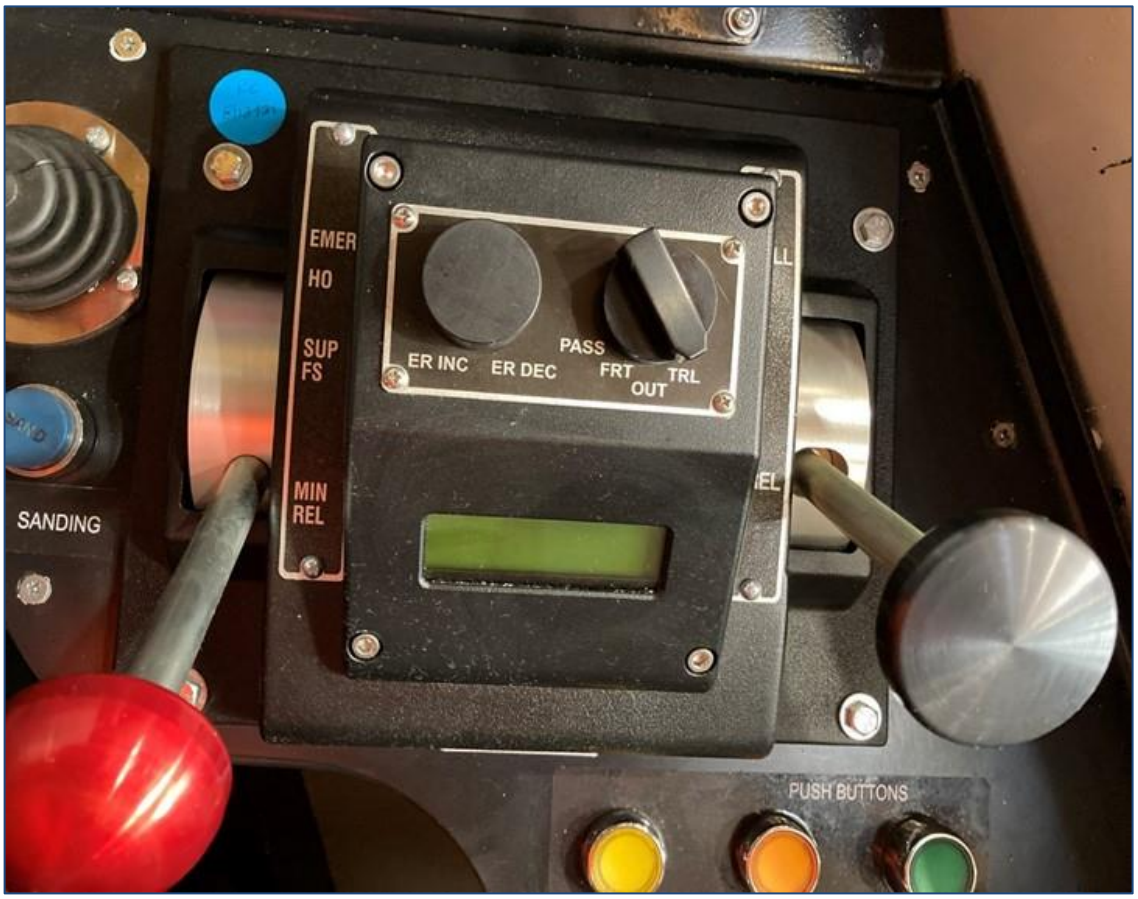


Fig. 47 Automatic (left) and Independent (right) brake handles.

7.1.1 EBV LCD display

This backlit display gives an instantaneous readout of the target ER pressure, based on the position of the automatic handle and the ER set point or release ER pressure setting.

Example:

1. The locomotive engineer has the auto handle in Release and ER pressure is 550 kPa.
2. They move the auto handle to make a 100 kPa reduction.
3. The ER target display will read ER TARGET = 450.
4. The ER pressure displayed on the duplex gauge will be the actual pressure in the equalizing reservoir, which will decrease at a service rate and eventually settle at the ER target value.
5. The target display will also display some crew advisory messages and fault information. See Section 7.1.8 NYAB system messages.

7.1.2 Automatic Brake Handle (ABH)

The EBV contains an Automatic Brake Handle (ABH). The ABH has indents at several defined positions:

- Release
- Min Reduction
- Full Service
- Suppression
- Handle Off
- Emergency

The handle is not removable.

7.1.3 Independent Brake Handle (IBH)

The EBV contains an Independent Brake Handle (IBH). The IBH can be used to control the independent brake pressure as applicable. Movement of the independent handle produces a graduated application and release of the Independent Application and Release pipe pressure.

The handle is not removable.

7.1.4 Independent release

The EBV contains an independent release feature. This is actuated by pushing the independent lever to the right side of the EBV.

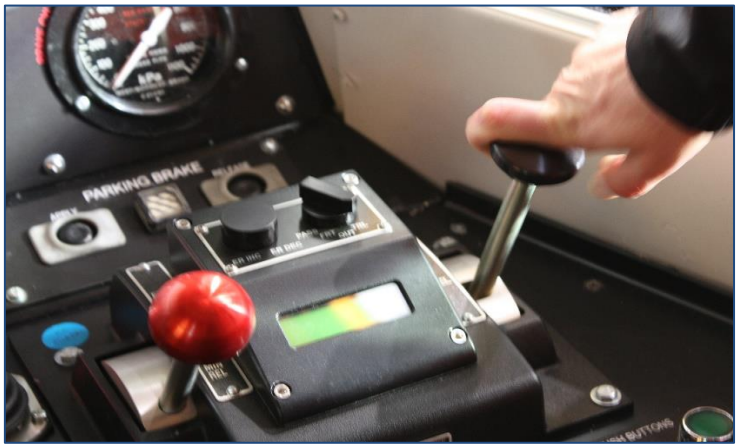


Fig. 48 Independent release - IBH pushed to the right.

7.1.5 Brake Valve Mode Selection Switch

The EBV contains a selection switch for the brake mode.

The positions indicate the possible modes for the system with four brake modes:

Abbreviation	In full	Brake mode
PASS	Passenger	Graduated release.
FRT	Freight	Direct release.
OUT	Cut Out	Brake valve is isolated.
TRL	Trail	Brake valve is set up for three pipe trail operation. Trail Loco alarm will show on ILD.

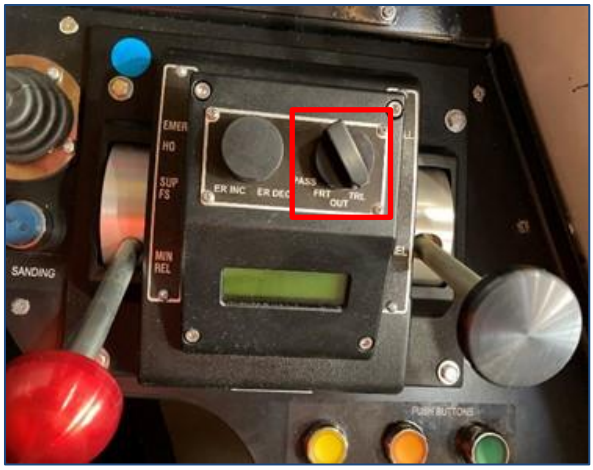


Fig. 49 EBV Mode selection switch

7.1.6 ER adjustment - not used.

The EBV contains an adjustment switch for the Equalizing Reservoir (ER) set point.

This switch is not used and is blanked off.

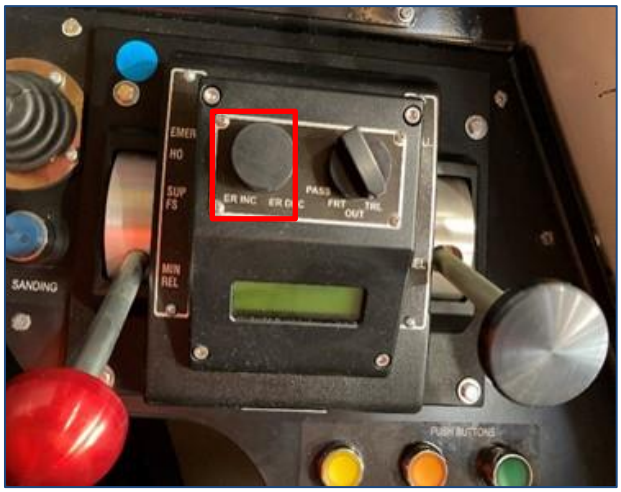


Fig. 50 ER adjustment blanked off.

7.1.7 Brake valve leading and trailing cab setup.

Step	Action
1	Once the electronic brake system is powered up the Active brake valve will display Safety Penalty Put Auto in SUPP There will be a short time delay whilst the system does various self-checks each time it is powered up. The active valve will be whichever EBV was set to FRT when the Battery Knife Switch was opened. 
2	Move the auto brake handle to the SUPP position. Once the auto handle is in the SUPP position the message in the LED window will display Safety Penalty Keep in SUPP. 
3	Leave the auto brake handle in the SUPP position until Okay to Run is displayed in the LED window.  The auto brake handle can now be placed to the REL position, and the Safety Penalty has been re-set.

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>4</td><td>Brake Valve set up once Safety Penalty is reset:

<table>
<tr><th>Item</th><th>Driving Cab</th><th>Non-Driving Cab</th></tr>
<tr><td>Mode selection switch</td><td>FRT or PASS position</td><td>TRL position</td></tr>
<tr><td>Automatic Brake handle</td><td>REL position</td><td>HO</td></tr>
<tr><td>Independent Brake handle</td><td>FULL position</td><td>REL</td></tr>
</table>

 
Once the system is powered up, if both Electronic Brake valves are set to FRT/PASS position at the same time, a penalty brake application will occur.
The penalty brake cannot be recovered until an EBV is set to FRT/PASS mode.
When more than one EBV is in a lead mode a fault 108 will be active in the LED display on the EBV.</td></tr>
</table>

If the reverse handle is moved into a direction before the EBV is put into PASS or FRT position, Tranzlog will detect this as an incorrect setup and trip the vigilance penalty brake.

7.1.8 Brake valve fault codes and corrective actions

The CCBII-P System diagnostic fault codes are reported to the operator on the EBVs LCD display screen.

The three-digit fault codes will be displayed as part of an air brake crew message.

Fault codes are displayed at the end of a crew message.

For example: the following crew message:
AIR BRAKE FAULT
TRAIL USE ONLY – 001
would indicate fault code '001'.

Refer to table below for corrective actions.

Only one 'Fault' is displayed in an EBV crew message at any given time, even though multiple faults may exist. Diagnostic faults are identified in the table below.

Fault Code	Description	EBV message	Corrective action
001	ER Control Node Fault	Fault 001 Active, Trail Use Only	1. Check cable connections at ERCP and RCP. 2. Cycle Air Brake Circuit Breaker. 3. If fault is still active, use in Trail until ERCP can be replaced.
002	ER AW4 Fault	Fault 002 Active, Trail Use Only	1. With parking brakes applied, place mode switch to Trail, Automatic Handle in Emergency, and Independent/ Holding Brake Handle in Full/On to clear fault. 2. If fault is not cleared or returns, use in Trail until ERCP can be replaced.
003	ER Transducer Fault	Fault 003 Active, Trail Use Only	1. Cycle Air Brake Circuit Breaker. 2. If fault is still active, use in Trail until ERCP can be replaced.

Fault Code	Description	EBV message	Corrective action
004	MR Transducer Fault	Fault 004 Active, Trail Use Only	Ok to run but replace BPCP at next service.
006	MVER Fault	Fault 006 Active, Trail Use Only	1. Cycle Air Brake Circuit Breaker. 2. If fault is still active, use in Trail until ERCP can be replaced.
009	FL Transducer Fault	Fault 009 Active, Trail Use Only	OK to run but replace BPCP at next service.
010	BP Transducer Fault	Fault 010 Active, Trail Use Only	1. Cycle Air Brake Circuit Breaker. 2. If fault is still active, use in Trail until BPCP can be replaced.
014	MV53 Fault	Fault 014 Active, Trail use only	1. Cycle Air Brake Circuit Breaker. 2. If fault is still active, use in Trail until BPCP can be replaced.
016	BP Control Node Fault	Fault 016 Active, Trail use only	1. Check cable connections at BPCP and RCP. 2. Cycle Air Brake Circuit Breaker. 3. If fault is still active, use in Trail until BPCP can be replaced.
018	MVEM Fault	(None)	OK to run but replace BPCP at next service.
023	13 Transducer High Fault	Okay to Run, Service Soon 023	1. OK to run, but BC on unit will fully release on graduated increases of BP (direct release). Disabled blended brake. 2. Replace 16CP at next service.

Fault Code	Description	EBV message	Corrective action
024	13 Transducer Low Fault	Okay to Run, Service Soon 024	1. OK to run, but BC on unit will fully release on graduated increases of BP (direct release). 2. Disabled blended brake. 3. Replace 16CP at next service.
036	16 AW4 Fault	Okay to Run, Service Soon 036	1. With parking brakes applied, place mode switch to Trail, Automatic Handle in Emergency, and Independent Handle in Full to clear fault. 2. If fault is not cleared or returns, system is OK to run, but BC on unit will fully release on graduated increases of BP (direct release). 3. Disabled blended brake. 4. Replace 16CP at next service.
037	16 Transducer Fault	Okay to Run, Service Soon 037	1. Cycle Air Brake Circuit Breaker. 2. OK to run, but BC on unit will fully release on graduated increases of BP (direct release). Disabled blended brake. 3. Replace 16CP at next service.
039	MV16 Fault	Okay to Run, Service Soon 039	1. Cycle Air Brake Circuit Breaker. 2. OK to run, but BC on unit will fully release on graduated increases of BP (direct release). Disabled blended brake. 3. Replace 16CP at next service.

Fault Code	Description	EBV message	Corrective action
052	16 Control Node Fault	Okay to Run, Service Soon 052	1. Check cable connections at 16CP and RCP. 2. Cycle Air Brake Circuit Breaker. 3. OK to run, but BC on unit will fully release on graduated increases of BP (direct release). 4. Disabled blended brake. 5. Replace 16CP at next service.
055	20 AW4 Fault	Fault 055 Active, Trail Use Only	1. With hand brakes applied, place mode switch to Trail, Automatic Handle in Emergency, and Independent/ Holding Brake Handle in Full/On to clear fault. 2. If fault is not cleared or returns, use in Trail until 20CP can be replaced.
058	MVLT Fault	Fault 058 Active, Trail Use Only	1. Cycle Air Brake Circuit Breaker. 2. If fault is not cleared or returns, use in Trail until 20CP can be replaced.
062	20 Control Node Fault	Fault 062 Active, Trail Use Only	1. Check cable connections at EBV, 20CP and RCP. Cycle Air Brake Circuit Breaker. 2. No Independent Brake function on trail units. 3. If fault is still active, use in Trail until 20CP can be replaced.
075	Auto Handle Open Fault	Fault 075 Active, Trail Use Only	1. Cycle Air Brake Circuit Breaker. 2. If fault is still active, use in Trail until EBV can be replaced.

Fault Code	Description	EBV message	Corrective action
076	Independent Handle Open Fault	(None)	1. Check Independent/Holding Brake Handle operation. 2. If handle in Full/On charges BC, then OK to Run. If not, use in Trail until EBV can be replaced. 3. Replace EBV at next service.
085	EBV Control Node Fault	Fault 085 Active, Trail Use Only	1. Check cable connections on EBV and at CCBII Brake Panel J100A and J100B (if dual EBV). 2. Cycle Air Brake Circuit Breaker. 3. If fault is still active, use in Trail until EBV can be replaced.
099	20TL Transducer Fault	Fault 099 Active, Trail Use Only	1. Cycle Air Brake Circuit Breaker. 2. If fault is still active, use in Trail until 20CP can be replaced.
102	MPIO Voltage out of range Fault	Okay to Run, Service Soon 102 -OR- (None)	1. Check cable connections at brake panel at MPIO J4 and J4 connection to electrical cabinet. 2. Cycle Air Brake Circuit Breaker. 3. If fault is still active, system is OK to Run but will function with disabled blended brake. 4. Replace MPIO or Service Blending Module at next service.

Fault Code	Description	EBV message	Corrective action
103	Blended Brake Control Node Fault	(None)	1. Check cable connections at Blending Module to RCP. 2. Cycle Air Brake Circuit Breaker. 3. If fault is still active, system is OK to Run but will function with disabled blended brake. 4. Replace Service Blending Module (or MPIO) at next service.
106	ECP TBC Verification Fault	(None)	1. Cycle Air Brake Circuit Breaker. 2. If fault is still active, OK to run, use in conventional pneumatic until TCC can be replaced.
108	Cab Mismatch Fault	Fault 108 Active, Check Setup	1. Check mode selection of both EBVs. Ensure that only the EBV in the active cab is in a Lead Mode and that the EBV in the inactive cab is in the Trail position. 2. If fault is still active, power off Air Brake Circuit Breaker and use in Trail until EBV can be replaced.
113	10T Transducer Fault	Fault 113 Active, Trail Use Only	1. Cycle Air Brake Circuit Breaker. 2. If fault is still active, use in Trail until ERCP can be replaced.

Fault Code	Description	EBV message	Corrective action
118	RCP Control Node Fault	Fault 118 Active, Trail Use Only	1. Check cable connections at EBV, BPCP and RCP. 2. Cycle Air Brake Circuit Breaker. 3. If fault is still active, use in Trail until RCP can be replaced.
119	BP Not Reducing Fault	Okay to Run, Service Soon 119	1. Recharge BP and check BP reduction in response to Penalty Brake. If Penalty Brake reduction occurs, OK to Run. 2. If fault is still active, use in Trail until BPCP can be replaced.
125	MV26 Fault	Fault 125 Active, Trail Use Only	Use in Trail until ERCP can be replaced.
130	ROL Transition Fault	ROL Enabled, Transition Fault	1. Use proper exit from ROL operation. 2. If unexpected, check communication cables between CCB and ROL system.
136	CP16 BP Transducer Fault	Okay to Run, Service Soon 136	1. OK to run, but BC on unit will fully release on graduated increases of BP (direct release). Disabled blended brake. 2. Replace 16CP at next service.
140	MR/FL Dual Transducer Fault	Okay to Run, Service Soon 140	OK to Run but replace BPCP at next service.

Fault Code	Description	EBV message	Corrective action
141	Lon/Ethernet converter comm loss	Fault 141 Active, Trail Use Only -OR- Unable to Boot, Service LCI	1. Ensure that LON Cable is properly seated at LON. 2. Converter and RCP. 3. Cycle AB Circuit Breaker. 4. Verify communication present between locomotive and Lon converter device. 5. If fault is still active, use in Trail until LON Converter can be replaced.
141	Lon/Ethernet converter comm loss	Okay to Run, Service Soon 141 -OR- Okay to Run, Service LCI	1. Ensure that LON Cable is properly seated at LON Converter and RCP. 2. Cycle AB Circuit Breaker. 3. If fault is still active, system is OK to Run but will function with disabled (Loco to Lon converter) communications. 4. Verify communication present between locomotive and Lon converter device. 5. Replace LON Converter.
146	Mode Change at Speed Fault	Fault 146 Active, Check Setup	1. If Moving, Toggle mode switch to ensure mode is set to the original mode of operation and wait for zero speed prior to mode change. 2. If stationary - check Zero speed input to CCB System and ensure it is functioning properly. 3. If stationary and Zero speed input operating properly, power off air brake circuit breaker and use in trail until RCP can be replaced.

Fault Code	Description	EBV message	Corrective action
147	AST Transducer Fault	Okay to Run, Service Soon 147	1. OK to run, BC will be limited to AW0 load weigh compensation pressure command. 2. Verify Air spring pressure into the CCB is within vehicle defined parameters. 3. Replace 16CP at next service.
151	ECP comm loss, Exit ECP	Okay to Run, Service EPCP	1. Cycle Air Brake Circuit Breaker. 2. If fault is still active, Ok to run, use in conventional pneumatic until CPEP can be replaced.
152	BP ERT transducer fault	Okay to Run, Service Soon 152	1. OK to Run, Loss of accurate ER pressure reporting to locomotive computer during penalty enforcement. 2. Replace BPCP at next service.
153	Blended Brake Module request out of range	Fault 153 Active, Trail Use Only	1. Check cable connections at brake panel at MPIO J4 and J4 connection to electrical cabinet. 2. Cycle Air Brake Circuit Breaker. 3. Verify voltage command to the MPIO or service blending module is within vehicle defined parameters. 4. If fault is still active, use in Trail until MPIO or Service Blending Module can be replaced.

Fault Code	Description	EBV message	Corrective action
157	TPM Comm Loss Fault	157 Active, Trail Use Only	1. Check cable connections at TPM to RCP. 2. Cycle Air Brake Circuit Breaker. 3. If fault is still active, use in Trail until TPM can be replaced.

7.1.9 Potential High Brake Cylinder Pressure

Higher than expected Brake Cylinder pressure can be experienced during a power off or diagnostic fault condition under the application of the:

- Emergency brake
- Combined Full Service and fully applied independent brake.

In order to release an applied automatic Full Service or Emergency brake, brake pipe pressure must be raised above equalization pressure of the auxiliary and brake cylinder pilot volumes.

7.1.10 When Locomotive is powered off when braking.

When brake system is shut down via the Battery Isolation Switch or Air Brake circuit breaker while under a braking sequence, a high equalization pressure is generated. Restoring the system power and releasing the brakes will release all Brake Cylinder pressure.

7.1.11 Diagnostic Fault

Certain diagnostic faults will cause the brake system to automatically enter backup pneumatic mode.

If the system enters backup pneumatic mode while in a braking sequence the equalizing pressure will be high.

Releasing the brakes or utilizing the bail off method will release all BC pressure.

This condition is alleviated once the BC pressure is released, and brake will operate normally in either backup or computer control.

7.1.12 Brake Pipe Protective Device

The Control Circuit Governor is a brake pipe pressure switch. It functions to remove power or prevent the application of power, if the brake pipe pressure is reduced below a set figure.

Tranzlog will do the same and send out an alert thru the radio to train control.

Thus, an emergency brake application removes power without any further action by the driver. It is set to open at 350 kPa on a falling pressure and closes at 475 kPa on a rising pressure.

7.2 Spring Applied Park Brake

A spring applied; air released parking brake is fitted to the four brake units on the central bogie on 3B & 4B wheels only. Each brake cylinder on this side of the bogie is a brake cylinder with an integral park brake unit, these are similar to those used to DL locomotives.

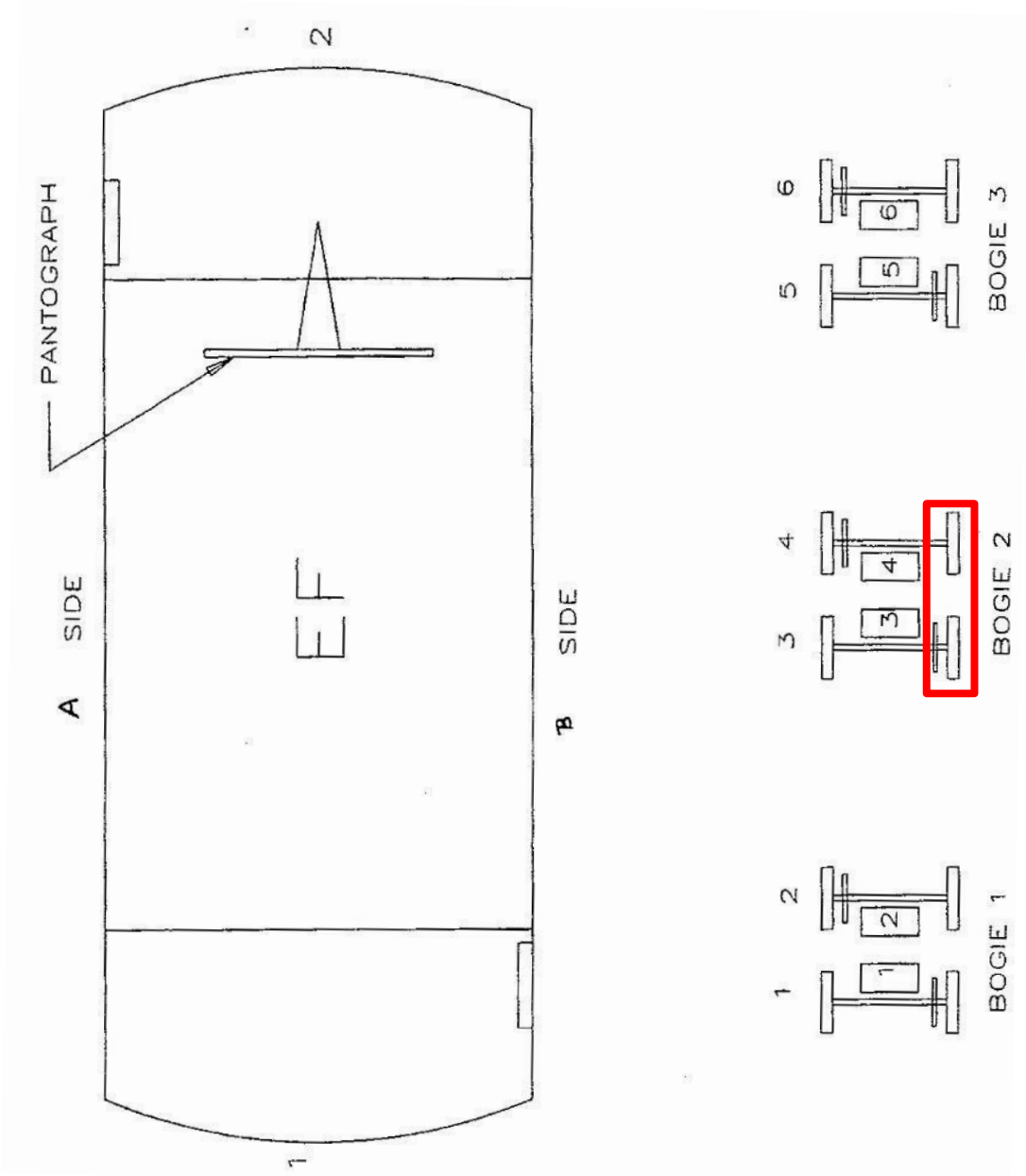


Fig. 51 Park Brake Cylinder location diagram

7.2.1 Park Brake operation from the cab

The spring applied park brake is operated by the Apply / Release pushbuttons on the driver's control desk or by manually operating the operating valve situated on the brake rack.

Fig. 52 Cab Park Brake controls

Indication	Meaning
	Park Brake applied
	Not applied or released. or Battery switch off
	Park Brake released

The cab park brake pushbutton indicator panel only operates when the battery switch is closed.

7.2.2 Park Brake Gauge

A gauge on the brake rack indicates the state of the park brake, if GREEN the park brake is released, if RED the park brake is applied. This gauge is located on compressor side of the brake rack.

The park brake is train lined, so that with the jumper cable between locomotives it may be operated from any cab in the consist.

Fig. 53 Park Brake Gauge

The operation of the solenoid operating valve allows air to be released from the park brake cylinder. Spring pressure behind the piston head overcomes that of the decreasing cylinder pressure.

7.2.3 Manually apply the Park Brake

At the park brake operating valve on the brake rake, manually push the knurled knob on the valve to the apply position which allows air to escape from the park brake cylinder. The park brake may also be released manually at the operating valve by pushing the “release” knob.

7.2.4 Manually release the Park Brake

If insufficient battery voltage or insufficient air pressure is available, the park brake can be manually released in a manner like DL Park Brakes.

Underneath the brake unit is a ring, pulling it down will release the park brake, you will hear it click as it releases. It can take considerable downwards pressure to operate the manual release.

It is important to understand that releasing the brake in this manner will result in the park brake having been released mechanically and it will remain in the release position until main reservoir air is restored to the cylinder. This can be achieved by either pushing the desk apply button or by manually operating the valve, and provided main reservoir air is present, this action will release the manual mechanical release mechanism and set the park brake for normal operation.

When a dead EF locomotive is to be moved from one storage road to another storage road, it must be air coupled to the shunt locomotive to operate the park brake.

One or two park brake units may be left applied to act as a lazy handbrake if required. Always ensure the wheels rotate when park brake units are left applied.

If the shunt locomotive has a main reservoir pipe, then couple the main reservoir pipes.

If the shunt locomotive has brake pipe only, then couple the brake pipes and open the dead engine device.

On the dead engine, close the battery switch and operate the park brake from the pushbuttons in the driver's cab.

If the battery is flat, the park brake may be operated manually from the brake rack.

IMPORTANT:

- When towing dead the park brake gauge on the brake rack must be checked to ensure that the park brake is released. A visual check must be made to ensure the brake blocks are off 3B & 4B wheels.
- **Always visually check the park brakes have released correctly.**
- **Dragged park brakes WILL overheat the wheels and destroy them.**

7.2.5 Park Brake operating valve.

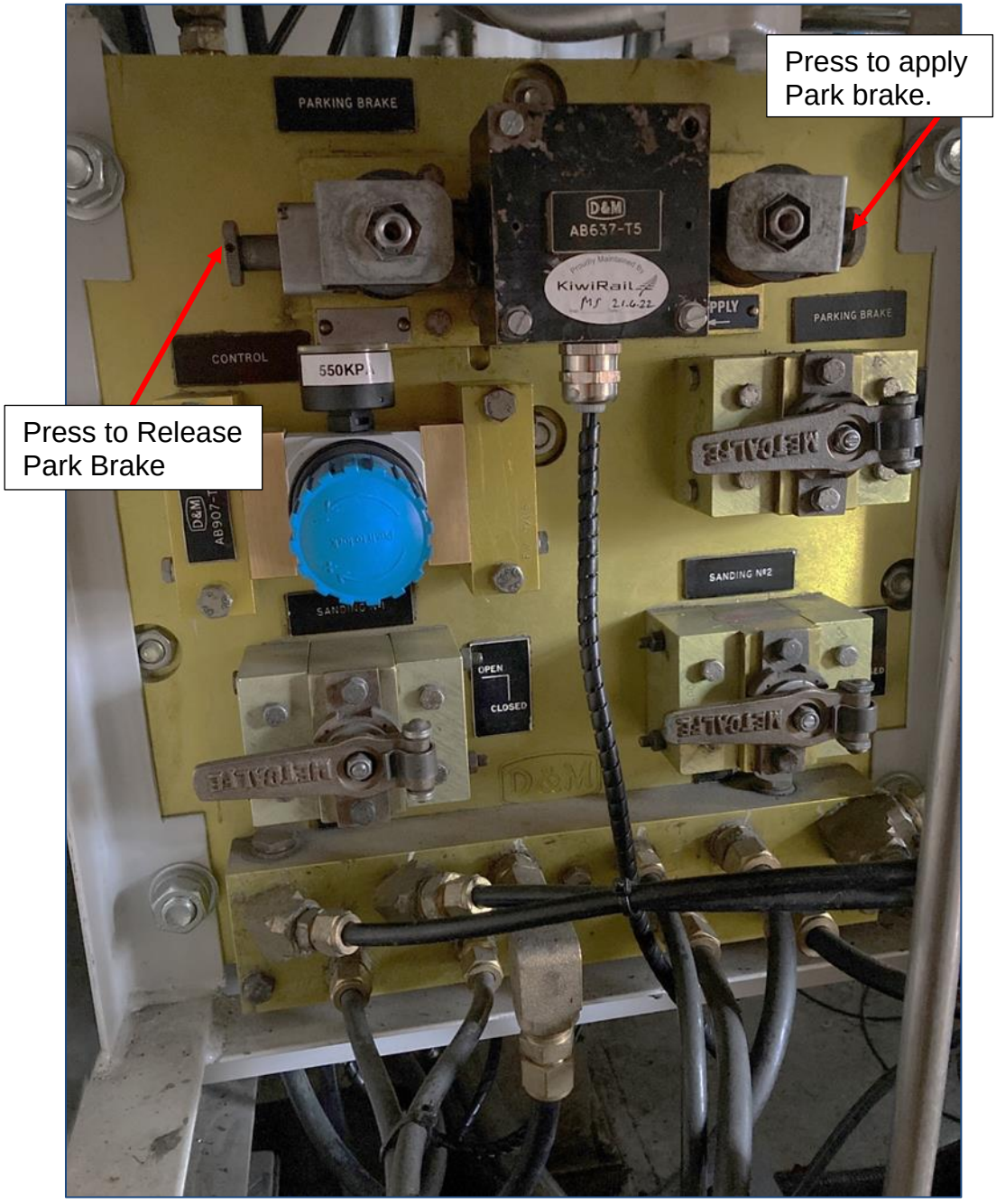


Fig. 54 Park Brake Operating Solenoid diagram.

The park brake operating valve is located on the walkway side of the brake rack, in the lower left corner.

If sufficient main reservoir air is available on the loco, press the left knob in to release the park brake, the valve latches in the last position it was placed in and will not change when the battery switch is turned off or on.

The park brake can be reapplied by pushing the right-hand knob.

7.3 Regenerative Braking System

This system changes the dynamic energy of the locomotive / train into electrical energy which is then fed back into the overhead line to be used to drive other locomotives which share the same power system. The main function of the regenerative braking system is to serve as a holding brake when descending long grades.

Simultaneous operation of the locomotive regenerative and independent pneumatic brake systems is not normally required but is available when necessary.

The following combinations of regenerative and pneumatic braking are obtainable:

- Regenerative brake only – variable effort.
- Regenerative brake on the locomotive and pneumatic brake on the train simultaneously but each applied separately.
- Pneumatic braking of the locomotive and train.

The air brakes on the trailing wagons will not be released under loss of electric power. The regenerative brake will not override any independent locomotive brake application that the driver has made and under these conditions, excessive braking of the locomotive wheels will be corrected by the wheel slide protection.

7.3.1 Regenerative Brake Control

During regenerative brake, braking effort is selected by the driver by moving the separate braking handle to give a range of constant braking effort covering the speed range from 20 to 60 km/h. Constraints are provided to prevent armature and field currents from exceeding normal working levels.

7.3.2 Regenerative Brake Interlocks

Electrical and mechanical interlocks in the power and brake control system are provided to prevent incorrect operation of the brake system.

Mechanical interlocks on the driver's power and brake controller ensure that power and regenerative brake cannot be selected together. When the regenerative brake is in use an interlock is provided to reduce or cancel the regenerative brake should braking effort promote wheel slide. If the regenerative brake is in use and the speed is too low to get sufficient brake effort, the automatic air brake on the locomotive is restored by the regenerative brake proving relay.

In the event of loss of line volts, the regenerative brake proving relay will operate and re-apply the automatic air brake on the locomotive. When electric power is regained and regenerative brake is re-established, the automatic brake portion of the air brake applied to the locomotive will be released. It will not, however, release any application of the automatic air brakes on the trailing vehicles.

When a traction motor group is isolated because of any fault condition, regenerative brake cannot be used i.e., any fault in the electric circuit during regenerative brake operation will inhibit the regenerative brake and restore the locomotive automatic brake.

If an emergency brake application is initiated, for any reason, e.g., vigilance penalty brake, regenerative brake is discontinued.

7.3.3 Regenerative Brake switch

Movement to "off" will prevent the regenerative brake from operating on this locomotive. It must remain "on" for correct operation and must only be operated when the locomotive is not in regen brake.

This switch is located on the startup panel.

8.0 Start Up and Shut Down Processes

8.1 Pre-Start Ground Inspection

Check:

- That the locomotive is beneath a live overhead wire.
- Drawgear, brake hoses, springs and cowcatcher.
- Jumper socket covers and dummies are on headstock hoses.
- That all air valves are correctly positioned.
- That unused headstock hoses are on their dummy couplings.
- That couplings are properly made between coupled locomotives.
- Cooling air flexible ducts to traction motors.
- Sand boxes are full.
- All air drain valves are closed.
- Brake rigging and brake valves.
- Loose and dragging parts.
- Wheels are chocked as required.

On the control panel where the BIS is, check switch at side is in “loco supply” position.

When the battery switch is opened, capacitors in the electronic power supply need up to one minute to discharge.

Re-closing the battery switch before this happens can cause a shutdown to occur in the power supply.

Before an electric locomotive is moved to or from a non-electrified line, or from an energised to an isolated section or vice versa, the Loco Engineer must ensure the pantograph is lowered.

8.2 Start up procedures.

When these locos are started up without a portable UHF radio in the charger/holder in the cab, selcall tones are transmitted which cause severe interference on channel 1.

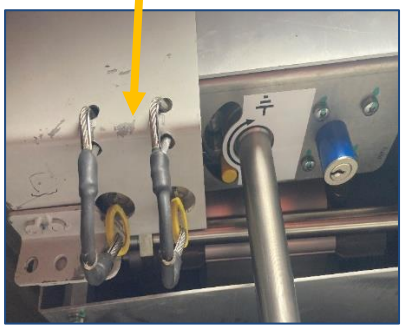
To avoid this interference, loco crew must ensure before starting up, a portable UHF is in the charger/holder. It must not be removed until the radio is shut down.

After radio tests in the depot have been completed, the portable UHF radio must be left in the charger/holder in the cab.

Check the VCB Earth Switch is OPEN and the three VCB keys are in their correct places.

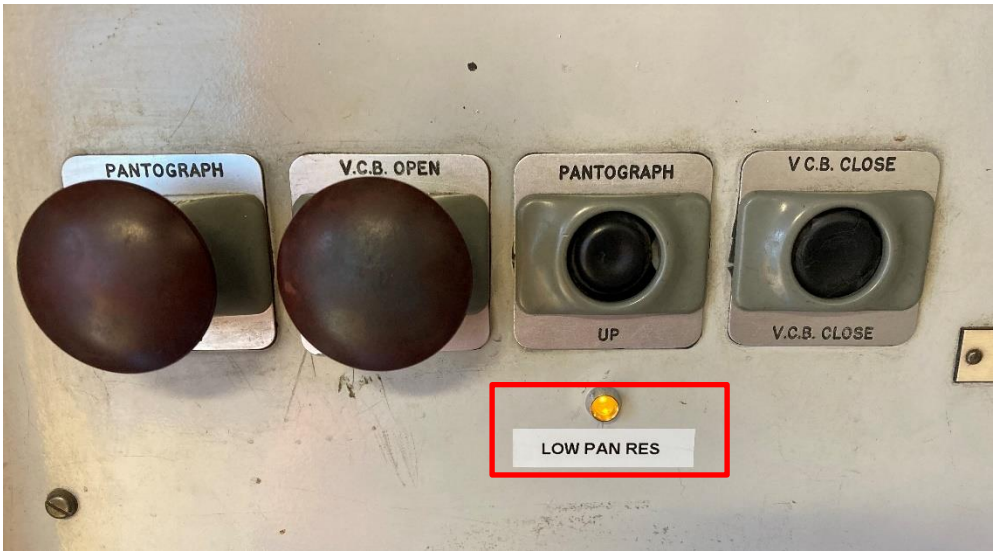
- The one blue key controls the air supply to the VCB.
- The two **yellow** keys operate the earth switch lock.
- An instruction sheet is fitted to the traction motor blower ducting below the VCB.

Fig. 55 Key switches to check before start up



The two **yellow** keys work together and lock the earth switch in the Earthed position. They can only be operated when the BLUE key has been placed into the adjacent BLUE key switch and turned. **Shown in Normal operating position**.	Turning the **blue** key will isolate and release any compressed air supplied to the VCB. It will also lower the Pantograph. The key can then be removed and placed in the lock adjacent to the **yellow** keys to operate the earth switch. **Shown in Normal operating position**.

Step	Action
1	Turn BIS on, the ILD will boot up (about 30 seconds) and after a short delay information will be visible on the screen.
2	Ensure that all CB's and switches are on and correctly positioned.
3	Check that the Lighting Supply switch is at "loco supply" and that group cut-out, test, control cut-out and Regen switches are normal.
4	The group cut out switch must only be operated when the yellow lamp alongside is lit. Failure to do this may cause the disconnect switch to fail.
5	Check that battery voltmeter reading is at least 78 volts.
6	Ensure ILD has booted up and is showing main screen. Ensure the Primary screen message is showing, if it is not press the Primary button.
7	Check SCSR is in holder in the leading cab desk cupboard.
8	Check fire system as per section 5.7 Fire Suppression system. This fire system can lower the pantograph and open the VCB.

Step	Action
9	a. Do not press the Pantograph Up button until the Low Pan Res light goes out. If pantograph reservoir pressure is too low to raise the pantograph, the **Yellow Low Pan Res light** will be illuminated. The auxiliary compressor will automatically charge the reservoir and the indicator will go out. This takes around 4 minutes.  **Fig. 56 Pantograph up button panel** b. To raise the pantograph, press and hold the Pantograph Up button for approximately 10 seconds, or until full line voltage is indicated on the ILD screen. c. To start the locomotive, press and hold the VCB Close button for 1 second, then release.
10	If the earth switch is closed, follow the procedure set out in Section 9.1.12 Locomotive Isolating and Earthing procedure to unearth the locomotive.
11	Press in and hold the pantograph up button for 10 seconds. Failure to do this will cause the pan to lower again. The pressure switches need to detect the correct air pressure before they will allow the pantograph to stay up.
12	Ensure pantograph rises and contacts the wire.
13	Check the line voltage gauge on the ILD in the cab and ensure that reading is green.

Step	Action
14	 In an interlocked area, the loco engineer must not close the VCB unless it has been ascertained from Tran Control that all signals in the area are at STOP. Press the VCB button in firmly then release. The locomotive should now start up extinguishing the VCB indicator on the ILD.
15	Check battery charge voltage is 110 volts. If more than 120 volts, open VCB and report fault.

All auxiliaries will now start-up in the following order:

1. The Motor Alternator runs up to speed.
2. The Transformer and Convertor oil pumps start after approx. 5 seconds.
3. The Main Blower runs up to ½ speed.
4. After 4 seconds No.1 Traction Motor Blower runs up to ½ speed.
5. After 8 seconds No.2 Traction Motor Blowers runs up to ½ speed.
6. After 12 seconds the Main Compressor will start.
7. The Main Reservoir will now be charging.
8. When air pressure is correct, apply the independent brake, release the park brake.
9. Observe the park brake indicator has changed to OFF. If the park brake is applied, NO AMPS (no power), can be obtained.

Overhead Line Voltage Indicator

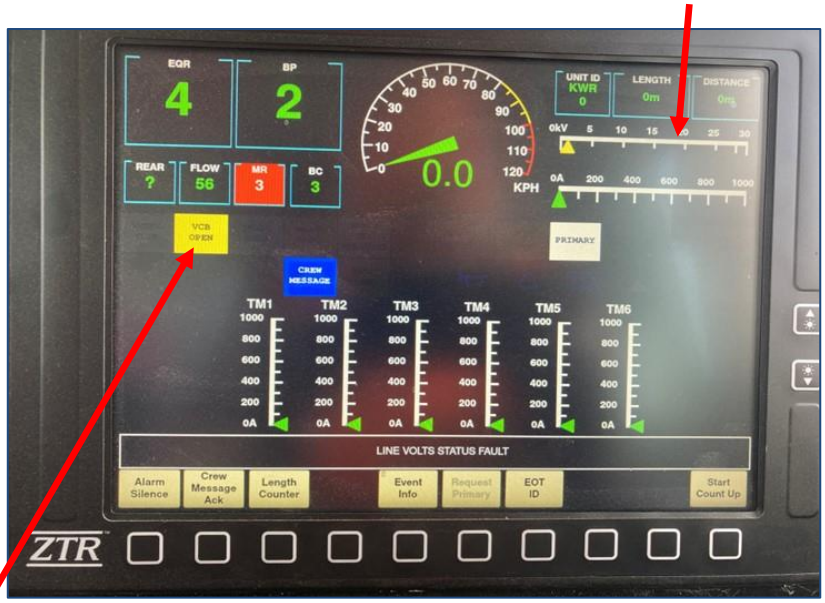


Fig. 57 ILD startup indications

VCB OPEN message.

8.3 Set up Multiple Locomotives

Step	Action
1	Make the mechanical coupling.
2	Set-up all brake equipment as per Section 7.1.7 Leading and Trailing cab setup.
3	Lower all pantographs.
4	Open BIS on each locomotive.
5	Insert jumper cable, always use the north end locomotives jumper.
6	Close BIS on lead locomotive and raise pantograph. **Do not** close the VCB.
7	Close BIS on the trail locomotive(s) and raise pantograph(s).
8	Start each locomotive in the normal manner.

8.4 Split Multiple Locomotives

Begin with the trail locomotive.

Step	Action
1	Apply the park brake and the independent brake.
2	Close the EP headstock isolating valve.
3	Close the MR headstock isolating valve.
4	Close the BP headstock isolating valve.
5	Remove jumper cable and place inside north locomotive.

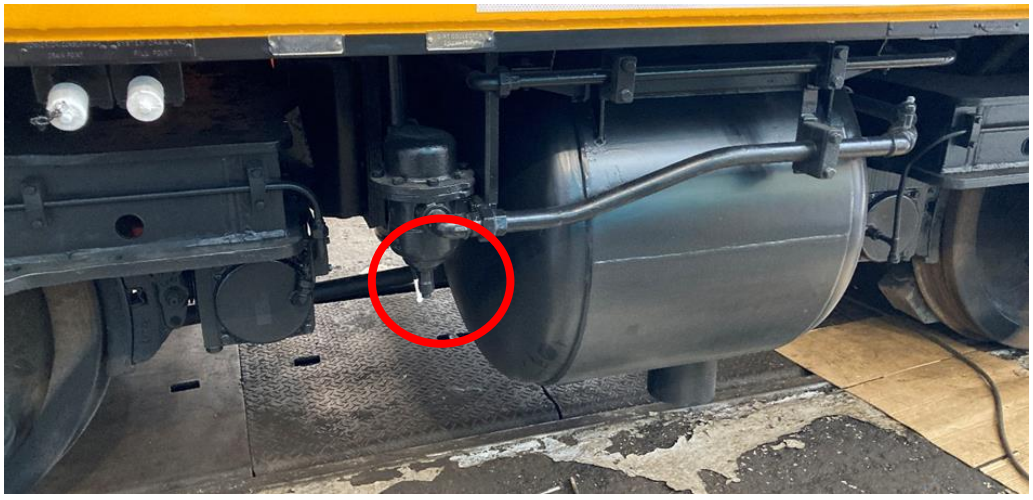
8.5 Changing Ends

If the Reverser Handle is moved with the EBV in TRAIL, Tranzlog will detect incorrect brake setup and trip the Vigilance Penalty brake.

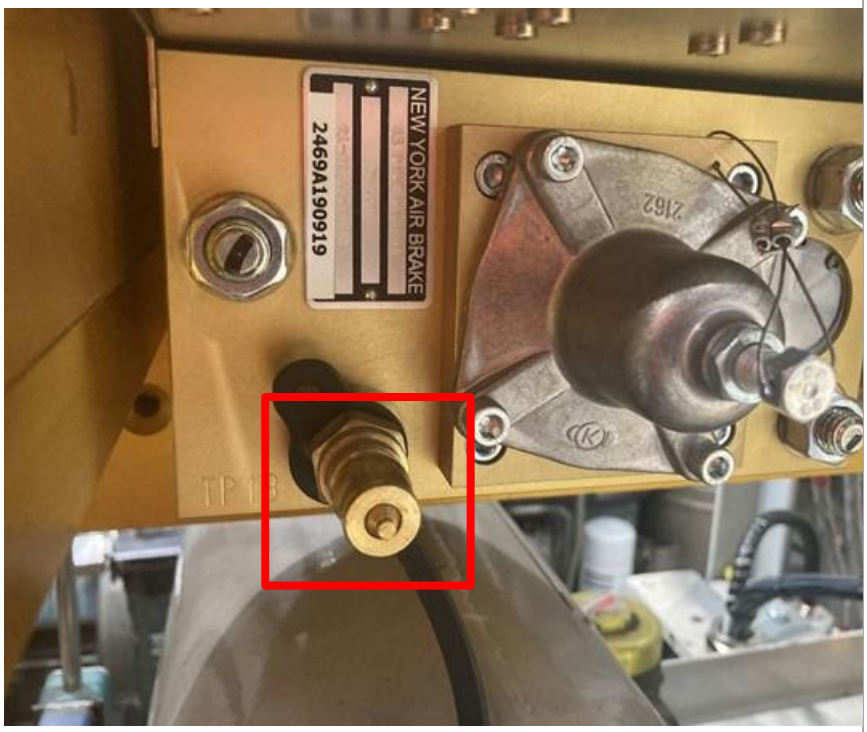
Step	Action
1	Apply IBV to full.
2	Centre and remove the reverser handle.
3	Apply park brake.
4	Check the park brake indicator has changed to **on**.
5	Change the brake valve selector switch to trail. Check the Trail Loco alarm is showing on ILD.
6	ABV to handle off.
7	Move independent brake valve handle to release.
8	Turn head and taillights **off**. Turn headlight selector switch to TRAIL.
9	Remove portable radio.
10	Turn **off** all cab lights.
11	Proceed to the other end with reverser handle and portable radio.
12	Insert portable radio.
13	Insert reverser handle.
14	Move Independent brake valve handle to full.

Step	Action
15	Change the brake valve selector switch to FRT or PASS as required. Ensure ILD Trail Loco alarm has extinguished.
16	Check BV LCD screen for messages. Move Train Brake handle to release.
17	Release park brake.
18	Check the park brake indicator has changed to **off**.
19	Turn headlight selector switch to the appropriate position. Turn **on** head and taillights as required.

8.6 Towing Dead EF locomotive with NYAB fitted, BP coupled only.

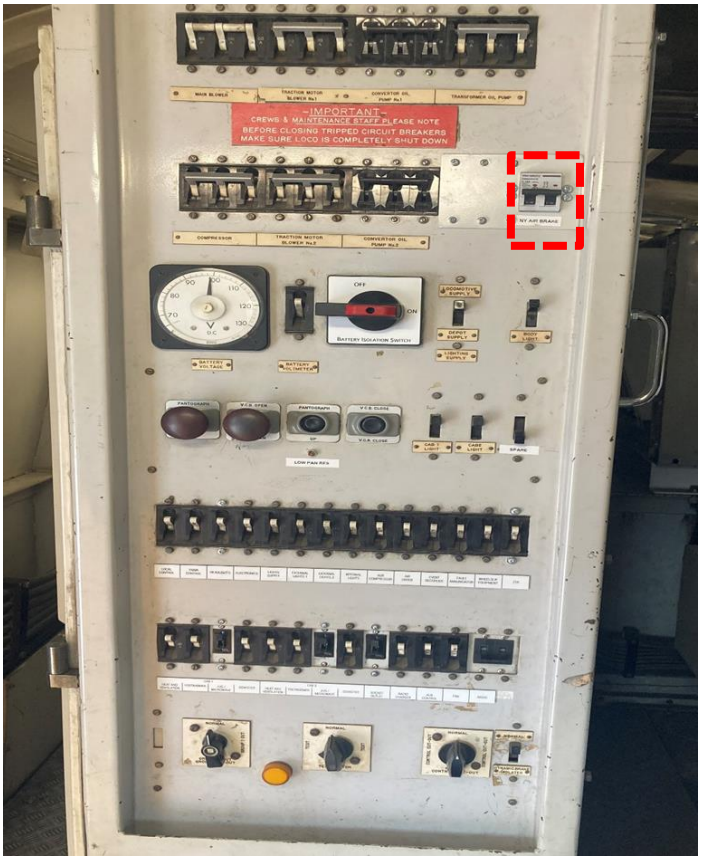
Step	Action
1	• When towed with only the brake pipe coupled, the No2 main reservoir must be reduced to **200kpa or less**. • The cab main reservoir air gauges will show the pressure in No2 main reservoirs. • The drain valve for the No2 main reservoirs is located on the dirt collector. It is located No1 end between bogies 1 and 2 on A side.  **Fig. 58 Drain Valve No2 MR**

Step	Action
2	Operate the DED on the brake rack, if it is sealed closed, the seal will require to be broken. (located on ERCP portion).  **Fig. 59 Dead Engine Device**
3	At least one headstock EP valve must be opened, taken off its dummy hose coupling and left opened. This will prevent any dragging brakes caused by trapped air in the system.

Step	Action
4	Only 200 kPa is held in the main reservoirs when towing dead with BP only coupled, this is not sufficient to correctly release the park brakes. The park brakes may need to be manually released a shown in section 7.2.4. a. When towing dead a visual check must be made to ensure the brake blocks are off the wheels. **This step must only be carried out after the BIS has been opened.** One quick disconnect fitting must also be bled of air. This can be accomplished by removing the rubber covers and pressing in the fitting in the centre. A small amount of air will be exhausted. The rubber covers should be put back after bleeding the air out. Bleed the quick disconnect fitting on the 13CP module.  **Fig. 60 13 quick disconnect fitting on the 13CP module.**

Step	Action
5	Couple the BP hose and open the headstock valve slowly. • The KM2 vent valve may trip and vent the brake pipe if the brake pipe valves are opened to quickly. The vent valves automatically open when they detect a preset flow of air. It can take a considerable time for the main reservoir to equalise (20-30 minutes). If the brake pipe is lowered below 200 kpa for any reason, the park brake may apply due to insufficient main reservoir pressure. Visually, always ensure the 4 park brake units release after this. The park brake may not release electrically due to low air pressure, in this case the park brakes must be released manually as shown in section 7.2.4

8.7 Towing an EF locomotive, 3 pipe coupled, battery switch on

Step	Action
1	Open all circuit breakers except the NY Air Brake circuit breaker.  **Fig. 61 NYAB Circuit breaker**
2	Leave the battery switch in the ON position.
3	Couple all 3 (MR, EP, BP) headstock hoses and open the valves. Slowly open the brake pipe valve. • The KM2 vent valve may trip and vent the brake pipe if the brake pipe valves are opened to quickly. The vent valves automatically open when they detect a preset flow of air. • If the vent valves trip there will be a message on the BV LCD screen “trainline error.” • The BV will not reset until a time delay of 60 seconds has finished. Follow the messages on the BV LCD screen to reset the brakes.
4	Ensure both brake valves are in Trail. Ensure ILD Trail Loco alarm shows.
5	Ensure the Park Brakes are released by a visual check.
6	Carry out a brake test, apply and release. • Visually check brake blocks leave wheels.

8.8 Towing an EF locomotive dead, 3 pipe coupled, battery switch off.

Step	Action
1	Brake valve handles: • Train brake to Handle Off • Independent to Release.
2	Brake Valve selectors both in Trail position. Ensure ILD Trail Loco alarm shows.
3	Open the battery switch.
4	Couple all 3 (MR, EP, BP) headstock hoses and open the valves. Open the BP slowly. • The KM2 vent valve may trip and vent the brake pipe if the brake pipe valves are opened to quickly. The vent valves automatically open when they detect a preset flow of air.
5	Ensure the park brakes have released by a visual check.
6	Carry out a brake test, apply and release. • Visually confirm brake blocks leave wheels.
7	When towing a Class 30, low main reservoir pressure will cause the park brake cylinders to apply. Replenishing the main reservoirs will cause the park brake cylinders to release. **Always visually check** the brake blocks have released from the wheels.

8.9 Shutting Down

Step	Action
1	Move the independent brake handle to **full** position
2	Apply the park brake by pressing the **apply** pushbutton.
3	Observe the park brake indicator has changed to **on**.
4	Check for any warnings on the Fire system display panel.
5	Switch **on** the body lights.
6	Switch **off** all external lights and all cab services, except the cab lights.
7	Press the VCB **open** pushbutton.
8	ILD will now display VCB Open message.
9	Press the **pantograph down** pushbutton.
10	Observe the pantograph has completely lowered.
11	Select **off** on the BIS. Note: If the pantograph is still raised when the battery switch is turned off, the pantograph will automatically lower.
12	Leave the CBs on the starting panel in their normal operative positions, as they are not intended to be used as switches.
13	Place chocks under wheels as required.

8.9 Securing unattended EF locomotives.

Locomotives are not to be left unattended unless the independent and park brakes are applied and are chocked with Rail Operating Code processes.

9.0 Operating the Locomotive

9.1 Safe Operating processes

9.1.1 Locomotive fires

In the case of a fire in a locomotive, the pantograph is to be lowered using the emergency pushbutton before attempts are made to extinguish the fire.

If the fire system detects the fire, it will open the VCB and lower the pantograph after a time delay.

For fire system operation and description see Section 5.7 Fire Suppression system.

Any Locomotive Engineer who uses a fire extinguisher from an electric locomotive must immediately note the use in the Loco 54D book and arrange a replacement at the earliest opportunity. The dry powder fire extinguishers provided in the cabs and equipment compartment of these locomotives must be used strictly in accordance with the instructions appearing on them.

If a major fire occurs on a locomotive in an electrified area, arrangements must be made with Traction Control to have the overhead line equipment isolated.

9.1.2 Over-Running of Section Insulator

On no account must any portion of an electric locomotive:

- Be permitted past a section insulator placed in the overhead wiring between the running line and a siding, while the overhead line equipment of the siding is dead.
- Be permitted to pass between one portion of the running line and another portion temporarily out of service and dead.

9.1.3 Electric Locomotive driven off the contact wire.

If an electric locomotive is driven off the overhead wire the pantograph should automatically fall.

- If this does not happen the Locomotive Engineer must immediately lower the pantograph with the emergency pushbutton and then report the incident to Train Control who must advise Traction Control.
- The pantograph must be examined by RSAS staff before being raised for further use, Traction staff must inspect the overhead line equipment.

9.1.4 Overhead power supply trips out

The Locomotive Engineer must advise Train Control of the operating condition just prior to losing power. A Loco 346 with the relevant information is to be forwarded to their manager.

If the overhead power is lost the Locomotive Engineer must stop the train with the air brake as the regenerative brake does not work without the power supply connection. Loss of overhead power is indicated by the line voltmeter reading “0” volts.

When a delay may be lengthy, conserve locomotive battery life by shutting down as much of the auxiliary equipment as possible and:

- Open the CBs on the main control panel; The pantograph will drop automatically when control power is lost.

When power is restored again restart the locomotive under normal conditions.

If the overhead power is not restored within 15 minutes, the Locomotive Engineer must secure the train unless otherwise instructed by Train Control.

When power is restored, as directed by Train Control, restart the locomotive.

9.1.5 Traction Power Failure

When the power fails, Traction Control will advise Train Control as soon as possible of the extent and duration of the failure. Train Control will inform the Locomotive Engineers of trains affected.

When it is necessary to isolate power, Traction Control must advise Train Control who will advise Locomotive Engineers affected that there will be a momentary loss of power while switching procedures are carried out.

9.1.6 Closing the VCB

Because the effect it may have on the signalling system the Locomotive Engineer must NOT close the VCB unless Train Control or the Signalman confirms that all signals in the area are at “Stop”.

9.1.7 Securing of Trains when overhead power fails.

If overhead power is lost or compressor fails, the Locomotive Engineer must advise Train Control as soon as possible and stop the train with air brake, preferably away from gradients. Main reservoir air pressure is lost rapidly during a power loss or compressor failure.

If the train stops on a gradient, Locomotive Engineers can reduce the loss of main reservoir air by placing the brake valve isolating switch to “out” position after applying the train brakes with a full-service reduction. This will prevent further air flow to the brake pipe and retain all main reservoir air pressure for the operation of locomotive brakes at maximum brake cylinder pressure. This avoids having to immediately place handbrakes on the wagons to secure the train.

9.1.8 Damage to Overhead Line Equipment

If a Locomotive Engineer observes or has reason to believe that the condition of the overhead line equipment is unsafe or may interfere with the running of trains, he must lower the pantograph promptly. Train Control is to be advised as soon as possible.

9.1.9 Damaged Pantograph

- If a Locomotive Engineer has reason to think that the pantograph is damaged, he must lower the pantograph, stop the train and report to Train Control.
- In cases where the pantograph cannot be completely lowered, the VCB must be opened, and Train Control plus Traction Control advised.
- If a pantograph has become entangled in the overhead equipment no attempt is to be made to clear it except by a person qualified to do so following isolation and earthing of the overhead.
- In cases where a pantograph fails to make firm contact with the overhead contact wire and the electric current is arcing between the contact wire and pantograph, the VCB must be opened immediately, and Train Control advised. No attempts should be made to clear the pantograph except by a suitably qualified person.

9.1.10 Electric Locomotive Derailed

When an electric locomotive is derailed, the Locomotive Engineer must immediately push the emergency button which opens the VCB and lowers the pantograph. They must then close the locomotive earthing switch and lock it closed using the “Derailment Padlock” from the adjacent glass window enclosure.

Fig. 62 Derailment padlock

This padlock may only be removed by the authorised RSAS persons from the Palmerston North Electric Locomotive Depot.

In the case of a locomotive being derailed with all wheels off the rails and the pantograph so damaged that it cannot be lowered fully clear of the overhead line equipment, or if there is some object caught between the overhead line equipment and the locomotive, it may be dangerous to touch the locomotive and the ground or rail simultaneously. The following precautions are to be take until the overhead line equipment has been isolated and earthed:

- The Locomotive Engineer is to radio particulars to Train Control and ask for the overhead line equipment to be isolated and earthed. The locomotive crew are to remain on the locomotive until this has been done. If circumstances make it necessary to leave the locomotive before isolation and earthing, it must be done in such a manner that person's do not touch the locomotive and ground or rail simultaneously, i.e., they are to jump from the locomotive.

- The locomotive must not be touched by person's standing on the ground, rail or on an adjacent vehicle until the overhead line equipment has been isolated and earthed.

- The locomotive must not be uncoupled from the adjacent vehicle until the overhead line equipment has been isolated and earthed and a "Permit to Work" issued.

- When rerailed, the locomotive must be inspected by an authorised RSAS person to ensure no part of the locomotive will foul the track or overhead. No such locomotive may be moved under its own power unless it has passed inspection by an authorised RSAS person.

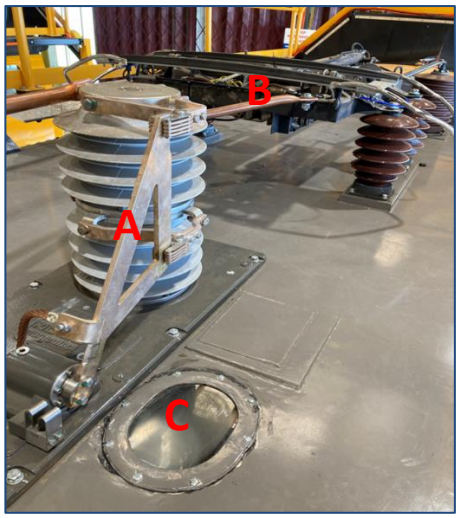
9.1.11 Locomotive Isolation and Earthing Procedure

EF locomotives have a combined Vacuum Circuit Breaker (VCB) and Earth Switch.

The earth switch is used when:

- the locomotive has derailed, or

- as part of required high voltage electrical isolation and earthing protection.



B.
Pantograph fully down.

A.
Earth Switch in earthed position.

C.
Pantograph viewing window.

Fig. 63 Roof mounted VCB layout

The key switches and operating lever are mounted on the ceiling in the car body under the pantograph area. The keys and locking ensure the isolation and earthing process can only be performed in the correct order.

KEYS become captive in the mechanisms to prevent unsafe actions.

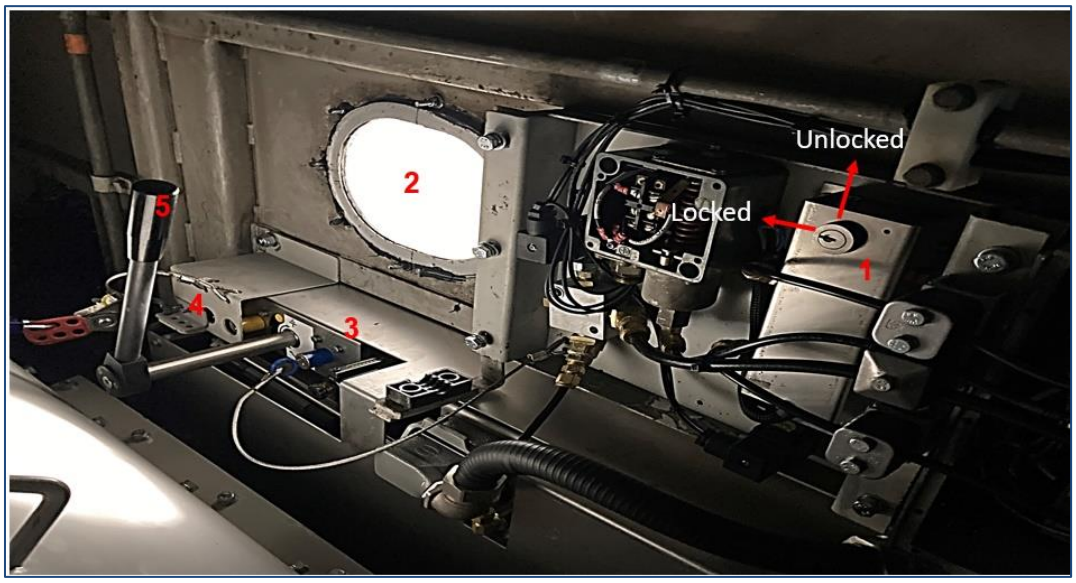


Fig. 64 Location of VCB operating handle and key switches

VCB and Earth switch legend

Number	Equipment
1	Protection Valve with **Blue** key holder.
2	Pantograph viewing window
3	VCB **Blue** key holder (shown in locked position)
4	**Yellow** key holders and locking plate. (in locked & earthed position)
5	Earth switch operating handle. (in earthed position)

The **Blue** key isolates the air supply to the pantograph.

The **Yellow** keys lock the earth switch.

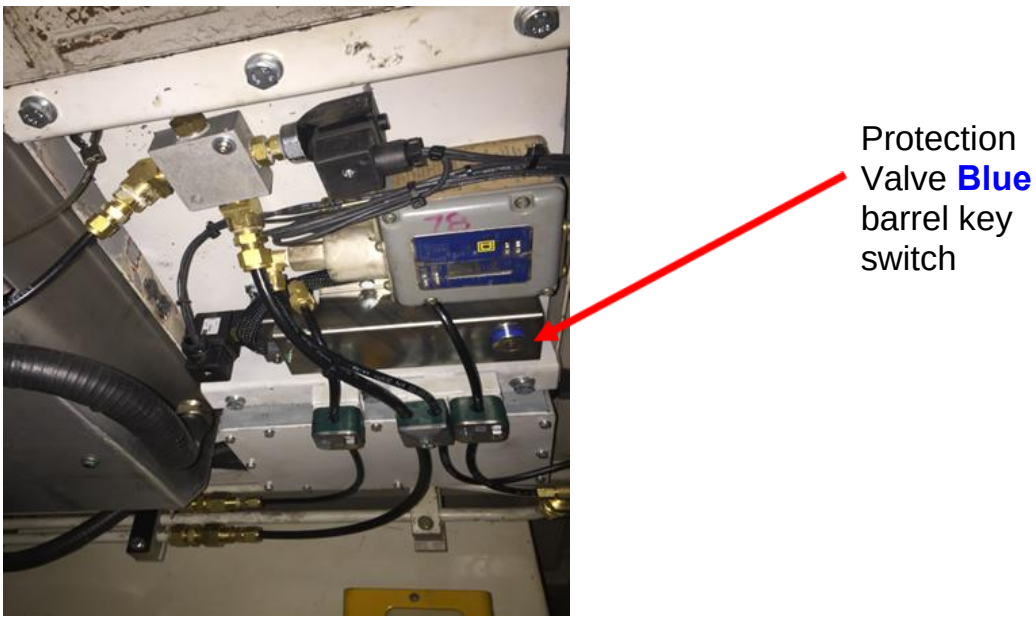


Fig. 65 Protection valve key switch

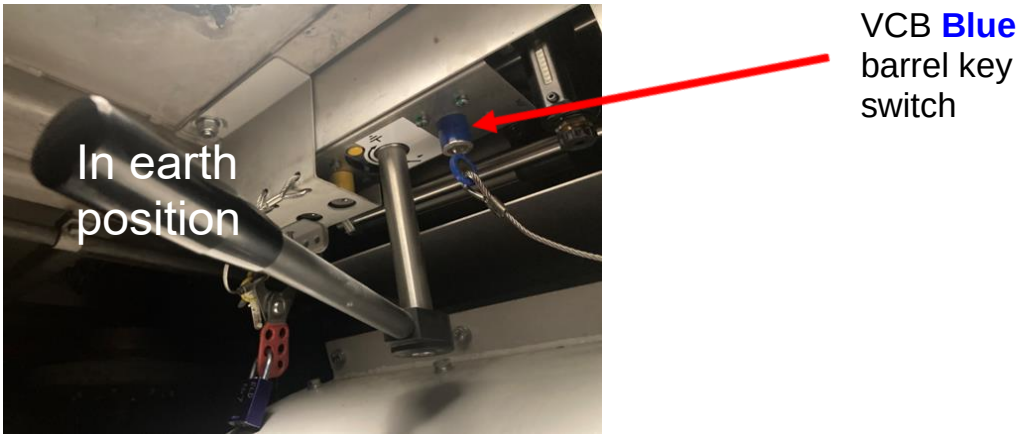


Fig. 66 Earth switch operating handle

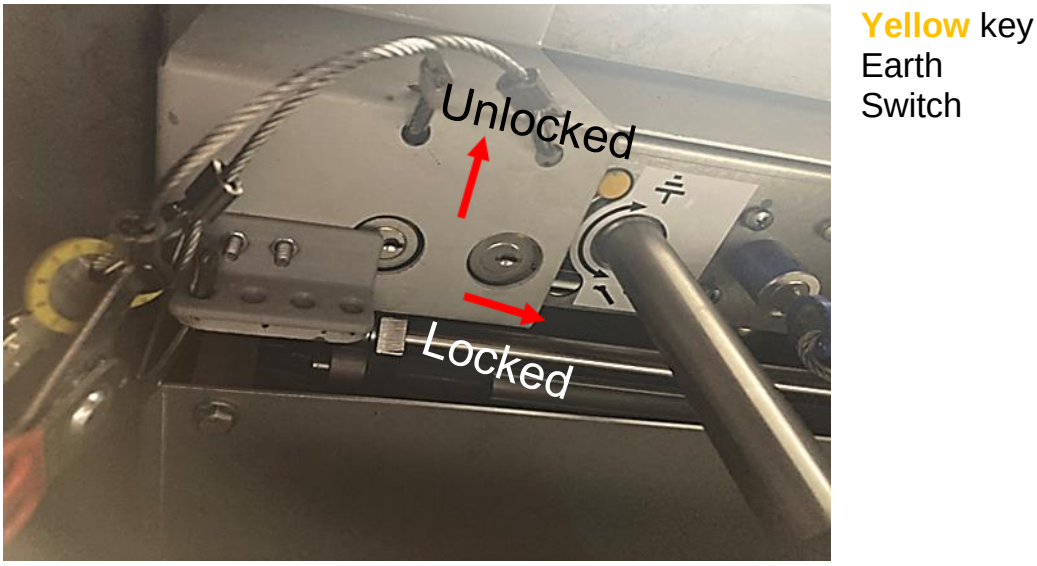


Fig. 67 Earth switch positions

Procedure to EARTH the locomotive, to close earth switch.

Step	Action
1	Turn and remove the **Blue** key in the protection valve. The pantograph will lower if it is still raised.
2	Move the **Blue** key to the **Blue** barrel on the VCB, this then allows operation of the earth switch.
3	Look through the viewing window and ensure the pantograph is fully down.
4	Turn the operating handle clockwise to close the earth switch. Look through the viewing window and ensure the earth switch has closed correctly.  The handle cannot be removed.
5	The **Yellow** keys can now be removed and left hanging on their lanyards. The earth switch is now locked in the earthed position and the **Blue** key held captive.
6	The lock slider may now be slid across and a derailment padlock fitted and the **Yellow** keys locked out.

If RSAS persons have earthed the locomotive and have not completed work on the locomotive, their personal locks will be on the switch plate. The earth switch cannot be closed until the last RSAS padlock has been removed.

If the earth switch is found closed, and there are no personal padlocks on the earth switch, and there is nothing to indicate why it may be closed, contact RSAS persons to ascertain if the switch may be opened.

If the locomotive has been derailed it will have the derailment padlock fitted as per 9.1.10 Electric Locomotive Derailed, this padlock can only be removed by authorised RSAS persons in Palmerston North.

It is important to note that the VCB will not close until sufficient control air pressure of approx. 600kpa is available. The air pressure can be observed on the brake rack pressure gauge.

- With the VCB open there is no 25Kv supplied to the loco to power the transformer, MA, main compressor and blowers.
- If the air pressure is low, the battery powered auxiliary compressor will supply air to the VCB to enable it to close.
- The auxiliary compressor may take up to 4 minutes to supply sufficient air pressure.

9.2 Clearing Brake Pipe

Before coupling a locomotive to a train, the locomotive brake hoses must be blown out by opening and closing the coupling valve.

When the locomotive is coupled to an uncharged train, the automatic brake is left in Release position and the headstock brake pipe valve is opened gradually, otherwise the brake system will prevent the brake pipe being charged. The main reservoir pressure should be kept as high as possible.

If there is a sudden rush of air such as from a:

- burst hose.
- hose break
- BP valve fully opened on a vehicle close to the locomotive.
- when first coupling onto the train and the brake pipes are opened quickly.

The KM2 dump valves will operate and dump the brake pipe immediately to 0 kPa, the brake system will also go into Penalty mode and will require resetting.

The KM2 will automatically reset when the BP is pumped up again from 0 kPa.

There are two of these valves fitted to each EF locomotive. Warning notices have been fitted adjacent to each KM2 valve.

Fig. 68 KM2 vent valve warning notice

One KM2 valve is fitted behind each headstock at 1B and 2A corners.

They will open and vent the brake pipe to atmosphere if they detect a preset flow of air in the brake pipe.

When coupling the loco, the brake pipe valves should be opened slowly to prevent the KM2 valves venting.

When coupling stand clear of the exhausts of the KM2 vent valves.
If the valve trips it will suddenly vent the brake pipe to atmosphere without any warning.

9.3 Event Recorder

A Tranzlog event recorder is fitted to these locomotives.

The event recorder also records many of the locos operating conditions to assist RSAS staff to locate faults that occur during operation of the loco.

9.4 Vigilance Equipment

Tranzlog vigilance equipment is fitted, with a variable non predictable time cycle. The Tranzlog unit is in the cabinet on the rear wall, B side of No.1 cab of the locomotive. The cabinet door also contains the download port.

The vigilance lamp above the ILD has a two-position dimmer switch fitted.

The vigilance time cycle on these locomotives is random.

During operation of the locomotive, resetting of the equipment is done by one of the following actions:

- Pressing the cancelling button.
- Moving the master controller power handle.
- Moving the regenerative brake handle.
- Sounding the warning horn.
- Fully applying the independent brake.

If resetting is not done within the time cycle, the vigilance light on the driver's desk is illuminated, if resetting is not done within another 10 seconds the alarm will sound in the cab.

If a further 10 seconds pass without resetting, a penalty brake is automatically applied.

To reset the penalty brake, wait 50 seconds and then press the reset button located on the outside of the VD cabinet in the number one cab.

Fig. 69 No1 Cab Penalty Brake reset button.

Follow the directions on the brake valve to reset the brake system.

The authority of Train Control must be obtained before the Locomotive Engineer moves the train after a penalty application.

9.4.1 Overspeed System

Tranzlog locks the vigilance on and sounds the buzzer at 105 km/h on these locomotives. When road speed rises above the warning alarm speed, the vigilance beeper will sound before tripping the penalty brake.

To reset, wait 50 seconds and press the vigilance reset button. If road speed falls below the alarm speed the system automatically resets, and the alarm stops.

9.5 Wheel slip and Slide Detection System

The Davis & Metcalfe type EWS2 wheel slip and slide detection system monitors the performance of the locomotive under slip or slide conditions.

During a wheel slip in power, the characteristics of the separately excited traction motors cause the tractive effort to reduce rapidly on the axle that loses adhesion.

In the event of a single axle slip, field control of the motor ensures that the tractive effort is not restored until the axle has ceased to slip.

In the event of a complete group slipping, i.e., M1-3 or 4-6, the tractive effort for the group is reduced rapidly until the axles have ceased slipping.

Wheel slide during braking is indicated to the regenerative brake equipment on a per axle basis so that any regenerative braking effort present can be reduced until the slide is corrected, and at the same time a high-speed dump valve is energised which rapidly dumps any air pressure in the brake cylinders on the bogie containing the sliding axle. This controlling any slide that may occur while the locomotive is being braked by regenerative brake alone.

When wheel slip / slide occurs, an alarm on the ILD is illuminated and will extinguish after the fault is cleared.

9.6 Traveling though Neutral Sections of Overhead

This instruction applies only when a current demand of more than 200 amps is required before and after the neutral section.

When approaching a neutral section, the loco engineer must ensure that the train has sufficient speed for the loco to coast through the neutral section without stalling.

Step	Action
1	As the train approaches a neutral section, move the power handle or, if in regenerative brake, the regenerative brake handle to give traction motor current of no more than 200 amps.
2	Leave the handle at this position as the locomotive passes through the neutral section until power is restored and the previous current level is re-applied to the traction motors.
3	Increase the traction effort as required.

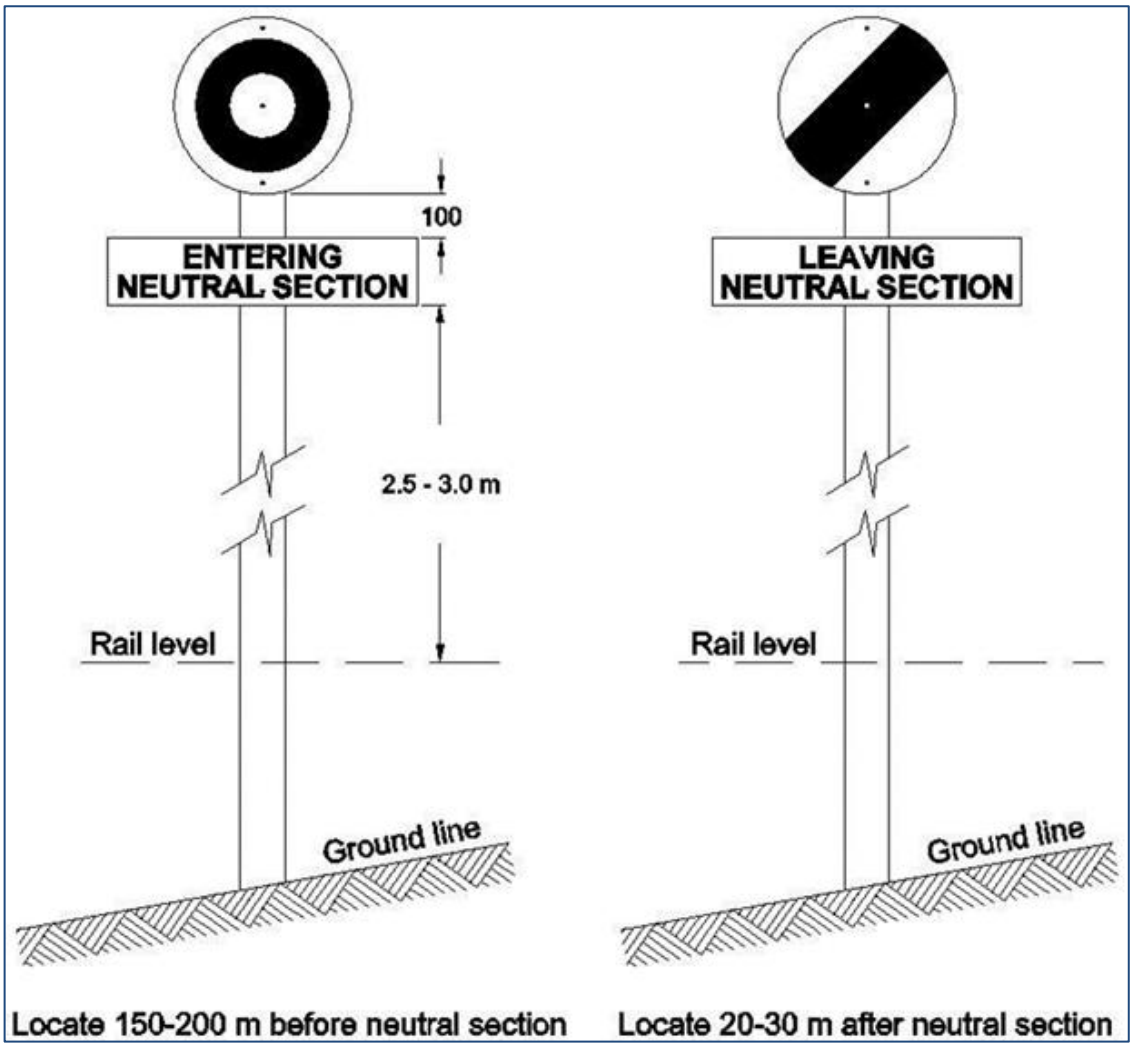


Fig. 70 Neutral section trackside signage

9.6.1 Automatic Power Control (APC) at neutral sections

A permanent magnet fixed alongside the rails 20 meters before and after a neutral section, signals the proximity of a neutral section to the locomotive's receiver and control equipment.

The receiver for the APC equipment is located at the lower end of a bracket which is suspended from the side plate of the "B" side of No.3 bogie.

On receipt of a signal from the first magnet, the control equipment automatically ramps off the main and auxiliary supply convertors and opens the VCB just before entering the neutral section.

If an electric locomotive stops in a neutral section and is unable to proceed, the Locomotive Engineer must immediately notify Train Control who will arrange for assistance to be provided.

On receipt of a signal from the second magnet, the control equipment automatically closes the VCB then ramps on the auxiliary and main supply convertors back to their original control levels. Any regenerative braking or power which was applied before entering the neutral section is also restored without any action by the driver.

If power or regenerative braking is not restored, the driver may have to push the reset button.

During the period the VCB is open, the annunciator indicator on the ILD is displayed to show the power is off.

9.7 Reduced Voltage Performance

The locomotive can start and run trains on the ruling gradients at full load but at reduced balancing speed.

If…	Then…
The line voltage falls to 19 kV	Auxiliary equipment will function normally to ensure control, ventilation, battery charging and main reservoir air supply.
The line voltage falls below 19 kV.	Locomotive Engineers are to reduce power to prevent further reduction of line voltage. Below 19 kV, the auxiliary equipment will continue to function but at reduced performance.
The line voltage falls below 17.5 kV.	The control equipment will automatically remove traction power. At 15 kV the VCB will be opened.

9.7.1 Half Power Switch

The switch is located on the assistants' desk switch panel.

The purpose of the Half Power switch is for the convenience of the crew if Extended Feeding of substations is required, and Line Volts is reduced such that the locomotive control system automatically removes traction power.

If the overhead line volts are reduced due to having too many electric hauled trains in the same section, or because one substation has been isolated for maintenance, the Locomotive Engineer will be advised of the situation by Train Control.

If this occurs the Half Power switch reduces power, crew may find some reduction in speed for their normal operation.

There is no reduction on locomotive tractive effort

Step	Action
1	Move the master controller to off.
2	Move the half power switch on the driver's desk to half power.

Operation of the locomotive in the first bridge maintains the level of the line volts but train speed will fall. The half power switch is not used for normal operating conditions.

9.8 Overhead power failure on a steep grade

Step	Action
1	Stop train using normal stopping procedure.
2	When stopped fully apply independent brake.
3	Move ABV to full-service position.
4	Place BV mode selection switch to "out".
5	Apply locomotive park brake before leaving locomotive.
6	Chock each wheel – one side of locomotive only.
7	Apply as many handbrakes as deemed necessary.

9.8.1 Overhead power restored.

Step	Action
1	Confirm power restored with Train Control.
2	Ensure full independent brake applied.
3	Change BV Mode Selection Switch to FRT, Release ABV, this will recharge the train. Follow any message shown on the BV LCD display.
4	Once train recharged make a full-service automatic brake reduction.
5	Release handbrakes – then locomotive park brake.
6	Release train brake – set train forward half a metre.
7	Reapply sufficient automatic brake to hold the train.
8	Reapply full independent brake, and park brake.
9	Remove the wheel chocks – keep hands clear.
10	Replace chocks in the locomotive

9.9 Serial Braking process on a steep grade.

Step	Action
1	Approach gradient at correct speed. Make a minimum BP reduction, when this has taken effect increase reduction to 70 kPa watching the equalizing reservoir gauge (This ensures that sufficient brake cylinder is applied to take a firm hold of the train).
2	Increase the brake pipe reduction as necessary to control train speed. (Watching the equalizing reservoir gauge).
3	The locomotive brake should be kept off while the train brake is applied (Gives some reserve braking available if required).
4	Prepare to release the automatic brakes by applying the independent brake in 25 kPa increments slowly until 100 kPa is reached on the brake cylinder gauge. Commence when ready as this depends on the releasing speed and how heavy the train & how steep the gradient.
5	This will slowly settle the locomotive back into the train and when at the correct speed release, the automatic brake. Train brake is now recharging.
6	When speed dictates re-apply the automatic brake by 70 kPa (watch equalizing reservoir gauge) hold the loco independent brake applied at 100 kPa holding the handle depressed in bleed-off position. (This will hold the loco brake applied at 100 kPa and will prevent any further pressure from building in the loco brake cylinders). The train will be slightly bunched with both loco brake and train brake applied. Further apply train brake as required to control speed (bleeding off the automatic application on the loco brake) but maintaining the loco brake at 100 kPa.
7	Repeat steps as above until train reaches the bottom of gradient. If unable to obtain a full brake recharge of brake pipe pressure, then the train must be brought to a stop for subsequent brake releases to enable recharge.

9.10 Setting Back on a steep grade.

Step	Action
1	Ensure the train is lightly stretched when braking and once the train has stopped under normal braking procedures, make a 100 kPa automatic brake reduction and apply full independent brake.
2	Contact TCO and agree on intentions / permission / brief pilot, such as setting back procedures when no riding position available.
3	Set reverser handle in direction of intended movement.
4	Select maximum regenerative brake on brake throttle, power not to be used.
5	Release automatic brake application.
6	Slowly reduce independent brake application from fully applied to 100kPa.
7	Maximum Speed setting back on a steep grade is 15km/h.
8	As speed reaches 10km/h, make a minimum automatic BP reduction.  This will increase the independent brake application slightly, so a small bleed off required to maintain the 100kPa applied
9	Bring the movement to a stop, then fully apply the locomotive independent brake.
10	Increase minimum reduction to 70kPa or greater and after equalisation has occurred release the automatic brake to recharge the train.
11	After a full BP pressure recharge has been obtained, repeat from step 5 down.
12	If Regenerative Brake is not working or fails:

Step	Action
1	Apply the independent brake up to 100Kpa.
2	Stop the train with the automatic train brake.
3	Fully apply the independent brake.
4	Release the train brake and wait unit the train is fully recharged.
5	Slowly reduce the independent brake to 100 kPa.
6	Repeat steps 1 to 5.

This method may be repeated several times to get the train safely off the grade when required to set back or reverse direction using the following key principals:

- Keep the train stretched.
- Low Speeds when descending
- High Air Pressures

9.11 Burst Hose Procedure on a steep grade

Step	Action
1	• Apply independent brake. • Centre reverse lever. • Follow the message displayed on the BV LCD display. • Put ABV in release position. • Apply locomotive park brake before leaving the locomotive.
2	Check second locomotive for penalty brake application.
3	Chock each wheel – one side of locomotive only.
4	Apply as many handbrakes as deemed necessary.
5	Locate burst hose and mark spot, then return to locomotive.
6	At front of locomotive, slowly open BP valve. The KM2 valves may operate.
7	Enter cab and place BV Mode Selection Switch to “out”. When you leave cab and when replacing the hose, there should be no air flow as BV is in the “out” position, and BV is isolated. BP air will be at zero with brakes fully applied
8	Proceed back, repair burst hose, couple BP hoses, open BP valves.
9	Check whole train to ensure it is not damaged or derailed.
10	Proceed back and close BP valve on front of locomotive.
11	Place BV Mode Selection Switch in the FRT position.
12	Follow any message shown on the BV LED screen. The BP should now be able to be recharged.

Step	Action
13	Once BP is fully charged, make a full-service reduction ensuring the TEM is giving a reading. Leave the brakes applied.
14	Proceed back and release handbrakes, remove chocks.
15	Once back in the cab release ABV and recharge BP ensuring pressure comes up on TEM – completes intermediate brake test.
16	Release loco park brake and proceed as normal.

9.12 Group cut-out switch

If a convertor or traction motor fault is signalled on the ILD, the group cut-out switch is moved to either Group 1 Out or Group 2 Out which will electrically operate the isolator in the isolation / suppression cubicle and cancel the fault condition. Cancellation of the fault light is proof that the isolator has moved correctly.

Regenerative braking is not possible when either traction motor group is isolated.

Always open the VCB before operating this switch

Fig. 71 Group cut out switch.

This switch must only be operated when the VCB is OPEN and the adjacent Yellow Lamp is illuminated, or when main reservoir pressure exceeds 800kpa.

Failure to do so may cause the disconnect contactor to fail.

9.13 Test Switch

The is next to the Group cut out switch. When moved from “normal” to “test” it enables repair staff to record information from the control circuit on their electronic test equipment. It must remain in “normal” for correct operation.

Operation of this switch will cause the pantograph to automatically drop.

9.14 Control cut-out switch

Operation of this switch isolates the major portion of the control wiring in the locomotive. The trainline wiring is still energised so in multiple operation it is possible to control the power in the trailing locomotive from the master controller of the leading locomotive which may have its pantograph down – provided that the Control Cut-Out switch is moved to “cut-out”. It must remain in “normal” for correct operation.

10.0 Fault Indications on ILD

Legend

Indication	Meaning
A	Crew Message Indication on ILD
B	VCB tripped on ILD
F	Flag on relay
R	Repeated by Crew Message warning on ILD

Device	Function	Indication	Action	Location
Auxiliary Overload Relay	Operates if secondary current to battery charger and MA set excessive. Trips VCB	F, B, R, A	Driver reset.	Button on ILD.
Battery Charger Failed Relay	Alarm only.	A, R	Note and report at earliest opportunity.	
Buchholz Alarm	Operates when oil level falls below normal minimum.	A, R	Note and report at earliest opportunity.	
Buchholz Trip	Detects low oil or surge. Trips VCB.	A, R B	Driver to call for assistance.	
Circuit Fault Relay	Trips VCB.			

Device	Function	Indication	Action	Location
Control Electronics Fault Relay	i. Alarm Stage ii. Shutdown Stage Trips VCB	R A (GP1/GP2) R, B A (GP1/GP2)	Driver reset. Isolate faulty group if fault recurs.	Button on ILD. GP cut-out switch on start-up panel
Convertor Low Oil Switch	i. Alarm Level – operates when oil falls below normal minimum. ii. Shutdown Level – operates when oil level falls unacceptably low. Traction power removed.	A (GP1/GP2) R	i. Note and report at earliest opportunity. ii. Isolate faulty group.	GRP cut-out switch on start-up panel
Convertor Oil Flow Failure Switch	Flow switch in oil circuit of each convertor operates if flow falls below safe level.	A (GP1/GP2) R	If MCB tripped, reclose. If recur, isolate.	MCB and GRP cut-out switch on start-up panel
Convertor Over Temperature Switch	Detects over temp. Removes traction power.	R A (GP1/GP2)	If MCB tripped, reclose. If recur, isolate faulty group	MCB and GP cut-out switch on start-up panel.
Earth Fault Relay Armature circuits	Operates if earth fault occurs in armature circuits (positive side) or Armature Convertor input. Trips VCB	F, B, R, A (GP1/GP2)	Driver reset. Isolate faulty group if trip recurs.	Button on ILD. GP cut-out switch on start-up panel.
Earth Fault Relay Auxiliary Circuits	Operates if earth fault occurs in auxiliary circuits. Trips VCB	F, B, R, A	Driver reset.	Button on ILD.

Device	Function	Indication	Action	Location
Earth Fault Relay Field Circuits	Operates if earth fault occurs in field circuits or field Convertor input. Trips VCB	F, B, R, A	Driver reset. Isolate faulty group by trial if trip recurs.	Button on ILD. GP cut-out switch on start-up panel.
Earth Leakage Relay	Operates if primary earth occurs. Trips VCB	F, B, R, A	Driver reset.	Button on ILD.
Line Voltage Detector	Detects if line voltage goes outside limits. Trips VCB Line Voltage shown in RED on ILD.	A, B	Return controller to “off” and stop train using air brakes. Resume when line voltmeter indicates voltage normal and VCB recloses.	
Low Battery Voltage Relay	Detects low battery volts. Removes traction power.	A, R	Driver to call for assistance.	
Low Main Reservoir Pressure Switch	Alarm only	A, R	If MCB tripped, reclose. If recur, driver to call for assistance.	MCB on start-up panel.
Main Blower Failure Relay	Detects blower failure. Trips VCB	A, R B	If MCB tripped, reclose. If recur, driver to call for assistance.	MCB on start-up panel
Motor Alternator Set Load Contactor	Operates if MA set output lost. Trips VCB.	A B, R	Driver to call for assistance.	

Device	Function	Indication	Action	Location
Motor Overload Relay	Operates if motor armature current excessive. Trips VCB	F, B, R, A (GP1/GP2)	Driver reset. Isolate faulty group if trip recurs.	Button on ILD. GP cut-out switch on start-up panel.
Power Factor Correction	Operates if power factor correction circuit faulty.	B, R A (GP1/GP2)	Isolate faulty group.	GP cut-out switch on start-up panel.
Primary Overload Relay	Operates if primary current excessive. Trips VCB	F, B, R, A	Driver reset.	Button on ILD.
Secondary Overload Relay	Operates if secondary current to convertor is excessive. Trips VCB	F, B, R, A (GP1/GP2)	Driver reset. Isolate faulty group if trip recurs.	Button on ILD. GP cut-out switch on start-up panel.
Surge Suppression Fuses-Armature Convertors	i. Alarm Stage – all windings still have acceptable protection. ii. Shutdown Stage – some windings have no protection. Trips VCB	R A (GP1/GP2) R, B A (GP1/GP2)	i. Note and report at earliest opportunity. ii. Isolate faulty group.	GP cut-out switch on start-up panel.
Surge Suppression Fuses-Auxiliary Winding	Alarm only – If Aux. suppression circuit fault occurs. Suppression circuits on other windings give temporarily acceptable protection.	A	Note and report at earliest opportunity.	

Device	Function	Indication	Action	Location
Traction Motor Blower Failure Relay	Detects blower failure. Removes traction power.	R A (GP1/GP2)	Note and report at earliest opportunity.	
Transformer Oil Flow Failure Switch	Light only.	A, R B	If MCB tripped, reclose. If recur, driver to call for assistance.	MCB on start-up panel.
Transformer Over Temperature Switch	i. Alarm Level – operates when trans. Oil temp rises above normal. Removes traction power. ii. Shutdown Level – operates when trans. Oil temp becomes unacceptably high. Trips VCB.	A, R	Auto reset when temp falls	Button on ILD.
Transformer Relief Valve	Operates if internal pressure in mains trans. becomes excessive. Relieves pressure. Trips VCB. Latched switch,	B, R, A	Driver to call for assistance	

11.0 Locomotive Operating Fault Indications on ILD

Indication	Fault and Effect	Action
Brake Cylinder Pressure	Air brake applied on all three bogies. Lights at 100 kPa brake cylinder rising pressure. Goes off at 100 kPa brake cylinder falling pressure.	If the brake cylinder light does not lite, it may indicate a bogie has been isolated.
Crew Message This is a train lined signal	Check which ILD is flashing.	1. Press the Crew Message Ack pushbutton to stop the light from flashing. 2. The light will extinguish after the fault is cleared.
Half Power	Half power switch on the driver's desk is in Half Power and the power is being limited at that time. Locomotive(s) will only take half maximum power.	Return switch to Normal when no longer required.
VCB Open	VCB opened automatically due to fault. VCB OPEN Indicator flashes on ILD. VCB opened deliberately. Light steady.  This is a trainline signal indicating that a VCB is open on a locomotive coupled in multiple.	Check which ILD indicator is flashing then follow the procedures. Follow the normal start procedure. With the throttle closed and reverser handle in direction, press the RESET button to close the VCB.

Vigilance This indication comes on if the vigilance is not cancelled within time cycle.	Warns driver to cancel before penalty brake application is made. If the warning is ignored, then after 10 seconds the vigilance warning device sounds. If this is ignored, then after a further 10 seconds an emergency penalty brake is applied.	Cancel by one of the following actions: • moving the power handle • moving the brake handle • moving the selector handle • operate the cancelling switch. • sound the horn. • apply the independent brake 210 kPa minimum. If an emergency brake application is made: 1. move the auto brake valve handle to the emergency position. 2. Wait 50 seconds, then press the Reset button on the vigilance door. 3. Call Train Control to advise why it activated. 4. The brake valve will display the message “trainline emergency” and wait 60 seconds before the brakes can be reset.

Indication	Fault and Effect	Action
		5. Reset the brake system.
Wheel slip	Wheel slip / slide occurring. The power / electric brake is automatically reduced. Dump valves are energised to remove the air brake on the affected bogie. If the slide is not corrected after 5 seconds, the dump valve will be de-energised and the air brakes re-applied. A large wheel slip can cause a double control fault to occur.	Reduce power or braking effort. Reduce air brake application. If this occurs, the wheel slip / slide equipment must be reset by either moving the power or brake handle to Off, then returning it to the Min position, or by pressing the Reset button on the driver's desk.

Indication	Fault and Effect	Action	If Fault Repeats
Auxiliary Earth Fault	Earth fault on locomotive auxiliary circuits. VCB opens.	• Press VCB Close pushbutton on starting panel or • With throttle closed, set Forward or Reverse on the selector handle. • press Reset button on the desk.	Cut-out each group in turn to locate faulty group and continue journey if possible.
Auxiliary Overload	Overload on auxiliary winding of main transformer. VCB opens	• Press VCB Close pushbutton on starting panel or • With throttle closed, set Forward or Reverse on the selector handle. • press Reset button on the desk.	Cut-out each group in turn to locate faulty group and continue journey if possible.

Indication	Fault and Effect	Action	If Fault Repeats
Auxiliary Surge Suppression	Fuse blown on surge suppression on auxiliary winding on main transformer. Alarm only.	None.	Continue to nearest depot and report the fault.
Battery Charger Failed	Charger failed. No immediate effect.	1. Press VCB Open pushbutton, wait 10 seconds. 2. Then press the VCB Close pushbutton.	Switch off all unnecessary lights, continue to nearest depot and report the fault.
Buchholz Alarm	Gas in transformer or low oil level.	Report incident before leaving locomotive.	
Buchholz Trip	Oil surge in transformer or low oil level. VCB opens.	Call for assistance.	

Indication	Fault and Effect	Action	If Fault Repeats
Control Fault Group 1	Fault in control electronics. Removes traction power.	Notch controller off and press the Reset button on the desk. Cut out Control Group 1.	1. Press VCB Open pushbutton 2. Set group cutout switch to Group 1 Out. 3. Press the VCB Close pushbutton. The locomotive will now operate on traction motors 4, 5 and 6 only.
Control Fault Group 2	Fault in control electronics. Removes traction power.	Notch controller off and press the Reset button on the desk. Cut out Control Group 2.	1. Press VCB Open pushbutton 2. Set group cutout switch to Group 2 Out. 3. Press the VCB Close pushbutton. The locomotive will now operate on traction motors 1, 2 and 3 only.

Indication	Fault and Effect	Action	If Fault Repeats
Convertor Oil Flow Group 1	Group 1 oil pump failure. Light only. May operate in cold weather due to slow oil movement.	1. Place master controller in Off. 2. Check oil pump No.1 MCB. 3. Close if tripped.	1. Press VCB Open pushbutton 2. Set group cutout switch to Group 1 Out. 3. Press the VCB Close pushbutton. The locomotive will now operate on traction motors 4, 5 and 6 only.
Convertor Oil Flow Group 2	Group 2 oil pump failure. Light only. May operate in cold weather due to slow oil movement.	1. Place master controller in Off. 2. Check oil pump No.1 MCB. 3. Close if tripped.	1. Press VCB Open pushbutton 2. Set group cutout switch to Group 2 Out. 3. Press the VCB Close pushbutton. The locomotive will now operate on traction motors 1, 2 and 3 only.

Indication	Fault and Effect	Action	If Fault Repeats
Convertor Oil Level Group 1	Group 1 Convertor oil level low. Alarm only. Oil low and motor and field contactors open.	1. Press VCB Open pushbutton 2. Set group cutout switch to Group 1 Out. 3. Press the VCB Close pushbutton. The locomotive will now operate on traction motors 4, 5 and 6 only.	
Convertor Oil Level Group 2	Group 1 Convertor oil level low. Alarm only. Oil low and motor and field contactors open.	1. Press VCB Open pushbutton 2. Set group cutout switch to Group 2 Out. 3. Press the VCB Close pushbutton. The locomotive will now operate on traction motors 1, 2 and 3 only.	

Indication	Fault and Effect	Action	If Fault Repeats
Earth Leakage	Earth fault on transformer primary. VCB opens.	• Press VCB Close pushbutton on starting panel. or • With throttle closed, set Forward or Reverse on the selector handle. • press Reset button on the desk.	Shut down and call for assistance.
Field Earth Fault	Earth fault on traction motor fields.	• Press VCB Close pushbutton on starting panel. or • With throttle closed, set Forward or Reverse on the selector handle. • press Reset button on the desk.	Cut-out each group in turn to locate faulty group and continue journey if possible.

Indication	Fault and Effect	Action	If Fault Repeats
Line Volts	Line voltage out of limit.	1. Check line volts gauge. 2. If in operating zone, notch off to reset. 3. Visually check to see if the pantograph is contacting the overhead wire. 4. If overhead power is off, act to safely control train. 5. When power comes back on locomotive will automatically restart.	Repeat the procedure for the first occurrence.
Low Battery Volts	Battery voltage below limit. Motor and field contactors open.	If another EF is coupled, fit the jumper cable and carry on. If a single loco Call for assistance.	

Indication	Fault and Effect	Action	If Fault Repeats
Low Main Reservoir	Main reservoir pressure less than 600 kPa. Alarm only. There are 2 separate Low MR warnings. The internal warning shows as a RED box at the MR pressure indication on the ILD. The external warning shows as a text message in the faults area on the bottom of the screen. This will not show for 10 minutes when the loco is first started up.	1. Check the compressor MCB. 2. Close if tripped. 3. Check the main reservoir gauge reading. 4. Do not proceed if the pressure is below 550 kPa.	Call for assistance.
Low Oil Flow	Transformer oil pump failure or cold oil. Light only.	• Close the CB on the starting panel. • Press VCB Close pushbutton on starting panel. or • Set Forward or Reverse on the selector handle. • press Reset button on the desk.	Repeat action and continue journey if possible.

Indication	Fault and Effect	Action	If Fault Repeats
Main Blower	Main blower failed. VCB opens after 15 seconds.	• Check main blower MCB. • Close if tripped. • Press VCB Close pushbutton on starting panel. or • Set Forward or Reverse on the selector handle. • press Reset button on the desk.	Call for assistance.
Motor / Alternator	Fault on output. VCB opens.	• Press VCB Close pushbutton on starting panel. or • Set Forward or Reverse on the selector handle. • press Reset button on the desk.	Call for assistance.

Indication	Fault and Effect	Action	If Fault Repeats
Motor Blower Group 1	Motor blower 1 failure. All motor and field contactors open.	• Check the MCB motor blower 1. • Press VCB Close pushbutton on starting panel. • Close if tripped. or • Set Forward or Reverse on the selector handle. • press Reset button on the desk.	1. Press VCB Open pushbutton 2. Set group cutout switch to Group 1 Out. 3. Press the VCB Close pushbutton. The locomotive will now operate on traction motors 4, 5 and 6 only.

Indication	Fault and Effect	Action	If Fault Repeats
Motor Blower Group 2	Motor blower 2 failure. All motors and field contactors open.	• Check the MCB for motor blower 2. • Press VCB Close pushbutton on starting panel. • Close if tripped. or • Set Forward or Reverse on the selector handle. • press Reset button on the desk.	1. Press VCB Open pushbutton 2. Set group cutout switch to Group 2 Out. 3. Press the VCB Close pushbutton. The locomotive will now operate on traction motors 1, 2 and 3 only.
Motor Overload Group 1	Overload on traction motors 1, 2 and 3. VCB Opens.	• Press VCB Close pushbutton on starting panel. or • Set Forward or Reverse on the selector handle. • press Reset button on the desk.	1. Press VCB Open pushbutton 2. Set group cutout switch to Group 1 Out. 3. Press the VCB Close pushbutton. The locomotive will now operate on traction motors 4, 5 and 6 only.

Indication	Fault and Effect	Action	If Fault Repeats
Motor Overload Group 2	Overload on traction motors 4, 5 and 6. VCB Opens.	As above.	1. Press VCB Open pushbutton 2. Set group cutout switch to Group 2 Out. 3. Press the VCB Close pushbutton. The locomotive will now operate on traction motors 1, 2 and 3 only.

Indication	Fault and Effect	Action	If Fault Repeats
Over Temperature	Over temperature in transformer. • Traction power or regenerative brake cut-off. • Brake cut-out valve de-energises to allow brake to be applied. Do not shut the loco down, leave it running to allow the oil pumps and cooling fans to keep running. Leaving the reverse handle in direction allows a greater volume of cooling air to be forced through the radiators.	1. Stop the locomotive but do not open the VCB. 2. Check the external grills, and internal filters, in the transformer compartment are not blocked. 3. Press Crew Message Ack button on ILD then wait until alarm goes out. 4. Normal running can then be resumed.	If possible, continue under reduced power to depot.
	If temperature rises further, the VCB opens.	Call for assistance.	Call for assistance.

Indication	Fault and Effect	Action	If Fault Repeats
Power Factor Group 1	PFC capacitor fault or PFC circuit not operative.	Two stage alarm: • light only, book fault and continue journey. If traction power is lost or VCB opens, • cut out faulty group.	1. Press VCB Open pushbutton 2. Set group cutout switch to Group 1 Out. 3. Press the VCB Close pushbutton. The locomotive will now operate on traction motors 4, 5 and 6 only.
Power Factor Group 2	PFC capacitor fault or PFC circuit not operative.	Two stage alarm: • light only, book fault and continue journey. If traction power is lost or VCB opens, • cut out faulty group.	1. Press VCB Open pushbutton 2. Set group cutout switch to Group 2 Out. 3. Press the VCB Close pushbutton. The locomotive will now operate on traction motors 1, 2 and 3 only.

<table>
<tr><th>Indication</th><th>Fault and Effect</th><th>Action</th><th>If Fault Repeats</th></tr>
<tr>
<td>Pressure Relief Valve</td>
<td>Over pressure in transformer.
VCB opens.

<table>
<tr><th></th><th>If…</th><th>Then…</th></tr>
<tr><td>  </td><td>If Over Temperature and Pressure Relief Valve alarms light simultaneously</td><td>1. Check the local control MCB and if necessary, reset it before taking any further action.
2. Then press the VCB Close pushbutton to restart the locomotive.</td></tr>
</table>
</td>
<td>Call for assistance.

Advise Train Control that a track inspection is required for the section you have travelled through.

The relief valve may have operated and dumped the oil from the transformer on to the ballast / rails.

This may require cleaning up as it may create an environmental hazard.</td>
<td></td>
</tr>
</table>

Indication	Fault and Effect	Action	If Fault Repeats
Primary Overload	Overcurrent on transformer primary. VCB opens.	• Press VCB Close pushbutton on starting panel. or • Set Forward or Reverse on the selector handle. • press Reset button on the desk.	Shut down and call for assistance.
Secondary Overload Group 1	Overload on transformer Group 1 secondary winding. VCB opens.	• Press VCB Close pushbutton on starting panel. or • Set Forward or Reverse on the selector handle. • press Reset button on the desk.	1. Press VCB Open pushbutton 2. Set group cutout switch to Group 1 Out. 3. Press the VCB Close pushbutton. The locomotive will now operate on traction motors 4, 5 and 6 only.

Indication	Fault and Effect	Action	If Fault Repeats
Secondary Overload Group 2	Overload on transformer Group 2 secondary windings. VCB opens.	• Press VCB Close pushbutton on starting panel. or • Set Forward or Reverse on the selector handle. • press Reset button on the desk.	1. Press VCB Open pushbutton 2. Set group cutout switch to Group 2 Out. 3. Press the VCB Close pushbutton. The locomotive will now operate on traction motors 1, 2 and 3 only.

Indication	Fault and Effect	Action	If Fault Repeats
Surge Suppression Group 1	Fuse blown in Group 1 surge suppression circuits. Alarm only. OR Both fuses blown in one circuit causes the VCB to open automatically.	None. The locomotive can continue to run. 1. Press VCB Open pushbutton 2. Set group cutout switch to Group 1 Out. 3. Press the VCB Close pushbutton. The locomotive will now operate on traction motors 4, 5 and 6 only.	

Indication	Fault and Effect	Action	If Fault Repeats
Surge Suppression Group 2	Fuse blown in Group 2 surge suppression circuits. Alarm only. OR Both fuses blown in one circuit causes the VCB to open automatically.	None. The locomotive can continue to run. 1. Press VCB Open pushbutton 2. Set group cutout switch to Group 2 Out. 3. Press the VCB Close pushbutton. The locomotive will now operate on traction motors 1,2 and 3 only.	

11.1 Locomotive shuts down for no apparent reason

1. Check voltmeter, ensuring that it is not due to overhead power loss or voltage out of limits. If above 3kV voltage is indicated or the pantograph has dropped.

2. Press “Reset” pushbutton on the desk, ensuring the reverse lever is in a direction – try this three times.

3. Check ILD – book fault and, if a primary overload or any earth faults are indicated, attempt to reset three more times. If it is a group earth fault, cut-out the corresponding group and restart. Otherwise call for assistance.

4. Go to the electronics cubicle and book microprocessor module lights or power supplies. At the start up panel – push “VCB Close” try three times.

5. If pantograph does not raise, unseal and open pantograph bypass valve and raise pan.

11.2 No Amps Available from Standstill

1. Check that the park brake is released – check both cab indicators. Check the park brake indicator gauge on the brake rack, on the compressor side. It shows **red** for applied or **green** for released.

2. Has Tranzlog tripped?
   Press the **blue** reset button in No1 cab. The BV LCD display will show a message “Trainline Fault”. This is the same message that is shown if the brake system is in penalty mode.

3. Check that the main reservoir pressure is at least 850 kPa. Check the ILD does not have a Trail loco alarm.

4. Is the brake system ready, check the BV LCD display for messages. If the display does not have a message saying OK TO RUN, there is a problem and follow the message on the LCD display.

5. Are driving amps registering on the ILD?
   There are one set of readings for each motor and an average amp reading. If amps are registering the loco wants to go but something is preventing it, something like chocks under the wheels.

6. If the loco is not showing driving amps, ensure the reverse handle is in a direction then press and hold the reset button on the driver's desk for several seconds.

7. Check the ILD for messages referring to a current fault.

8. If no relevant messages are showing on the ILD screen, open the VCB and operate the group cut out switch to the GROUP 1 OUT position.

9. Close the VCB and try for amps, if they now register the fault is in Group 1 only.

10. If amps do not register, open the VCB and operate the group cutout switch to the GROUP 2 OUT position.

11. Close the VCB and try for amps, if they now register the fault is in group 2 only.

12. If driving amps do not register, open the VCB and operate the group cutout switch to the NORMAL position.

13. Check to see if the penalty brake has tripped.

14. Go to step 5 in 11.3 below.

11.3 Amps die off while in motion.

1. Check that it is not due to low voltage. Half power use may be necessary.

2. Check the VD has not tripped, press VD Penalty Reset button. The BV will also require resetting, follow the messages on the BV LCD display.

3. Throttle off and throttle on – try three times.

4. Throttle off with reverse handle in direction, Press Reset Button on desk and throttle on – try three times.

5. If moving stop train. Book fault including displayed ILD indications. If any earth faults are indicated, cut-out the corresponding group.

6. At the start up panel check that the three phase CBs at the top of the panel are all closed. Also check the single-phase CBs above the group cut-out switches (only some of these are relevant but if in doubt switch on) If any of these are open, push VCB open, close the CB and restart – try three times. If unsuccessful, cut-out the associated group (call for assistance if not a group fault).

7. Push VCB open, View the electronics thru the windows on the cubicle door. If any of the LED are RED, reset the electronics by tripping the electronics CB, wait for one minute to allow the system to fully power down, then reset the electronics CB – try three times.

8. At start up panel push VCB open and follow sequence for cutting out and trying each group.

9. If unsuccessful call for assistance.

11.4 Multiple Unit Consist

1. If, while in multiple, the ILD on the lead loco displays “Crew Message” and possibly “VCB Open”, with no other indications, then the fault is in the rear locomotive.

2. Reset at the desk – try three times.

3. If the fault does not clear – **do not accept the fault at the ILD.** Doing so switches out the ILD in the rear locomotive and it becomes impossible to determine the cause of the fault. When convenient go to the rear locomotive, book fault and shut down if not required. If required and still running (no “VCB Open” indication in the lead locomotive) proceed from step 4 In 12.3 above. If locomotive shuts down (“VCB Open” indication in lead locomotive) proceed from step 3 in 12.3

11.4.1 Un-refurbished Trail Locomotive faults

Refurbished EF locomotives have been fitted with a temporary fault accept button so that un-refurbished EF locomotives can run trail behind them.

A fault in an un-refurbished trail EF is indicated by a Trail Locomotive Annunciator Alarm Status Fault under Active Faults on the ILD screen. This gives the Locomotive Engineer three options:

1. Stop the train in a safe location, walk back to the trail locomotive and check the annunciator to see which faults have occurred. Take corrective action if required (e.g., cut out a group). Then accept the fault as per step 2.

2. Accept the fault by pressing the Unref. Trail Loco Alarm Accept button. The Trail Locomotive Annunciator Alarm Status Fault will disappear from Active Faults if the fault condition clears in the trail locomotive.

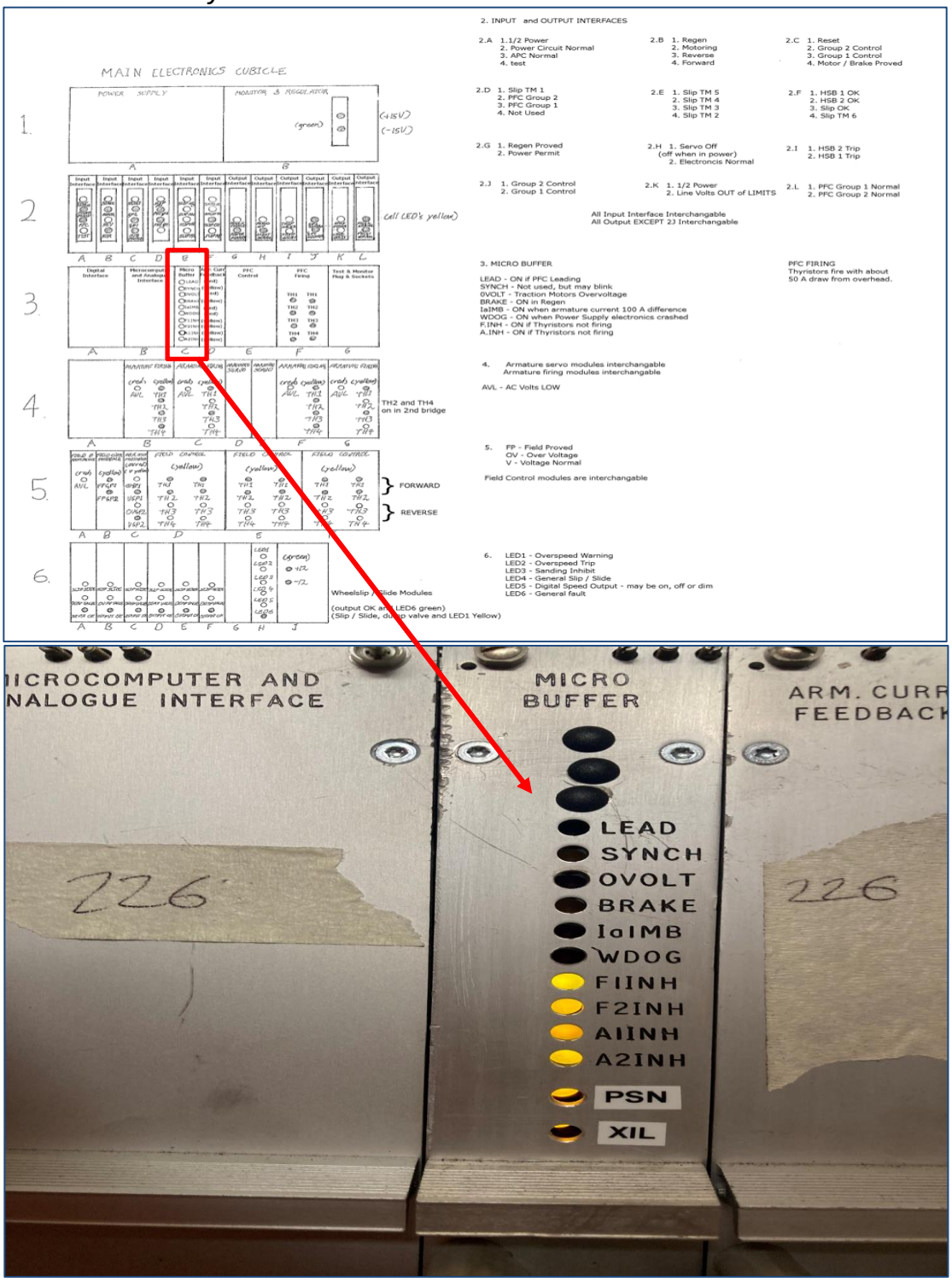
Fig. 72 Unref. Trail Loco Alarm Accept button.

3. Do nothing. The Trail Locomotive Annunciator Alarm Status Fault will remain in Active Faults even if the fault condition has cleared in the trail locomotive.

This feature will be removed when no un-refurbished EFs are in service.

11.5 Miscellaneous faults

1. Headlight failure, auxiliary compressor failure and other faults which will not disable the locomotive can be caused by a single-phase CB trip at the start up panel. These should be checked when such failures occur before any other action is taken.



Normal Electronics Indication viewed through the cubicle window.

11.6 Pantograph drops or will not raise.

The pantograph protection requires power supply to stay up, otherwise it will drop.

Check the following:

1. Check if the **Yellow** LED indicator is out. If it is lit, this indicates the auxiliary compressor is still working and there may not be enough air pressure to operate the pantograph correctly.

2. **Red** Emergency Down buttons are in unlocked position, (One in each cab) a small clockwise twist will release the button.

3. Check the fire system display panel to see if it has activated or any faults are visible.

4. Check the VCB earth switch **Blue** key is in the correct position. There is an operating guide attached to the No2 TM Blower ducting beneath the VCB.

5. Check the air pressure on the pantograph air gauge, located on the brake rack. If the pressure is low and the auxiliary compressor is not running, the pressure regulator setting should be checked to ensure it reads 500kpa. The regulator has a pressure gauge mounted on it.

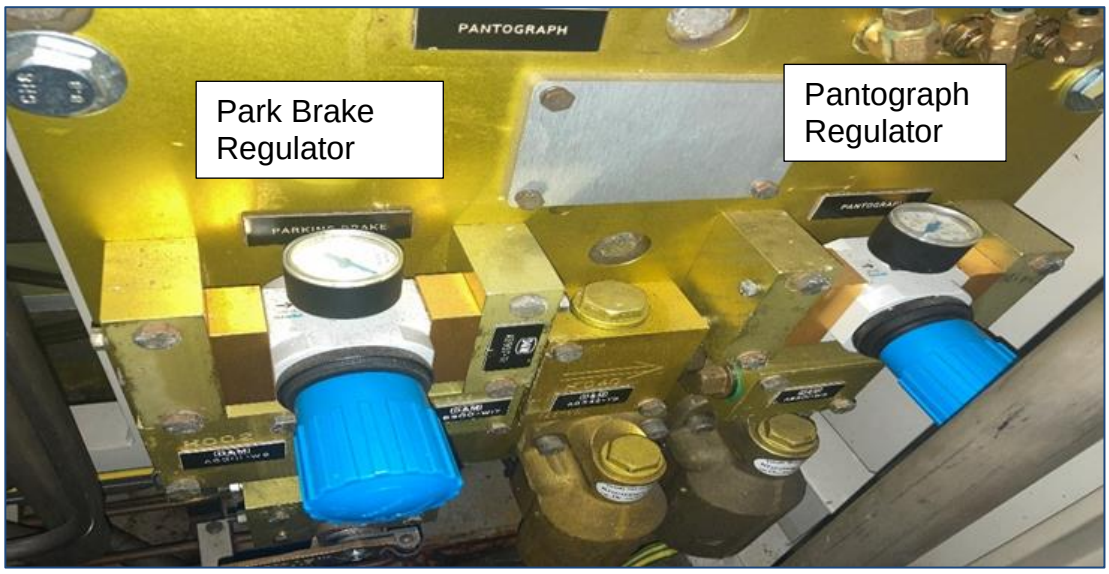


Fig. 73 Pantograph Regulator

6. Adjacent to the Pantograph air gauge is the pantograph isolation valve, this should be open to allow the air volume from the pantograph reservoir to be used to assist the pantograph.

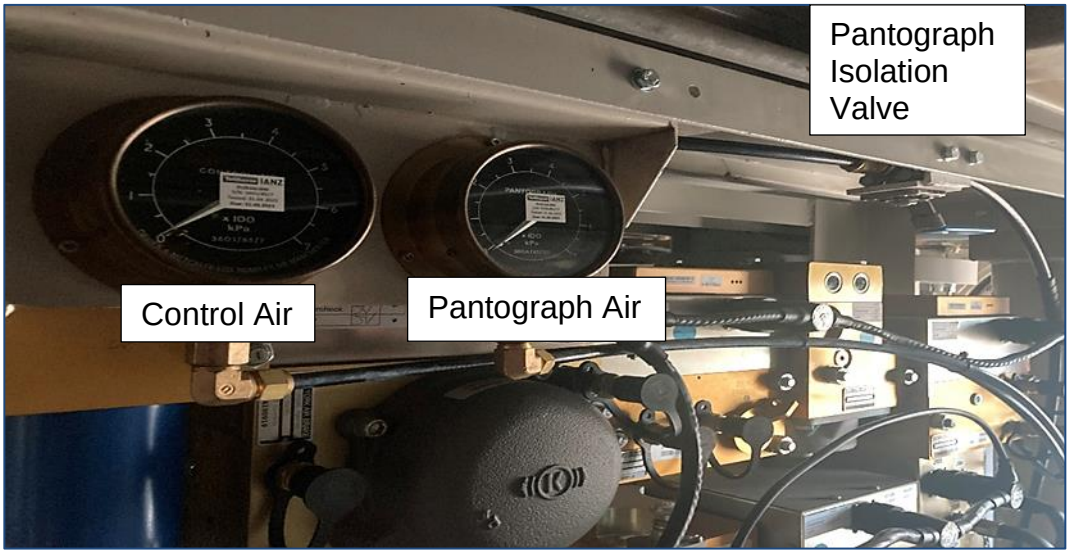


Fig. 74 Pantograph Isolation valve

7. Check the two air gauges either side of the ADD valve. If they differ in readings significantly there may be an air leak in the air supply to the pantograph carbons.

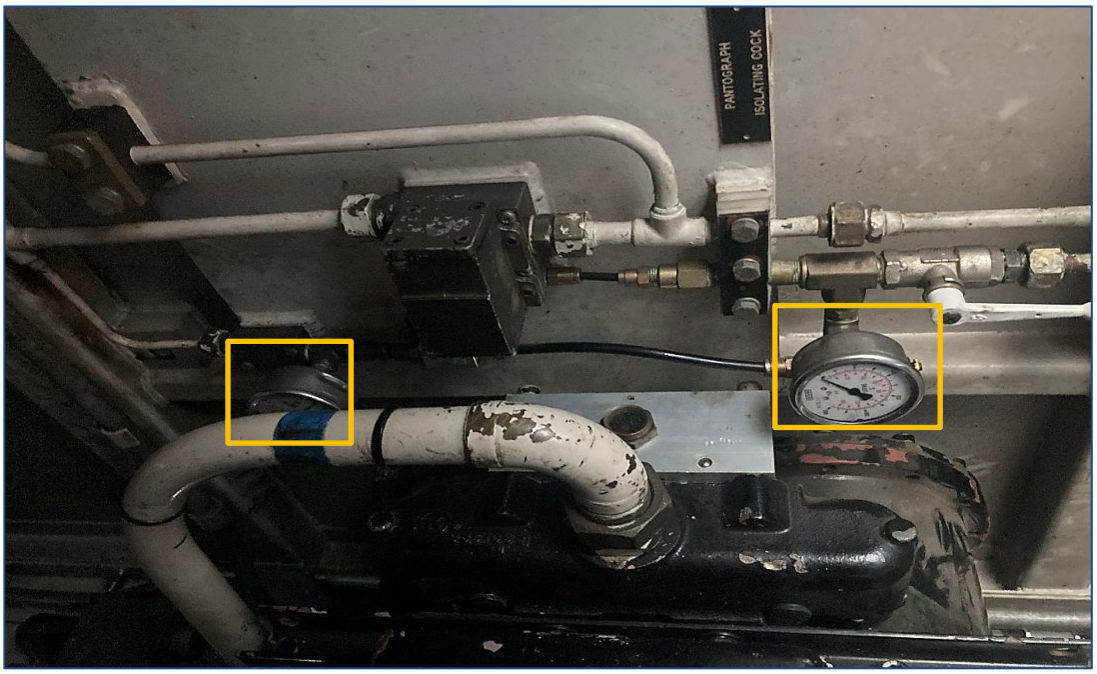


Fig. 75 Gauges to check.

8. Operate the bypass valve, turn it right angles to the pipe, and re-raise the pantograph. If the pantograph does raise, either the air is leaking from the carbons or the piping, or the over height has tripped.

With the bypass operated, all the safety features of the pantograph have been bypassed.

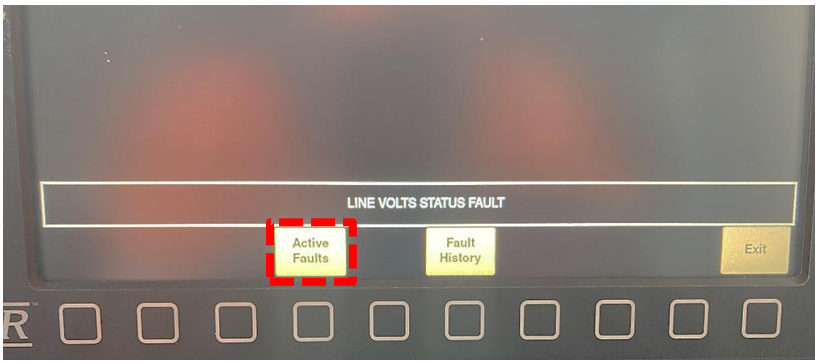
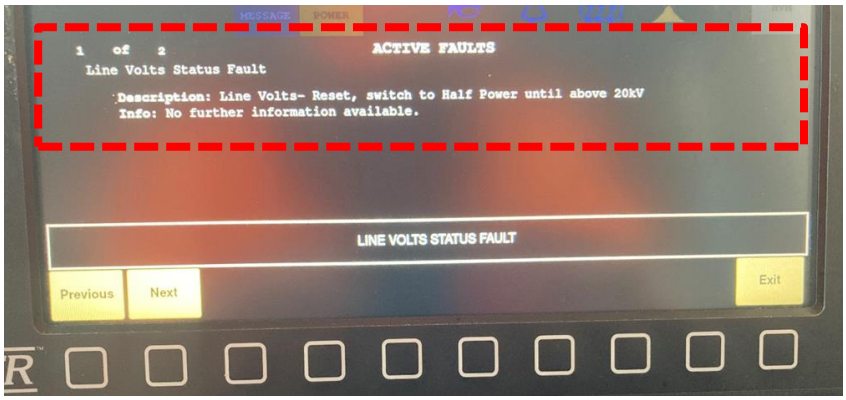
The loco must be removed from the overhead and repaired.

11.7 If an EF locomotive does not start.

If the loco does not start up and run correctly.

11.7.1 Check ILD

Step	Action
1	Check the ILD to see if the VCB OPEN message has extinguished. a. Visually check that the pantograph is on the overhead wire. b. If the pantograph is contacting the overhead, check the line voltage on the ILD. If 0 volts are showing, the overhead may be switched off. Try another EF, if it shows 0 volts contact the Traction Control Room on 06 3516839 or if no reply try Train Control.
2	Check the ILD fault log for any current faults that may prevent the loco starting. a. Some faults such as Blowers not running, oil pumps not running, control faults etc will be normal for a shutdown loco. b. Check the ribbon above the button icons, this will show the highest priority fault message. In this case, no line volts. c. Press the Event Info button. 

Step	Action
	d. Press the Active Faults button. 
	e. The top line will list the number of active faults. In this case there are 2 relevant faults. If more than one fault if evident, use the next and previous buttons to move between the various messages. 
	f. Check the ILD for faults referring to the Primary or Secondary overloads. These refer to the safety relay fitted in the main cubicle.

11.8 Earth Fault or Motor Overload Trips.

Check the following:

1. In the motor cubicles are located 4 relays with flags, the flags show as **RED** diagonal stripes on a white background when tripped. The Top 3 relays are Motor Overloads, the single relay in the bottom left corner is the Earth Fault. The Overload Relay may also trip at the same time as the Earth Fault.

2. Noting which flags are in the tripped position will assist diagnosing which traction group to cut-out.

3. Press the Reset button on the driver's desk, this will reset the relay but will not reset the indicating flag.

4. If the relay once again trips, cut out a traction group.

    a. Open VCB.

    b. On the start-up panel, the **YELLOW GCOS** light should now be lit, this indicates there is sufficient air pressure to reliably operate the disconnect switch.

    c. Cut-out the group having the problems.

    d. Close VCB.

5. Occasionally the Group Cut-Out switch becomes internally dirty, this can be cured by turning the switch to all the other positions several times before finishing back at the faulty group position.

Earth Fault trips when high voltage in traction circuit gets to the frame.

Motor Overload trips when traction motor amps exceed a per-set level.

Both can be reset by pressing the drivers desk **reset** button, although Earth Fault should be treated the same as Ground Relays in Diesel locos.

Earth Fault does **NOT** auto reset.

1. When 1st Earth Fault/Overload occurs, press reset.
2. When 2nd Earth Fault/Overload occurs, cut-out either traction group or reset.
3. When 3rd Earth Fault/Overload occurs, cut-out other traction group and reset.
4. When 4th Earth Fault/Overload occurs, tow loco home.

11.9 Constant Wheel slip

This may be caused by one of the following:

1. Actual true wheel slip, try applying light independent brake to see if it assists.
2. A wheel may be locked up, the loco will still move, but with difficulty.
3. An axle Alternator or drive may have failed.

In the case of (1), you will know if it is true wheel slip or not. These locos do not detect synchronous wheel slip (when all wheels slip at the same speed).

In the case of (2), most likely you will also smell burning or heat from the wheel if it has been skidded. You may also see smoke from a collapsed bearing. If possible, you will notice heat on the tube bearing (located between the wheels, and what the motor is bolted on).

In the case of (3), the loco will still be drivable, but only to a maximum speed of 5 kph.

Cutting out a traction group will not assist you with this problem.

With this problem you may also have a Control Fault on the ILD, plus the loco will have shut down. This is normal operation and will be able to reset once the wheel slip has stopped by pressing the desk **reset** Button.