Rail Operating Code

Code Supplement CS 4.12

Operating Instructions for DF Class Locomotives

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Original	-	-		-
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PICTURES OF DFB CLASS LOCOMOTIVES

1.0 TRAINING AND CERTIFICATION

Reserved for future use.

2.0 COMMONLY USED ABBREVIATIONS

ABV	Automatic Brake Valve
AG	Auxiliary Generator
AGCB	Auxiliary Generator Circuit Breaker
AGFM	Auxiliary Generator Field Module
B1	Braking Contactor
BCCB	Brightstar Computer Circuit Breaker
BCV	Battery Charging Voltmeter
FOR/RER	Forward/Reverse switch
BKS	Battery Knife Switch
CCB	Battery Charge Circuit Breaker
CDC	Control Device Compartment
CPF	Computer Power Filter
CPS	Computer Power Supply
CS	Control Stand
D7uP	Microprocessor Controller
DAS	Diagnostic Access Switch
DBCB	Dynamic Brake Control Circuit Breaker
DBCO	Dynamic Brake Cut Out Switch
DID	Diagnostic Information Display
EC	Engine Control Switch
ECP	Engine Control Panel
ESP	Engine Stop Switch
EWT	Engine Water Temperature Sensor
FPCB	Fuel Pump Circuit Breaker
GOV	Governor
GR	Ground Relay Switch
GRCO	Ground Relay Cut Out Switch
HLCB	Headlight Circuit Breaker
LA	Load Ammeter
PCONT	Power Contactor
PEB	Passenger Emergency Brake
LCCB	Local Control Circuit Breaker
LOT	Lube Oil Temperature Sensor

3.0 GENERAL

DFB locomotives first entered service as the DF class (EMD model GL22MC) from 1979 to 1981. There are two versions with subtle differences between them. Series 1 (20 units) and series 2 (10 units). They are the most recent diesel locomotives purchased prior to the DL class.
During 1992 a prototype locomotive was upgraded with a turbocharger and supporting systems to create the DFT class. The increased horsepower and performance warranted the fleet wide upgrade of all DF class locomotives to DFT class.
From mid-2006, a program to replace the original “Dash-2” control systems commenced. The GE Brightstar control system like the DX class was installed. This upgrade created the DFB classification. As of 2020, 22 locomotives have been upgraded with plans in place to convert all 30 locomotives.

Selected DFB locomotives are being modified to a ‘new universal passenger locomotive’ standard. They will be used on the ‘Te Huia’ Hamilton – Auckland passenger train and eventually rolled out to other passenger trains.

These locomotives have additional equipment and controls fitted in the cab to monitor the carriage safety and door systems.
There are new jumper cable sockets on the headstock to electrically connect the carriage safety and door systems to the locomotive.

These locomotives can still operate freight and passenger trains that are not fitted with the new systems.

Locomotive Details

Model designation	GT22MC
Bogie arrangement	Co-Co
Locomotive horsepower (gross)	2475 HP (1845 KW)
Locomotive horsepower (traction)	2275 HP (1700 KW)

Diesel engine:

Model	EMD 12-645E3C
Number of cylinders	12
Cylinder arrangement	45 ° “V” formation
Cylinder bore and stroke	9 1/16” x 10”
Operating principle	Turbocharged, Intercooled two stroke diesel with mechanical fuel injection
Idle speed	315 rpm
Full speed	900 rpm

Main generator:	
Model	AR6-D14
Nominal voltage DC	600
Maximum voltage DC	900
Continuous current rating	2700 amps
Notch 8 current limit	3600 amps
Auxiliary Alternator:	
Voltage DC	74V
Rating	18 KW
Traction motors:	
Model	EMD-D29CC
Number	6
Type	DC, series wound, axle hung with rubber nose suspension
Traction motor ratings (Amps):	
Continuous	450
1 hour	485
½ hour	510
¼ hour	545
When starting a train	550
Dynamic brake	375
Dimensions:	
Length over buffers	17.945 m
Height	3.815 m
Width	2.667 m
Supplies:	
Fuel	5010 litres with extended range tank.
Lube oil	618 litres
Cooling water	744 litres
Weight:	
Basic (including fuel, etc.)	87.6 tonnes

Locomotive operation

The locomotive operates by using the diesel engine and main alternator to generate power. The main alternator AC output is then rectified to DC power. This power is sent to the electrical cabinet behind the cab and then distributed to the traction motors, each of which is directly geared to a pair of driving wheels. A companion alternator is attached to the main alternator to provide power for the radiator fan motor and inertial filter extractor motor and to provide power to excite the main alternator field.
The diesel engine is also used to drive an air compressor to supply compressed air for the locomotive and train brakes as well as the auxiliary alternator / blower unit.

Locomotives may be operated independently or coupled to other units to form a multiple unit consist. When so equipped and coupled, all units are simultaneously controlled through jumper cables from the cab of the lead locomotive.

3.1 Passenger Modified Locomotives

3.1.1 Carriage systems monitored by Locomotive

- Activation of a smoke detector
- Airbag deflated.
- External door open while train is moving.
- Park brake applied.
- Passenger Emergency Brake switch (PEB) activated.

3.1.2 New Locomotive Features

- New panels with warning lights and buttons above the Locomotive Engineer front window and next to the speedometer.
- Different warning sounds for the new carriage alarms.

Tranzlog monitors many of these systems.

- Carriage Controls:
  - Air conditioning fresh air intake, open / close
  - Park brake, apply / release.
- Door controls:
  - Door release
  - Door close indication
  - 'Right of Way' gong for onboard crew
  - Emergency release
- Hardwired intercom to the carriages
- Jumper cable sockets (four).
  One on each side of the front and rear headstocks.

- The ability to override a Passenger Emergency Brake (PEB) activation.
- Train Monitoring System (TMS) information panel
- Traction interlock – no traction power while the doors are open.

3.2 Brightstar Control System & Associated Component Description

The Brightstar microprocessor control system fitted to the DFB class controls many of the functions of the locomotive. Its key function is to control the amount of wheelslip and enable maximum tractive effort to be applied. With the introduction of this microprocessor-based system a 25% increase in tractive effort was achieved over the older “Dash-2” control system.

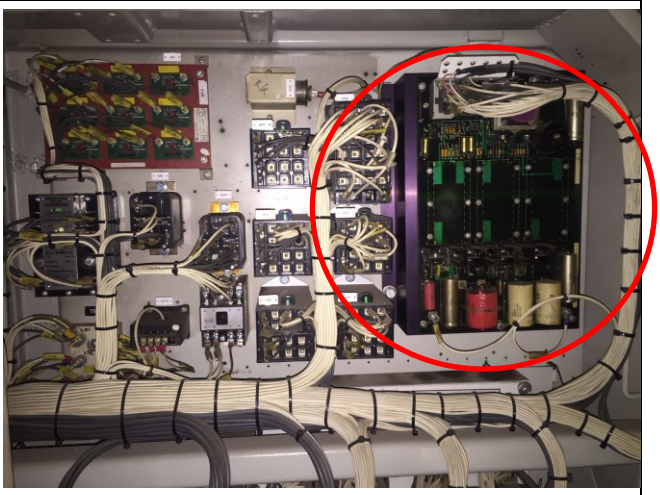
The system looks at individual traction motor current and voltage through current shunts on each traction motor circuit. It can determine from these readings if a wheel set is turning faster than another (slipping). Depending on the current / voltage differential and the time it took to get there, the system will employ four levels of wheelslip control. This is done to stop the locomotive from going into a synchronous slip (all wheels spinning) and prevent the train from stalling.
Secondary to this function, Brightstar manages the dynamic brake regulation and protection with the aim being to control wheelslip and protect the braking grids from excessive current or loss of grid cooling air, when dynamic brake is in operation. Another key function is to monitor engine oil and coolant temperatures and to de-rate the alternator output if excessive temperatures are detected. Some of the features to achieve these controls are listed below.

Engine Lube Oil & Water Temperatures (LOT & EWT):	Temperatures are monitored by sensors placed in the main water & oil outlet pipes. Radiator shutters and fan speeds are controlled by the processor at predetermined temperature ranges. If Brightstar detects that the oil and or water temps are getting too high (110^{o} C) it will start to decrease the horsepower output of the engine in an attempt to cool the engine down. It will progressively de-rate the horsepower to a point (114^{o} C) where the locomotive will not produce any power. It will still allow full engine RPM to help with the cooling of the water and oil.
SCR Control Panel:	The SCR control panel controls how much power the main alternator delivers to the traction circuit. Brightstar uses the SCR panel to regulate locomotive tractive effort and control wheelslip.
Dynamic Brake Fan Sensor:	A current transducer is placed in the DB fan power circuit and the system monitors the operation of the fan. If current is not detected in the fan circuit whilst operating the dynamic brake it will suspend its operation.

Barometric Pressure sensor (BPT):	A pressure transducer is placed in the clean air room to monitor barometric pressure. This is used to de-rate the alternator output should the locomotive operate at high altitude. In practice, this never occurs in New Zealand as we never run at high enough altitudes to require high altitude deration.
Ambient Air Temperature (AT):	A temperature sensor is in the clean air room. It monitors the ambient air temperature being used by the engine to generate power. Brightstar will limit engine horsepower if excessive ambient air temperature is detected.
Driver / Loco Interface (DID):	The Diagnostic Information Display is the interface between the Locomotive Engineer and the control system. The DID will display a fault if an abnormal operating condition is detected and the computer will initiate the ALARM mode. In the ALARM mode, the computer uses the DID panel to alert the operator to the fault by displaying a description of the fault and in some cases, ringing the alarm bell. Depending on the severity of the defect, the control system will take action. This action can vary from simply displaying an error message on the DID panel to displaying a message and restricting the operation of the locomotive. Some faults will have an automatic reset function, others require a manual reset carried out by the operator using the DID panel.
Traction Motor Thermal Protection:	The Brightstar has preset limits built into the control software and will limit the main alternator output if it reaches the prescribed limits. This function is employed to look after the traction motors and stop them from overheating causing serious damage.

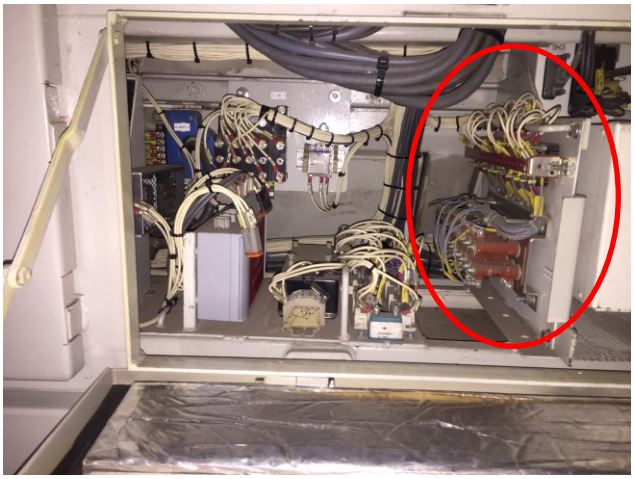
Main Brightstar components in DFB locomotives

DID Panel



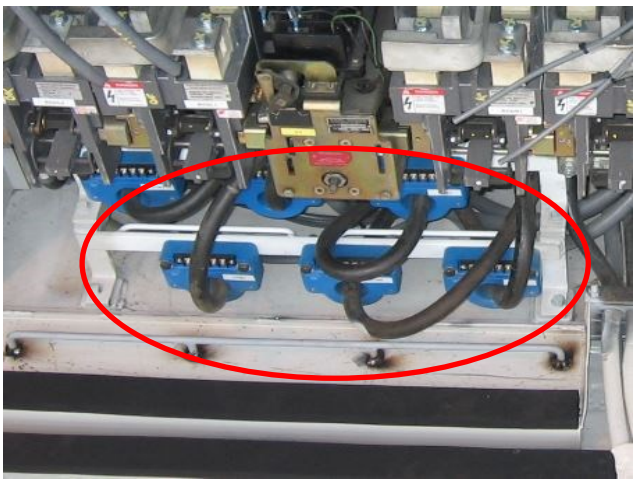
Computer power supply (no cover)

Brightstar Control Panel



Trainline Resistor Panel

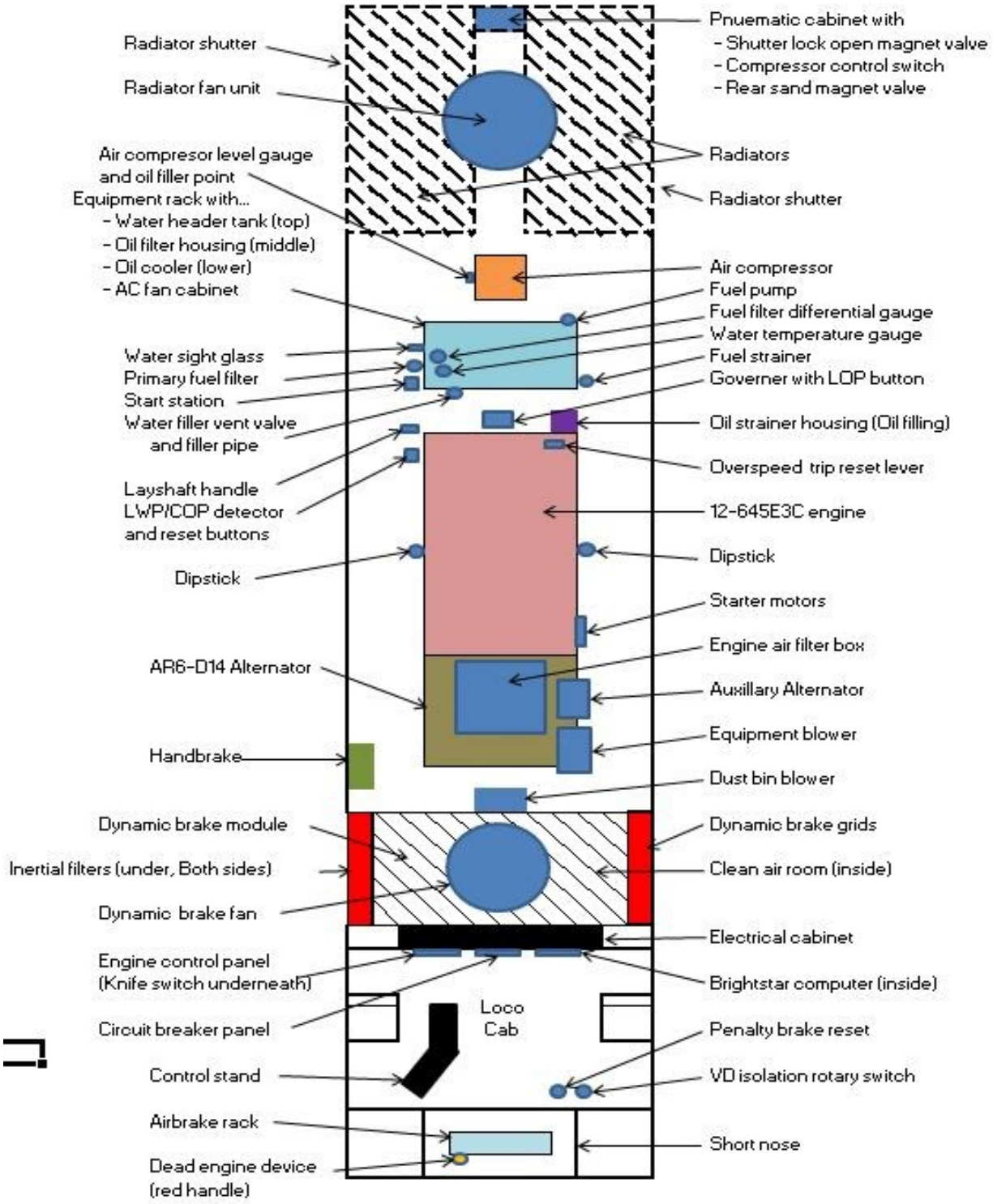
Computer Power Filter & SCR Panel



Traction Motor Current Transducers

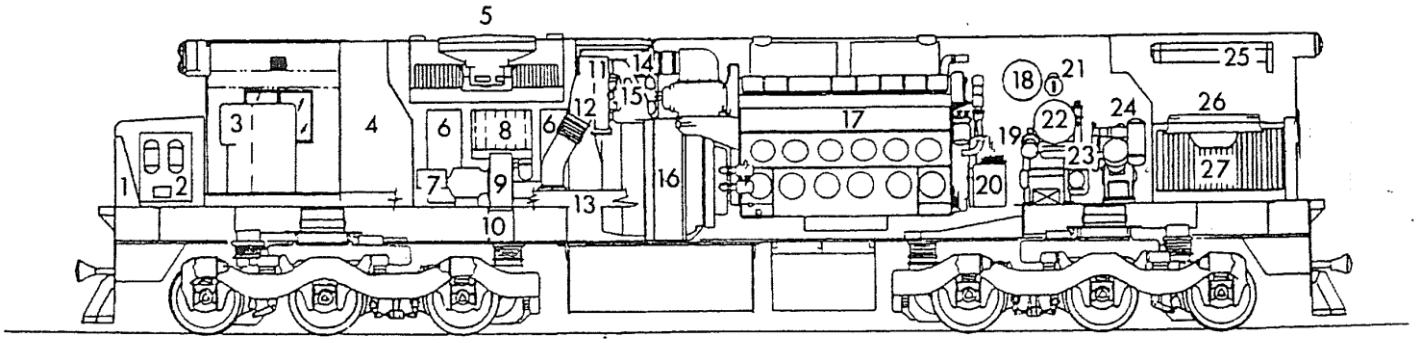
4.0 GENERAL DIAGRAMS

4.1 Schematic arrangement of DFB locomotive



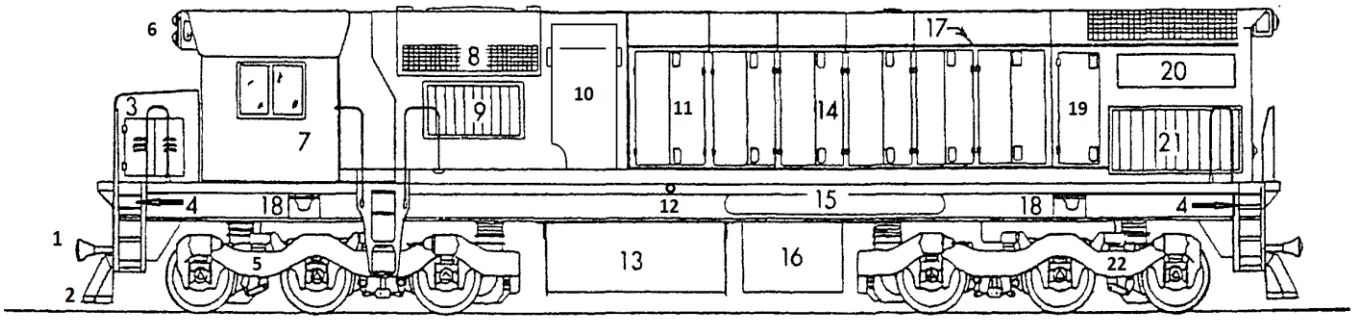
4.2 General arrangement of DFB locomotive (interior):

1. Collision Post
2. Air Brake Rack
3. Engineer's Control Stand
4. Electrical Control Cabinet
5. Dynamic Brake Unit
6. Access Door
7. Field Shunt Module
8. Inertial Air Filter
9. Dust Bin Blower
10. Dust Bin Blower Air Discharge
11. Generator I Alternator Blower
12. Traction Motor Blower
13. Traction Motor Air Duct
14. Engine Air Filter
15. Auxiliary Generator
16. Main Alternator AR6-D14
17. 12-645E3C Diesel Engine
18. Engine Water Tank
19. Lube Oil Cooler
20. Lube Oil Strainer
21. Low Water Switch
22. Lube Oil Filter
23. Fuel Pump
24. Air Compressor
25. Radiators
26. Cooling Fan
27. Fan Compartment



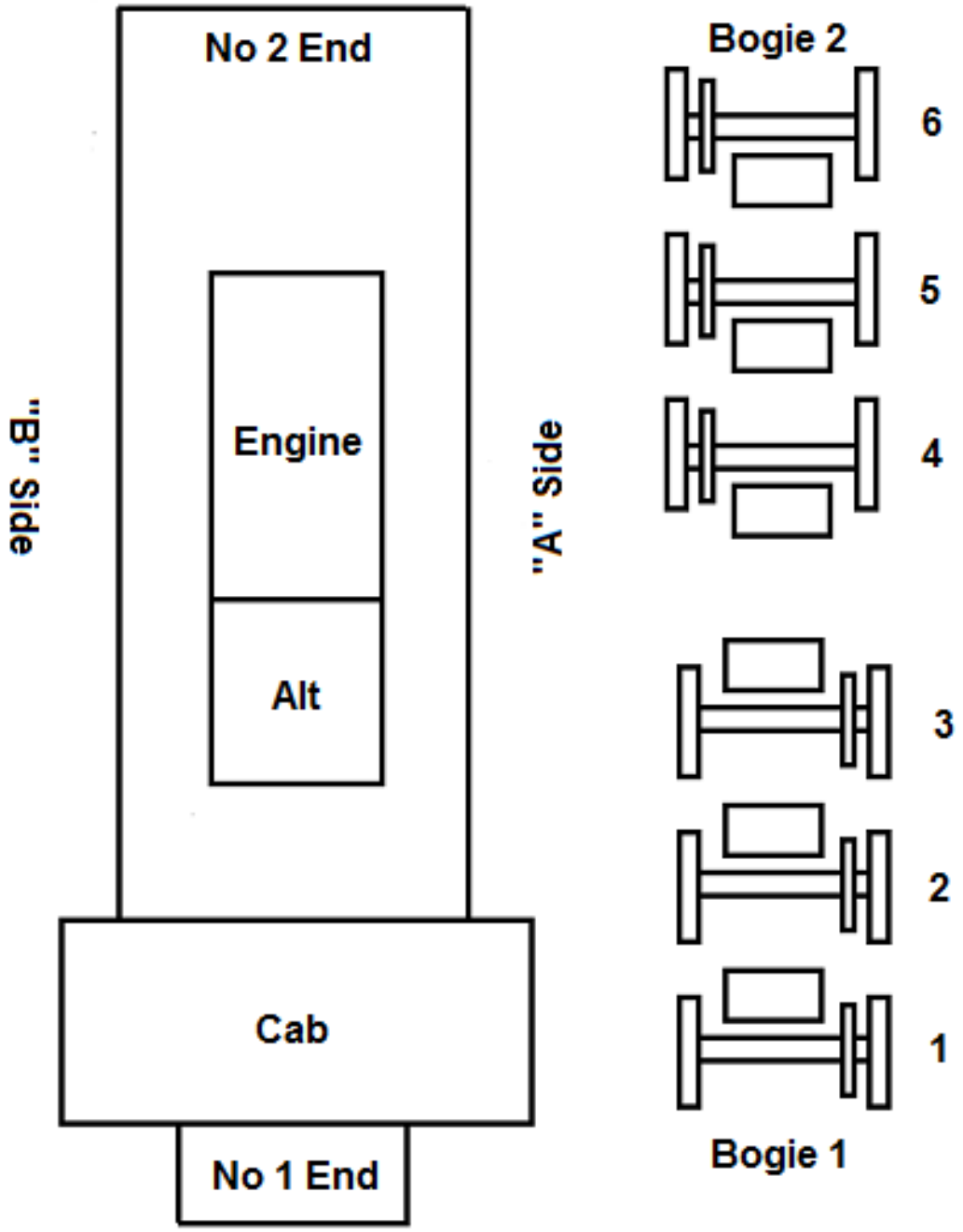
4.3 General arrangement of DFB locomotive (exterior):

1. Buffer
2. Cowcatcher
3. Short nose
4. Sand filler
5. Front bogie
6. Front headlight
7. Loco cab
8. Dynamic brake
9. Inertial air filter
10. TM blower blister
11. Alternator access door
11. Roof access ladder
12. RFID Tag
13. Fuel tank
14. Engine hood doors
15. Air reservoir
16. Battery box
18. Lifting point
19. Compressor access door
20. Cooling fan access door
21. Radiator shutter assembly
22. Rear bogie

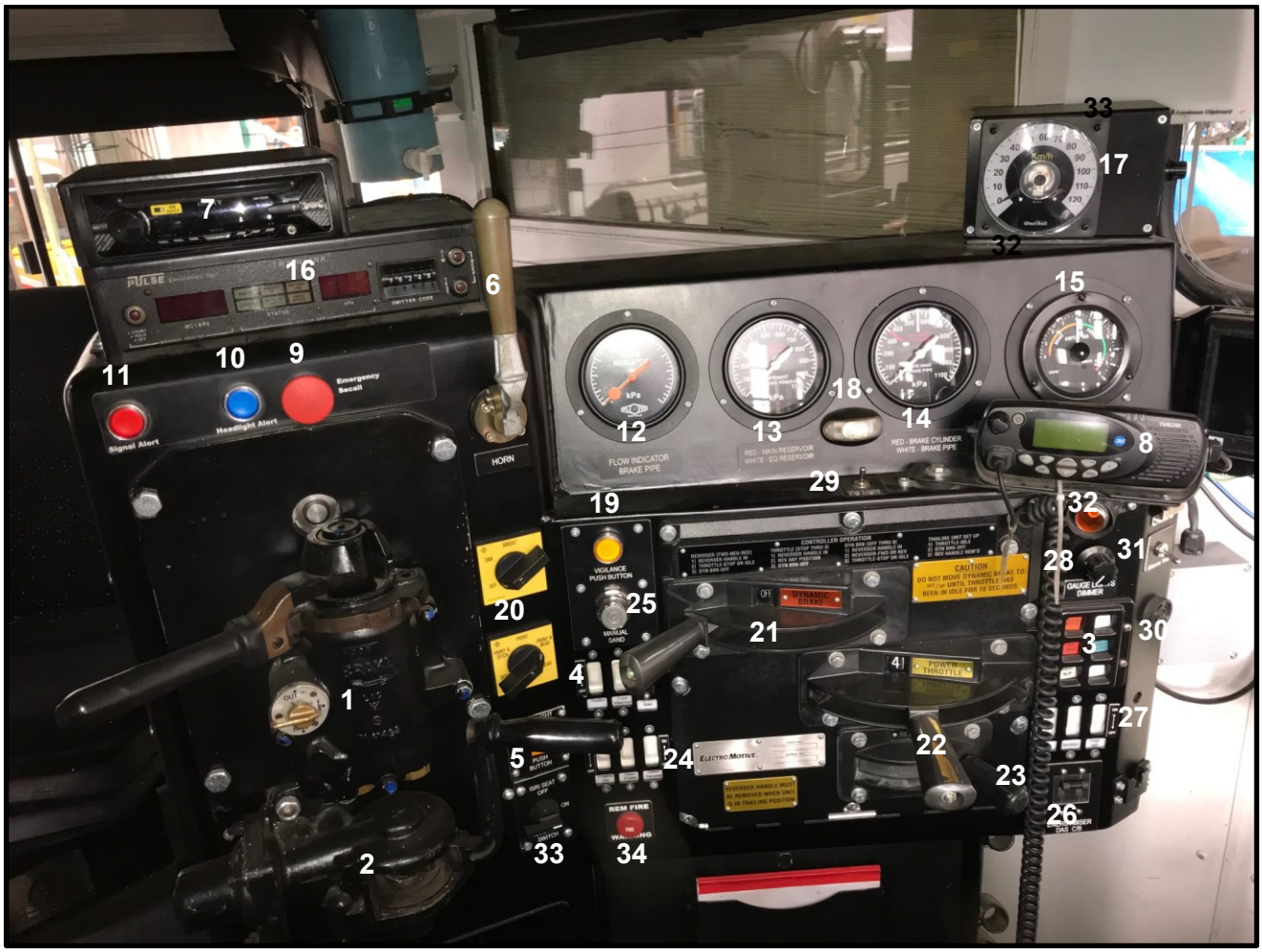


4.4 Traction Motor Arrangement

All DFB class locomotives have a Co – Co arrangement. (Six driving axles)



5.0 CAB CONTROLS / LAYOUT



5.1 Control Stand Component Identification:

1. 26C Automatic Brake Valve	2. SA26 Independent Brake Valve
3. Warning Light Panel	4. Radio / Footwarmer / DBCO switches
5. Ditchlight Push Button	6. Horn Valve
7. Entertainment Radio	8. Tait Radio (Broadcast)
9. Emergency Selcall Button	10. Headlight Alert
11. Signal Alert	12. Flow Meter Gauge
13. Main Res & EQ Res Pressure Gauge	14. BP & BC Pressure gauge
15. Load Ammeter	16. HEM Unit
17. Speedometer	18. Vigilance Light

Control Stand Component Identification (Contd.)

19. Vigilance Cancellation Button	20. Headlight Selector Switches
21. Dynamic Brake Control Handle	22. Throttle Control Handle
23. Forward / Reverse Selector Handle	24. Engine run/ Gen field / Fuel pump Cab Heater Control Switches
25. Manual Sanding Push Button	26. DAS circuit breaker (Driver Advisory System)
27. Vigilance / Gauge light and Window demister switches	28. Gauge light dimmer
29. White VD on/off toggle switch	30. Vigilance buzzer
31. Alert buzzer volume	32. Vigilance light
33. ISRI seat isolation switch	34. Remote fire warning light

5.2 Drivers Light / Wiper Control Panel

1. Drivers spotlight	2. LED & Spotlight On / Off switch
3. Drivers LED light	4. Drivers window wiper control valve
5. Centre window wiper control valve	6. LE door wiper control valve

5.3 Passenger Locomotive - Additional cab equipment

1. Carriage airbag deflated (yellow light)	2. Carriage smoke alarm activated (red light)
3. Carriage park brake apply push-button (red light)	4. Locomotive traction override button
5. Freight or Universal passenger selector switch	6. Passenger Emergency Brake (PEB) override (red light)
7. HVAC damper close / open push-button (white light)	8. Carriage park brake release push-button (green light)
9. Emergency door release override push-button (white light)	10. Carriage Train Management System (TMS)
11. Carriage to Locomotive intercom handset	12. PEB override acknowledge button with red light
13. All door closed (blue light) – shown with baffle down	14. Door release push-button (white light)
15. Alarm silence push-button (white light)	

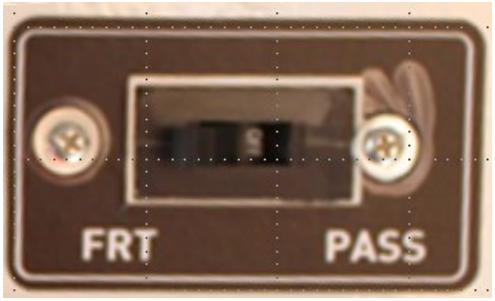
5.3.1 Alarm Silence

If this button is pressed while the smoke or airbag alarms sounds, it will only stop the sound, the fault still exists.

When the button illuminates with a white light, it indicates that alarm silence is active.

 If a second alarm is activated, the alert tone will not sound.

5.4 FRT / PASS Selector switch



FRT Position	PASS Position
Lead, Trail or Dead on a: • Freight Train • Passenger train that is not fitted with the universal passenger systems monitored from the locomotive	Lead locomotive on: • SR or other carriage that have the new universal passenger system monitored from the locomotive

5.5 Warning Indicating Lights (control stand)

5.5.1 Wheelslip Light

Will operate in all locomotives connected via jumper cables.

Illuminates when wheelslip is detected in trailing locos only.

There is no warning buzzer indication for wheelslip or slide.

5.5.2 PCS open light (Pneumatic Control)

Operates only in the affected unit of the consist. The alarm bell will operate in all units of the consist as long as the jumper cable is fitted. The PCS will operate when BP pressure has fallen below a safe value or when Tranzlog has activated the penalty brake. The train must be stopped, and BP pressure restored after taking the necessary action.

If the engine speed was above idle, all engines in the consist will go to idle speed.

The throttle must be placed in IDLE and brake pipe pressure restored to above 350 kPa to extinguish the light.

5.5.3 Brake Warning Light

This is to alert the driver of other locomotives (non-Brightstar) in the consist having reached their braking limit.

5.5.4 No power charge light

This light illuminates if the auxiliary generator output is lost. The auxiliary generator supplies 74V power to the locomotive control systems. The alarm bell will also sound in conjunction with the light.

5.5.5 STAT-X Fire Detection

DFB locomotives are being fitted with this detection / suppression system.

See Section 17.1 for detail of the system.

5.5.6 Vigilance Warning Lights

Will operate in the lead unit only.

1. Vigilance Reset Push Button – Internally Lit
2. Vigilance Light - Amber
3. Vigilance Light - White

5.6 Engine Control Switch

This switch is located at the top right-hand side of the engine control (EC) panel.
The positions of the switch are:

1. **Start / Stop / Isolate** - All circuits that are necessary for engine fuel prime & cranking are completed. The locomotive is unable to produce power.

2. **Run** - All circuits to obtain power, dynamic braking or self-load are completed

5.7 Load Ammeter (LA)

This instrument is located on the face of the control stand and is for the purpose of indicating traction motor current when the locomotive is in power and traction motor armature current when in dynamic brake.

The instrument face is colour banded, the bands of colours indicate normal and excessive operating currents.

Once the indicating needle passes from the green to red zones the Brightstar thermal protection counters start to count. If the predetermined thermal limits for the traction motors are reached, the control system will limit the alternator output in order to protect the traction motors from overheating and damage.

Traction motor ratings (Amps):

Continuous	450
1 hour	485
½ hour	510
¼ hour	545
When starting a train	550
Maximum dynamic brake	375

5.8 Battery Charging Ammeter

Located in centre left of the engine control panel.

Displays battery charging current. This can also be viewed on the DID panel.

Under normal operating conditions with the engine running, the gauge should be in the green zone.

This is regulated by the Brightstar control system.

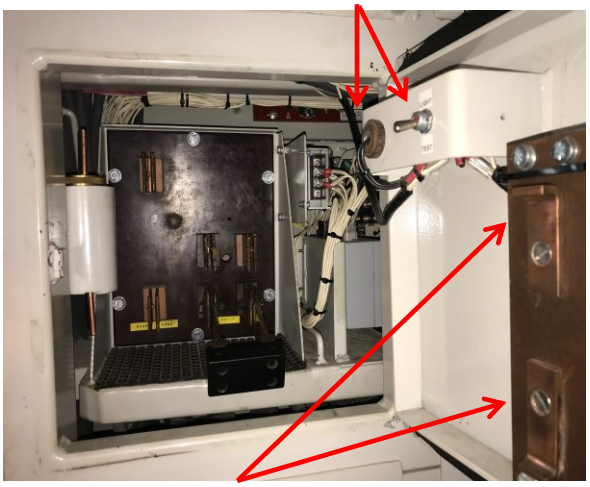
5.9 Battery Knife Switch (BKS)

Located in the left centre panel in the electrical cabinet.

Closing the battery knife switch allows power to be distributed to various electrical circuits. A spare fuse is provided in the compartment and a fuse testing station is mounted on the inside of the access door. Move the toggle switch to the “Light” position to test if the light operates then move the switch back to “Test”. Apply the fuse to the testing bars. A good fuse will operate the light when applied to the bars.

Battery Knife Switch Cabinet

Fuse testing toggle switch and light



Fuse testing bars

5.10 Engine Control Panel (ECP)

The Engine control panel is located on the left side of the electrical cabinet wall above the battery knife switch. It houses several devices used to set up and operate the locomotive as well as indicating the status of certain functions and faults.

	Device list and function:
1) Turbo lube failure light	This light indicates the turbo lube oil pump has failed to operate. If lit - Engine starting is prevented until the fault is rectified. Should this light illuminate when the engine is being shut down, the turbo lube pump may have failed. RESTART THE ENGINE IMMEDIATELY. Run the engine at idle for 15 minutes then shut down. Book fault in Loco 54D repair book.
2) Low voltage earth fault lights	*The switch next to these lights should be turned on to check for low voltage ground faults when preparing the locomotive for service.* One light brighter than the other indicates a fault and this should be reported in the Loco 54D book. Locomotive operation can continue with a low voltage earth fault present. *The switch should be turned off while operating the locomotive.*
3) Isolation switch	This switch has two positions. Start / Stop / Isolate position and Run position. The switch must be in the run position to get driving amps.
4) Battery Ammeter	This gauge displays the battery charging current when the engine is running. The needle can be anywhere in the green range. If the needle is in the red range with the engine running, there is a fault in the battery charging circuit. This should be booked up in the Loco 54D book.
5) Slide switch bank	These slide switches control various lights and also the fuel pump test function. The fuel pump test switch is for maintenance personnel use.
6) Ground relay cut-out switch	This switch isolates the ground relay from being able to operate. It is solely for maintenance personnel use when diagnosing high voltage ground faults. Operators should never attempt to isolate the safety action of the ground relay.

7) Dynamic brake cut-out	This switch isolates the dynamic brake by sending a signal to the Brightstar unit. Operators should use the DBCO circuit breaker located on the control stand if they wish to cut out the operation of the dynamic brake.
8) Engine stop button	This button stops the diesel engine. The isolation switch needs to be in the Start/Stop/Isolate position before depressing engine stop button. If the isolation switch is left in Run – The alarm bell will ring if engine stop is pressed.
9) Headlight control switch	This 4-position rotary switch is used to set up the headlights for single or multiple unit operation. The switch should be set up in accordance with the consist of the train

5.11 Circuit Breaker Panel

This panel is located at the top centre of the electrical cabinet that forms the rear wall of the cab. The circuit breaker panel has two colour coded sections. The circuit breakers in the black section must be on to operate the locomotive. Tripping of any circuit breaker while operating the locomotive should be booked up in the Loco 54D book.

Circuit breaker description and function (L to R. Top to Bottom)	
1). Lights	This circuit breaker provides the power to the various light switches on the locomotive including the gauge lights
2). Headlights	This circuit breaker provides the power to the front and rear locomotive headlights and the front ditch lights
3). Heated Windscreens	This circuit breaker provides the power for all the forward facing electrically heated glass.
4). Soakback pump	This circuit breaker provides the power to operate the turbocharger soakback pump. This pump provides cooling oil to the turbocharger for 30 minutes after the engine is shut down.
5). Radio	This circuit breaker provides power to operate the locomotive radio equipment including the power supply used for the entertainment radio
6). Hotplate / Inverter	This circuit breaker provides power to operate the Hotplate and immersion heater unit. On DFB locomotives with Air Conditioning – It provides the power to the 74/230V inverter unit.
7). Aux Heaters	This circuit breaker provides the power to the foot warmer units located on the side walls of the cab
8). Battery Charge	This circuit breaker protects the battery charging circuit when the locomotive batteries are being charged up using the charger sockets.
9). Cab heater / Fridge	This circuit breaker provides the power to the cab heater unit. On DFB locomotives with Air Conditioning – It provides the power to the fridge drawer.
10). Filter blower motor	This circuit breaker provides power to the Inertial filter blower motor. This blower extracts dirty air from the clean air room and discharges it outside the locomotive.

11). Reverser control	This circuit breaker provides power to the forward/reverse transfer switch motor used to change locomotive direction
12). Brake transfer control	This circuit breaker provides power to the power/dynamic brake transfer switch motor used to switch the locomotive between power and dynamic brake operation
13). Fuel pump	This circuit breaker provides the power to operate the fuel transfer pump. This pump draws fuel from the fuel tank for the operation of the diesel engine.
14). Local control	This circuit breaker establishes "local" power from the auxiliary generator to operate heavy duty switchgear and various control devices
15). Aux gen field	This circuit breaker protects the field circuit of the Auxiliary Generator. Varying the power through the auxiliary generator field regulates the output of the machine. The Brightstar computer controls the field regulation function.
16). Generator field	This circuit breaker protects the field circuit of the main alternator. Varying the power through the main alternator field regulates the output of the machine. The Brightstar computer controls the field regulation function.
17). Aux Generator	This circuit breaker protects the output circuits of the Auxiliary Generator. This generator powers up all the locomotive 74V circuits and charges the starting batteries
18). Brightstar	This circuit breaker provides the power to the Brightstar CPS unit. The CPS powers up the Brightstar computer and the sensor circuits.
19). A.C Control	This circuit breaker protects the field of the D14 companion alternator. This alternator provides 3 phase power to the cooling fan, Inertial filter motor and SCR assembly that excites the main alternator field.
20). Control	This circuit breaker provides power to the locomotive control circuits to allow starting and other functions.

5.12 Switches LBTS, LBSS and DAS

These 3 switches are located behind the right hand, upper electrical cabinet door. Two of these switches are used to configure the locomotive for self-loading. These are switches LBSS & LBTS. Both these switches are a two-position toggle switch. When both switches are placed into the “Self-Load” (SL) position the locomotive can be run up from idle to notch 6 to check the engine is delivering the required horsepower for that notch. The brake grid capacity is insufficient to absorb full notch 8 engine power and is therefore limited to notch 6.
For normal operation both switches must be placed into the “Run” position.

The third switch is the Diagnostic Access Switch (DAS). The DAS switch will give the operator or mechanical staff quick access to level two of the DID panel. Lift and hold the switch for 2 seconds to enter level 2 of the Brightstar system.

5.13 Diagnostic Information Display (DID)

The DID panel is the interface between the operator and the locomotive. It will display any faults that the control system detects. Operators and maintenance staff can interrogate the system through the DID and view many operating parameters while the locomotive is shut down or running.

There are three access levels to the DID:

Level 1 Automatic access, whenever the computer is powered up or when other levels have timed out. Access is for all operators and mechanical staff.

Level 2 Manual access using the DAS switch or password through the DID panel. Access is for all operators and mechanical staff.

Level 3 Manual access only through the DID panel, password protected. Access is for Mechanical staff only.

6.0 PRE-START PROCEDURES

6.1 Oil Levels

The following oil levels must be checked when preparing, putting away and at suitable intervals on the road.

6.1.1 Engine Oil Pan

Level must be between “full” and “add” marks. Check oil level with the engine at idle speed. Never allow the level to fall below the “add” mark. If the oil pan is filled above the “full” mark, there is danger of the crankcase pressure device operating through oil surging. The oil pan dipstick is located about halfway along the engine on both sides.

The oil filling point is through the oil strainer box (ice cream box) at the accessory end of the engine on “A” side.

6.1.2 Compressor Sump

Check with engine at idle speed. The gauge and filler are on “B” side. Never overfill the compressor sump because of the danger of oil carryover into the braking system. As long as the pointer is in the green zone, the level is satisfactory.

6.1.3 Engine Governor

When the engine is stopped, the glass will show overfull. Check with the engine at idle speed.

The level should be between the two lines engraved on the gauge glass. The governor should never be overfilled because the engine will operate erratically. If overfilled, the level may be lowered by opening the drain tap at the rear of the governor body.

If dirty (black) oil is observed in the sight glass the locomotive needs to go to the nearest repair depot for remedial work.

A filling cap is placed on top of the governor. When adding or draining oil, this must be done slowly. This is because the governor will react suddenly to the movement of the oil level. Use engine oil (Mobil RR2413) if a top-up is necessary.

Whenever oil is added to any part of the locomotive the amount must be shown in the Loco 54D book as well as the oil sheet.

7.0 START UP PROCEDURES

7.1 Starting the Engine in Lead Position

1. Check the Loco 54D book for any open bookings.
2. Check locomotive for “Not to be moved” or “do not start engine” boards.
3. Close the battery knife switch (BKS)
4. Check the circuit breakers on the circuit breaker panel “black” zone are all closed at the minimum:

Once the Battery knife switch and Brightstar circuit breaker are closed the Brightstar computer will power up. The full boot up time is around 90s during which time it carries out a software integrity self-test. If it detects an issue it will log the fault and a “Reset” will be displayed on the screen above the F4 key. This should be reset before starting the engine (see Section 24).

Observe DID panel, wait until it displays “Engine Not Running”.

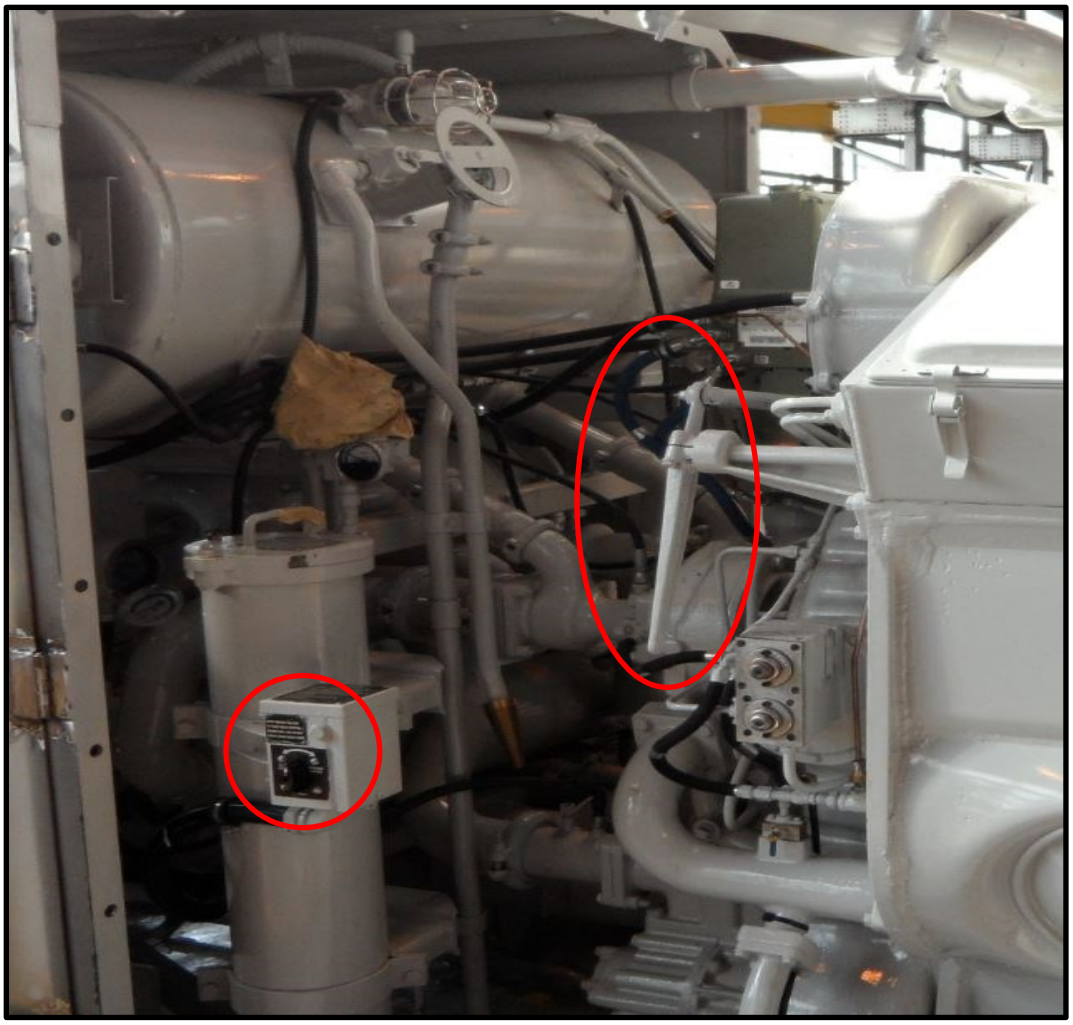
Ensure the EC switch is in the “Start/Stop/Isolate” position.

Check the forward / reverse selector handle is in “neutral” position.

Check the throttle handle is in “Idle” position.

5. Fuel Prime / Start Switch and Engine Layshaft:

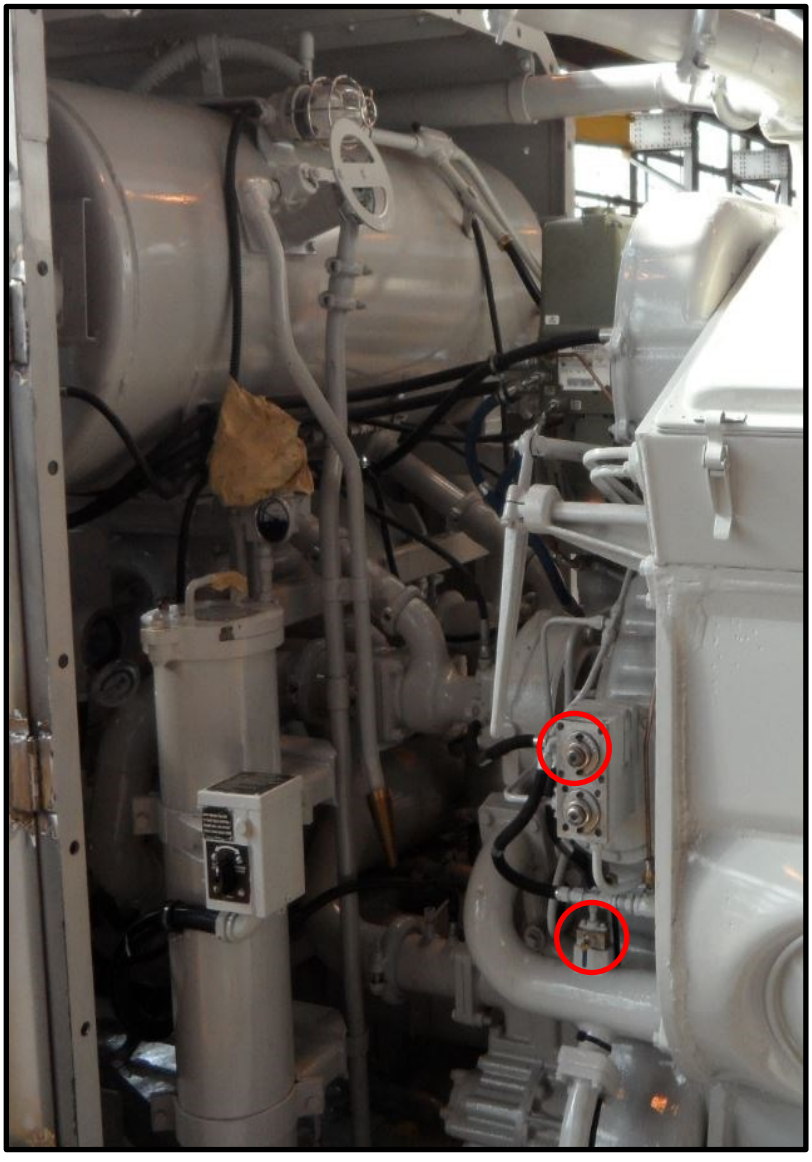
The prime / start rotary switch, located on the equipment rack must be held in the "Fuel Prime" position to operate the fuel pump. Listen for the pump running and when the sight glass closest to the engine has a clear flow of fuel, advance the engine layshaft at least halfway and move the rotary switch to the start position. As the engine cranks, slowly advance the layshaft further until the engine begins to fire. Quickly reduce the layshaft once the engine has begun to start and hold it at slightly above idle for a few seconds before releasing the layshaft completely.



CAUTION: With starter motors rotating the engine, the engine should fire immediately; under no circumstance should the engine be cranked longer than 20 seconds. Should the starter motors fail to rotate the engine, then the switch must be released immediately to prevent damage to starters and/or related electrical components.

6. Low water Reset Pushbutton and Bleed Tap

The low water button will often trip during engine starting. The detector should be observed once the engine is idling. If the water button trips, reset the button by pushing it in. If the button trips again, open the bleed tap, close it and reset the water button.
Repeat this a few times until coolant escapes the bleed tap. The button should now latch in.
If the reset button is not latched in time, the low oil pressure switch on the governor will trip and the engine will shut down. This must be reset at the governor, not the DID panel in the cab. The DID panel reset will happen automatically when the governor LOP is reset.



7. Check the EC panel and ensure that the auxiliary generator is running and that the batteries are now charging.

   When ready to move the locomotive, turn the “Start / Stop / Isolate” switch to the “Run” position.

8. Check the display panel top line.
   I = shows that the battery is charging, it will normally show under 10A after engine has been running for a time
   V = 74V Auxiliary Generator Voltage.
   Tw = Water Temperature
   To = Engine Oil Temperature

   Reset any stored fault messages. This is indicated by “Reset?”.

   Press soft key underneath message (F4), to see what the message is.

   Press button again to Reset. It may be necessary to enter level 2 to reset some faults. See Section 5.10

   The DID should now show that there are no newer or older faults.

   The locomotive is now ready for operation.

7.2 Starting Engines when Coupled in Multiple

1. Remove jumper cable from between coupled locomotives.
2. Start lead locomotive engine as per Section 7.1
3. Leave EC switch in “Start / Stop / Isolate” position.
4. Start each trail unit and leave EC switch in “Start / Stop / Isolate” position.
5. With all engines running, insert all jumper cables.
6. Now place EC switches to “Run”.

7.3 Coupling up for Multiple Unit Working

Prior to coupling and connection of the jumper cable each locomotive must be started separately.

When making and breaking electrical couplers, the couplers must be handled carefully so as to avoid damage to them. Before uncoupling or coupling electrical jumpers both engine control switches must be in the “Start / Stop / Isolate” position.

The procedure for coupling up should be as follows:

1. Bring the locomotives together and make the mechanical coupling, and all the hoses on one side coupled up and the headstock cocks opened.
2. Ensure both engine control switches are in “Start / Stop / Isolate” Position.
3. Set up brake equipment on all locomotives as per the Rail Operating Code, Section 4.
4. In all non-operating cabs place the reverser handle in the holder.
5. Check pins in coupler boxes and ensure the jumper heads are clean.
6. Insert the coupler and ensure it is completely home and held tight by the coupler box lid.
7. If the locomotives are coupled up in service the vigilance control must be tested, both brake valves tested in all positions, sand in both directions, horn and headlight.
8. Before moving, place the EC switch in the “Run” position on the rear locomotive, check all air gauges and release handbrakes.

7.4 Placing Units Online

After the diesel engines are started and inspected, units may be placed online as desired by placing the engine control switch in the “Run” position. The throttle must be in "Idle”, dynamic brake disengaged, and the forward / reverse selector handle centred and removed in all units in the consist before placing any unit online.

7.5 Multiple Unit Jumper Test

After coupling up in multiple and it is required to test the jumper connection, proceed as follows:

1. After all the controls on both locomotives have been set up correctly.
2. On the lead locomotive turn the engine control switch to “Isolate”.
3. Advance the throttle lever and check that the trailing engine responds to the throttle advance.
4. Place the throttle lever to “Idle”.
5. Release all brakes and place the reverser lever in the direction of travel.
6. Advance the throttle lever until the trail unit pushes the lead unit.
7. Place the throttle lever to “Idle” and turn the engine control switch to “Run”.
8. Advance the throttle lever and check by the ammeter that the lead unit operates.
9. This test can also be carried out on the road when it is suspected that the trailing unit is not operating correctly.

8.0 OPERATING

8.1 Setting Locomotive Direction

When the reverser handle in the cab is placed in a direction of travel, the forward / reverse switch will motor over to the direction selected. The power contactors will pick up when a throttle handle request has been made and the locomotive will now produce traction motor current.

8.2 Isolating a Unit in Service

8.2.1 Trail Unit

1. Ensure the throttle handle is in the “Idle” position.
2. Ensure the forward / reverse selector handle is removed.
3. Turn EC to “Start / Stop / Isolate” position and leave it there.
4. Depress the “Engine Stop” button – this will shut the engine down.
5. Turn off all lights and heaters.
6. Open the battery knife switch.
7. Book any faults in the Loco 54D.
8. Remove jumper cable if necessary.

8.2.2 Lead Unit

1. Turn the EC switch to “Start / Stop / Isolate” position and leave it there.
2. Depress the “Engine Stop” button – this will shut the engine down.
3. Do not open the Battery Knife switch or the Control CB.
4. Trailing locomotives can be controlled from the lead locomotive in their various modes.

NOTE: Because the batteries are now supplying the control circuits and headlights, economise on power as much as possible. There is a maximum of 2 hours life in the battery before it becomes flat. It may be less depending upon battery conditions.

5. Book the fault in the Loco 54D book and advise Train Control.
6. Arrange to swap the lead locomotive with a trail locomotive at the earliest opportunity.

NOTE: If the locomotive is a lead unit, leave the engine running where possible to maintain battery charging. Turn EC switch to "Start / Stop / Isolate" position.

8.3 Poor Adhesion Conditions

The Brightstar controlled locomotives give their best demonstrated adhesion on slippery track when wheel creep takes place.
Wheel creep is where the leading wheelset is able to rotate at 5% faster than running speed. Wheel creep allows the locomotive to condition the track it is running onto, thus improving wheel rail adhesion, so that the locomotive can produce more tractive effort to haul the train.
When wheel creep is lost the Brightstar system must do large wheelslip corrections with slow re-application of power, resulting in large drops in speed, which often leads to a train stalling.

During testing, a method of driving was devised that allows wheel creep to be maintained, so that the locomotive continuously conditions the track it is running onto and is therefore able to maximise tractive effort and prevent stalling.

8.3.1 Basis for Poor Adhesion Operating Method

The basis for the method was the following observations:

1. Light application of independent brake provides mechanical dampening when wheel creep is lost. This reduces the magnitude of any wheelslip corrections so that higher tractive effort is maintained.
2. The Brightstar system does 4 stages of wheelslip correction. Wheel creep can be easily maintained when only stage 1 and stage 2 corrections are taking place.
3. Whenever wheel creep is lost, the initial observed electrical reaction, is that the driving amps increase to the throttle notch current limit. The Brightstar appears to react to the rise in current about 2 seconds after creep is lost.

4. Each throttle notch on a Brightstar locomotive has its own current and voltage limit.
5. If the locomotive throttle is in a high notch where the current limit is well above the current required to balance train rolling resistance, then a large wheelslip correction, with slow re-application of power is needed whenever adhesion is lost. This results in rapid speed loss and possible stalling.
6. If the locomotive throttle is set to a notch where the current limit is just above the current needed to balance train rolling resistance, then a very small wheelslip correction is needed whenever adhesion is lost. This results in a very small loss in tractive effort and rapid re-establishment of wheel creep.

8.3.2 Method

On the Move:

If a Brightstar locomotive encounters poor adhesion conditions on grades, sanding will automatically initiate, and slip corrections will be seen taking place on the driving ammeter. If the slip corrections get beyond 100-amp reductions, do the following:

1. Make a 70 to 80 kPa independent brake application, then check whether the driving amps settle down. If the amps settle, no further action is required, but continue monitoring the driving ammeter for further fluctuations.
2. If the driving amps don't settle, throttle back 1 notch, then check whether the amps settle down. If the amps settle no further action is required but continue monitoring the driving ammeter for further fluctuations.
3. If the driving amps don't settle with the throttle notched back 1 notch, then slightly increase independent brake cylinder pressure to 100 kPa and check the ammeter again. If the amps settle, no further action is required, but continue monitoring the driving ammeter for further fluctuations.
4. If the driving amps don't settle, throttle back 1 more notch and reduce independent brake cylinder pressure back to between 70 and 80 kPa. If the amps settle, no further action is required, but continue monitoring the driving ammeter for further fluctuations.
5. Once speed increases and the amps have stopped falling, advance 1 notch while still leaving the independent brake application in place. Continue notching this way until speed is 25 km/h when independent brake can be eased off.

From a Standing Start:

1. With the independent brake fully applied, release the automatic brake.
2. Begin notching up the throttle and incrementally reduce the independent brake setting as the throttle is advanced each notch. Aim to have the independent brake fully released when the throttle is in the notch that will hold the train without movement.
3. Move the throttle into the notch where movement will just begin and hold in this notch. As movement starts, bring the independent brake up to 75 kPa BC pressure.
4. Monitor the driving amps and make slight adjustments to the independent brake as required to keep the driving amps settled.
5. Once speed increases above 10 km/h and the amps have stopped falling, advance 1 notch while still leaving the independent brake application in place. Continue notching this way until speed is 25 km/h when independent brake can be eased off.

9.0 SHUT DOWN PROCEDURE

9.1 Shutting Down Loco in Lead Position

1. Ensure the air brake is applied.
2. Ensure the hand brake is applied.
3. Ensure throttle handle is in the “Idle” position.
4. Ensure the Forward / Reverser handle is centralised, and key removed.
5. Place the “EC” switch to the “Start/Stop/Isolate” position.
6. Depress the “Engine Stop” switch (ESP)
7. Once the engine has stopped rotating “Engine Not Running” will be displayed on the DID panel.
8. Open the battery knife switch (BKS)

9.2 Shutting Down Locos in Trailing Positions

1. Place the “EC” switch to the “Start/Stop/Isolate” position.
2. Depress the “Engine Stop” switch (ESP)
3. Once the engine has stopped rotating “Engine Not Running” will be displayed on the DID panel.
4. Open the battery knife switch (BKS)

10.0 DIESEL ENGINE

10.1 Engine Specifications

Description	Model 12-645E3C
Number of Cylinders	12
Stroke Cycle	2
Cylinder Arrangement	45 Degree “V”
Bore	230mm
Stroke	254mm
Turbocharger	Single
Weight Dry “Engine Only”	12,840kg

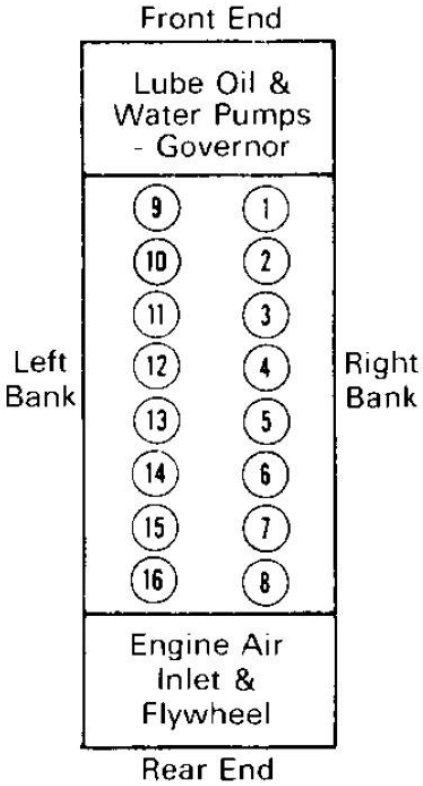
Cylinder location and the designation of the ends and banks of the engine are shown in this figure.

The governor, water pumps, and the lube oil pumps are mounted on the “front” end of the engine.

The turbocharger and flywheel are located at the coupling end or the “rear” of the engine.

Left and right will be in respect to looking toward the “front” of the engine when standing at the “rear.”

Cylinders are numbered from the front right moving backward and then from the front left moving backward.



10.2 Engine Speeds

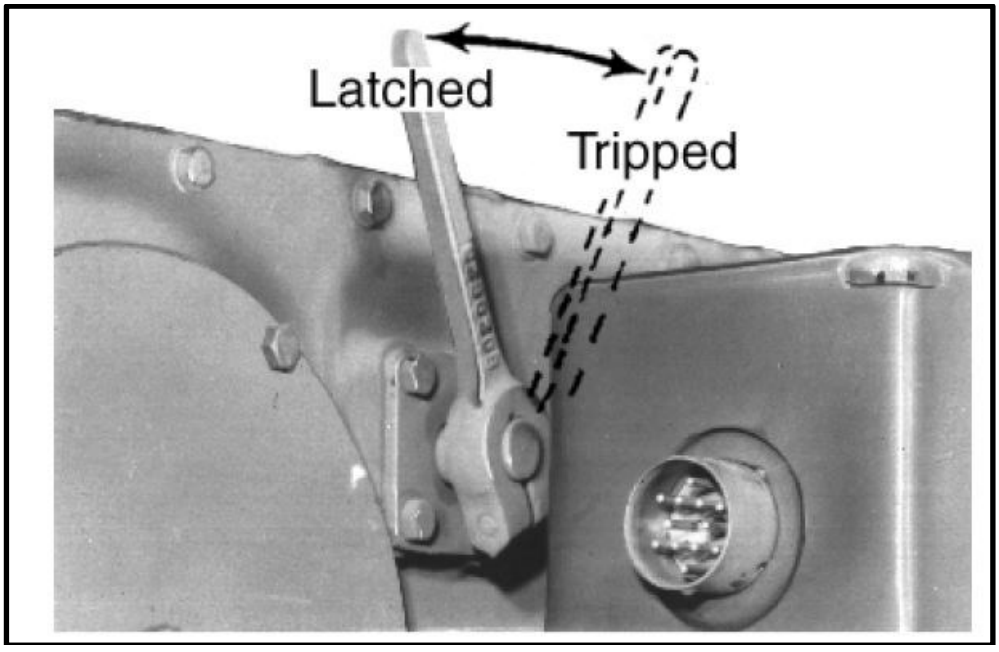
The Brightstar controls the diesel engine speed signals. The throttle signal from the locomotive controller is sent to Brightstar which then controls the engine governor speed setting solenoids thereby establishing the required engine speed.

10.2.1 Engine Over Speed Trip / Reset

An over speed trip mechanism is fitted to DFB engines.
This is used to mechanically prevent the injection of fuel into the cylinders should the engine speed become excessive.

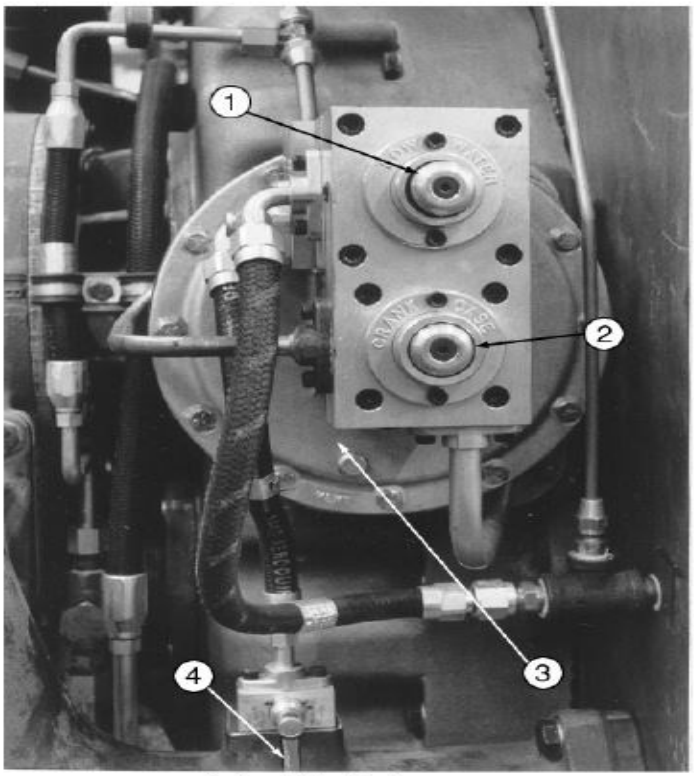
The figure below shows the mechanical over speed trip mechanism. If the engine speed should increase to over the specified limits, the over speed mechanism will shut down the engine.

The over speed trip lever is located next to the engine governor on the “A” side of the locomotive. If the over speed trip operates, the lever must be reset before the engine can be restarted.



10.3 Crankcase Over Pressure (COP) & Low Water Pressure (LWP) switch

The DFB engine is fitted with a combination low water and crankcase pressure detector pictured on the right.
The switch is a mechanically operated, pressure-sensitive device used to determine abnormal conditions of the cooling system and crankcase pressures on governor-controlled engines. If potentially harmful conditions exist, this protective device will act to cause an engine shutdown.



1. Low Water Portion
2. Crankcase Pressure Portion
3. Vent And Test Fitting
4. Test Cock

F29234

The Detector shuts the engine down using the low oil pressure button on the engine governor. The governor button must first be reset before resetting the buttons on the engine protector.

If the crankcase over pressure switch trips in operation, attempt to reset the button and continue operation. The low oil pressure button on the governor must be reset before re-latching the COP button.
If the COP switch trips again. Do not restart the locomotive. Call for relief and prepare the locomotive for towing.

WARNING: Following an engine shutdown caused by actuation of the crankcase pressure portion of the detector, do **NOT** open any handhole or top deck covers to make an inspection until the engine has been stopped and allowed to cool off for at least two hours. Do **NOT** attempt to further restart the engine until the cause of the actuation has been determined and corrected. The action of the pressure detector indicates the possibility of a condition within the engine, such as an overheated bearing, that may ignite the hot oil vapours with an explosive force if air is allowed to enter. Evidence of a crankcase explosion may be seen from dislodged inspection covers or excessive oil on the engine skirts around the covers.

Do not attempt to restart the engine if any evidence of a crankcase explosion has occurred.

If the low water pressure switch trips in operation
Make two checks - Water level and water temperature.

- **Check the water level on the header tank sight glass.** If the water level is not visible, check for obvious water leaks at pipe connections at the engine and equipment rack. Water will need to be added to the cooling system and both governor low oil and detector low water buttons reset for the engine to be restarted. Serious and obvious coolant loss will require the locomotive to be prepared for towing. If water is added to the engine and the engine restarted, check the engine oil level once running. If the oil level is high or the oil is obviously discoloured or contaminated, the water loss is internal to the diesel engine. Shut the engine down and prepare the locomotive for towing.

- **If the water level is visible on the sight glass, check the temperature gauge indication.** An overheating engine can trip the low water button. If the engine is found to be overheating, reset the governor oil button and low water button and restart the engine. Ensure both radiator shutters are open, and the cooling fan is operating. If the shutters are not open on an overheating locomotive, these can be locked open at the shutter magnet valve in the rear pneumatic compartment. If the cooling fan is not operating when the locomotive is restarted, shut the engine down and prepare the locomotive for towing.

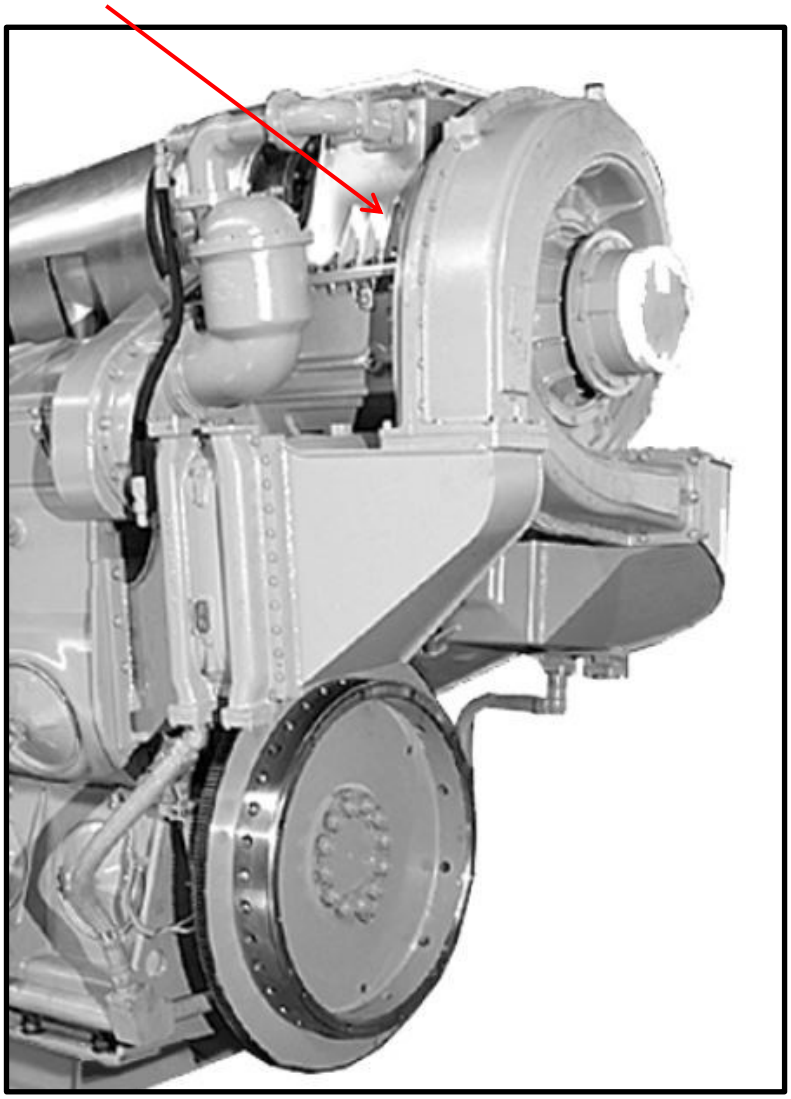
10.4 Turbocharger

The DFB locomotives are powered by a turbocharged EMD 12-645E3C diesel engine. Being a 2-Stroke design, the engine requires pressurised air for combustion and to purge the cylinders of exhaust gasses. On this engine, a special turbocharger is used for this purpose. During engine operation the turbocharger utilises exhaust energy as well as energy from the camshaft gear train to drive the turbine. In higher throttle notches (N6 and above) exhaust energy alone is sufficient to drive the turbine and the rotor assembly disengages from the camshaft gear train by the use of a Sprague type clutch located inside the turbocharger.

This turbocharging arrangement is a reliable and proven design. Failure of the turbocharger to operate correctly will result in the engine shutting down.

The most predominant mode of failure is the intermittent failure of the overrunning (Sprague) clutch inside the turbocharger. In this type of failure, the drive to the turbine from the camshaft gear train is lost. This normally occurs during a power reduction from above N6 whereupon the turbocharger is required to obtain gear driven energy to offset the loss of exhaust energy. If the clutch fails to pick up onto the gear train, turbine speed continues to reduce, and insufficient air is supplied to the diesel engine to maintain combustion. As the engine speed reduces, this is sensed by the engine control governor. The governor reacts to the speed loss by increasing the fuel delivered to the engine. As this fuel cannot be burnt, engine speed continues to reduce, and the engine governor may drop out the low oil pressure button. If the governor buttons remain latched, the engine will over-fuel to a stop. Clouds of white smoke from the unburnt fuel are seen at the exhaust stack. Normally the engine is able to be restarted and continue running. Book any failure of this type in the Loco 54D book as the turbocharger will require replacement.

Turbocharger



10.5 Cooling System

This DFB cooling system is a pressurised design. This raises the boiling point of the cooling water thus the engine can run at a higher temperature. The pressure limit is controlled by the header tank pressure cap. It will vent the cooling system once the pressure exceeds 145kPa (21 psi). To remove the pressure cap requires opening of a safety valve which automatically vents the system. Do not attempt to remove the pressure cap until the system has vented all pressure.

Two radiators in the rear of the long hood cool down the engine coolant. A single cooling fan draws air in through a pair of shutters on each side of the long hood and blows the air up through the radiators and out the top of the locomotive.

Brightstar controls the operation of the radiator shutters and the cooling fan. The system has a water temperature sensor fitted into the engine water outlet pipe and will open the shutters and adjust the fan speed as necessary. It is possible to lock the shutters open using the manual lever on the radiator shutter magnet valve. The magnet valve is located in the pneumatic compartment in the rear of the locomotive.

10.5.1 Horsepower Deration

Horsepower deration starts to occur if the water or oil temperature reaches 98°C. Brightstar will further de-rate the horsepower if the temperature continues to rise. By 114°C, there will be no traction horsepower available. Brightstar will still allow full engine rpm in an attempt to cool the water and / or oil.

10.5.2 Inhibitor

The cooling system contains an inhibitor which under normal conditions is coloured pink. The inhibitor used is a product called Nalcool 2000 and is used throughout the KiwiRail diesel loco fleet.

The inhibitor has three functions:

1. To give a visual readout of external leakage by the coloured incrustation being visible at the leakage area.
2. To inhibit corrosion within the cooling system.
3. To protect against sludge and mineral scale formation

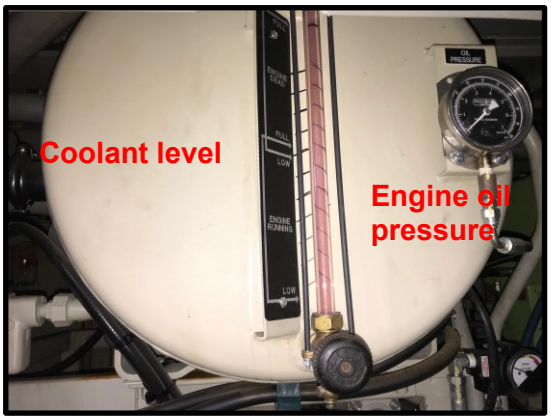
NOTE: Should the cooling water become discoloured in the sight glass (oily), the engine **must be shut down. Book the fault in the Loco 54D book.**

10.5.3 Engine Water Temperature Sensor

Located on the “B” side of the locomotive at the equipment rack water manifold. This sensor measures engine coolant temperature. The signal is sent back to the Brightstar control panel from which it will then control the shutters and radiator fan.

10.5.4 Equipment rack gauges and indicators

The “B” side of the engine equipment rack has several gauges fitted to observe coolant level, coolant temperature, engine oil pressure and fuel filter condition.



10.5.5 Water Pump

The cooling system is fitted with two gear-driven pumps at the accessory end of the engine below the engine governor.

Should water pressure in the engine fall below a pre-set value, the low water pressure button on the engine protector will “pop” out and this will trip the low oil pressure button on the engine governor and the engine will shut down. The alarm bell will ring in all units of the consist while the low oil pressure fault will be displayed on the DID panel of the affected locomotive.

10.6 Lubricating System

The lubricating oil system is a combination of three separate systems. The total capacity of the lube oil system is 620 litres.

- **The engine lubricating system** supplies oil for lubrication of the various moving parts of the engine.
- **The piston cooling system** supplies oil for the cooling of the pistons and lubricating of the piston pin bearing surfaces.
- **The scavenging oil system** sucks hot oil from the diesel engine and delivers it to the lube oil cooler and lube oil filters located on the equipment rack. Cool, filtered oil is then returned to the diesel engine for use by the lubrication system and the piston cooling system.

The engine is fitted with two oil pumps. The piston cooling and lubricating pump is a combination pump, that is, two pumps are contained in one housing with separate oil inlet and discharge openings. The scavenging oil pump is a similar design. Both pumps are gear-driven by the diesel engine.

Upon starting and idling the engine, it should be noted that the oil pressure builds up almost immediately. In the event of cold oil, the pressure may rise to the relief valve setting of approximately 862 kPa (125 psi).
Lubricating oil pressure is not adjustable. The operating pressure range is determined by such things as manufacturing tolerances, oil temperature, oil dilution, wear, and engine speed. The pipe plug can be removed from the opening in the pump discharge elbow and a gauge installed to determine the pressure.

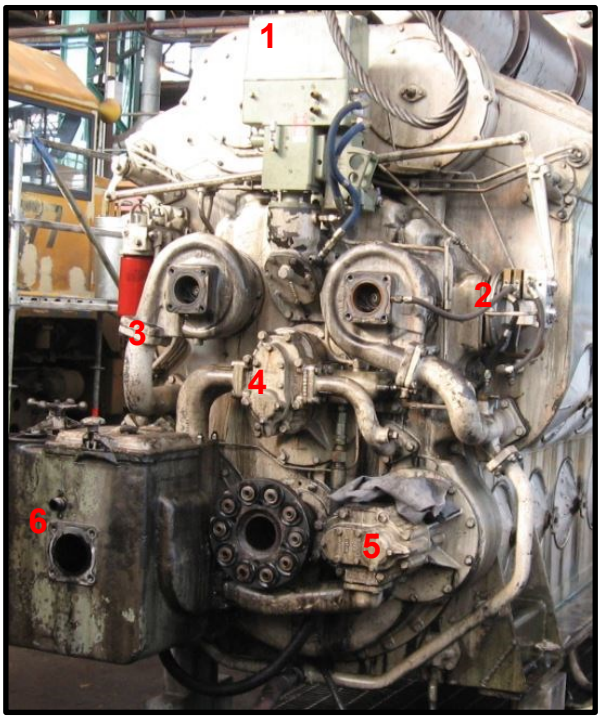
The minimum oil pressure is approximately 55-83 kPa (8-12 psi) at idle and 172-200 kPa (25-29 psi) at full speed. In the event of insufficient oil pressure, a shutdown feature built into the governor will automatically protect the engine by shutting it down. Maximum pressure is determined by the relief valve.

A pressure gauge placed on the side of the coolant header tank indicates engine lubricating oil pressure.

To check the engine oil level there is a dipstick located halfway down the engine on each side. The engine oil level must never go above the “full” mark or below the “add” mark. Oil is normally added into the oil strainer housing when required.

The engine equipment rack contains the oil filter housing and the oil cooler. Oil is cooled and filtered before being returned to the engine.
The engine oil temperature is monitored by Brightstar using a temperature sensor mounted in the scavenging oil pump discharge pipe.

1. Governor
2. Engine protector
3. Water pumps
4. Lube / Piston cooling pump
5. Scavenging pump
6. Oil strainer housing

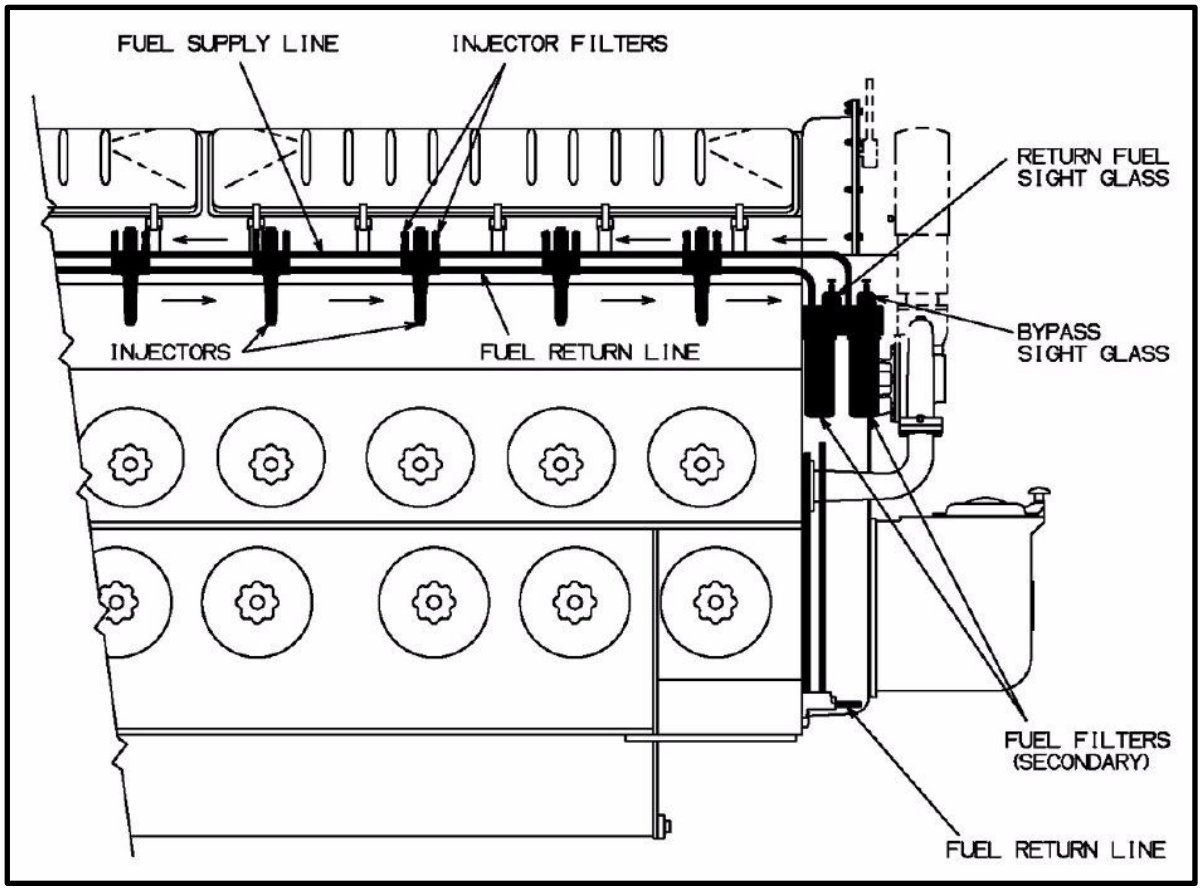


10.7 Fuel System

The basic engine fuel system consists of the fuel injectors, the engine mounted fuel filter, fuel supply and return manifolds, and engine mounted fuel lines.
Components external to the engine such as the motor driven fuel pump, fuel tank, fuel suction strainer, the primary fuel filter and connecting fuel lines complete the system.

In operation, fuel from the fuel tank is drawn up by the fuel pump through a suction strainer and primary fuel filter for delivery to the engine mounted (secondary) filters. It then passes through the filter elements to the engine fuel supply lines and injector inlet filter at each cylinder - into the injector. A small portion of the fuel supplied to each injector is pumped into the cylinder at a very high pressure, through the needle valve and spray tip of the injector. The quantity of fuel injected by the injector depends upon the rotative position of its plunger as set by the injector rack and governor. The excess fuel not used by the injector flows through the injector, serving to lubricate and cool the working parts. The fuel leaves the injector through the return fuel filter. This filter protects the injector in the event of a backward flow of fuel into the injector from the return fuel line.
From the return fuel filter in the injector, the excess fuel passes through the fuel return line in the manifold to the relief valve inlet of the engine mounted fuel filter. This valve restricts the return fuel, maintaining a back pressure on the injectors. The fuel continues down through the return line to the fuel supply tank.

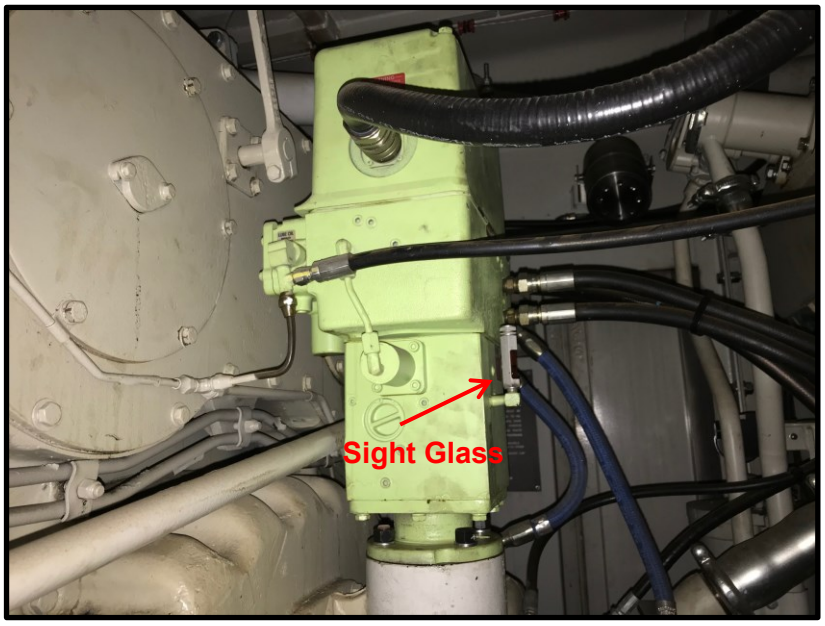
If any fuel is noticed in the bypass sight glass, the engine mounted fuel filters require replacement. With the fuel pump running, the return fuel sight glass should be full and free of bubbles. If any abnormalities are seen, these should be booked up in the Loco 54D book.


FUEL SUPPLY LINE
INJECTOR FILTERS
RETURN FUEL SIGHT GLASS
BYPASS SIGHT GLASS
INJECTORS
FUEL RETURN LINE
FUEL FILTERS (SECONDARY)
FUEL RETURN LINE

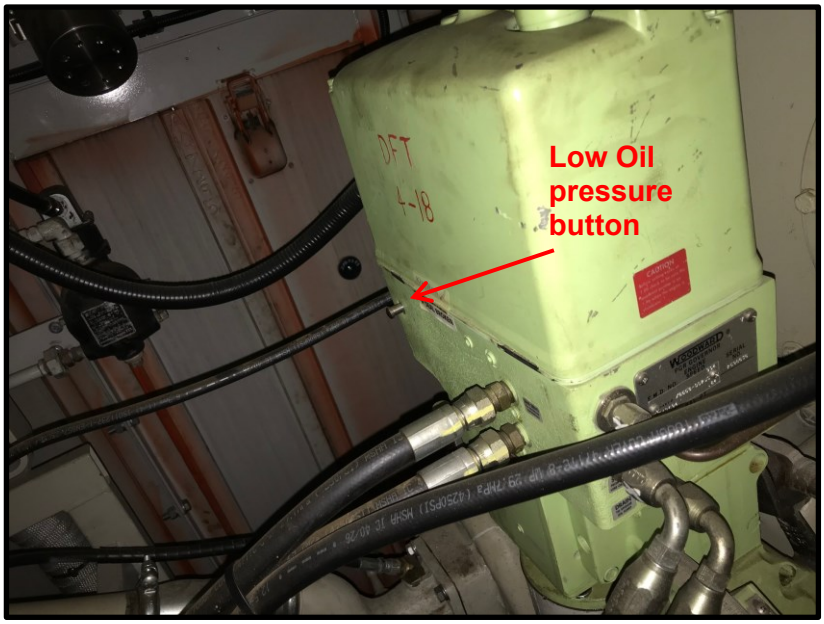
10.8 Engine Governor

This is a Woodward type PGEV governor and is fitted to all DFB class locomotives.

- The governor is mounted to the governor drive gearbox.
- Oil level must be checked **with the engine hot and running at idle speed.**
- Fitted with a low oil pressure shut down device.



The low oil pressure button is indicated below. If the button has tripped, a red band will be visible. To reset – push the button in toward the body of the engine governor.

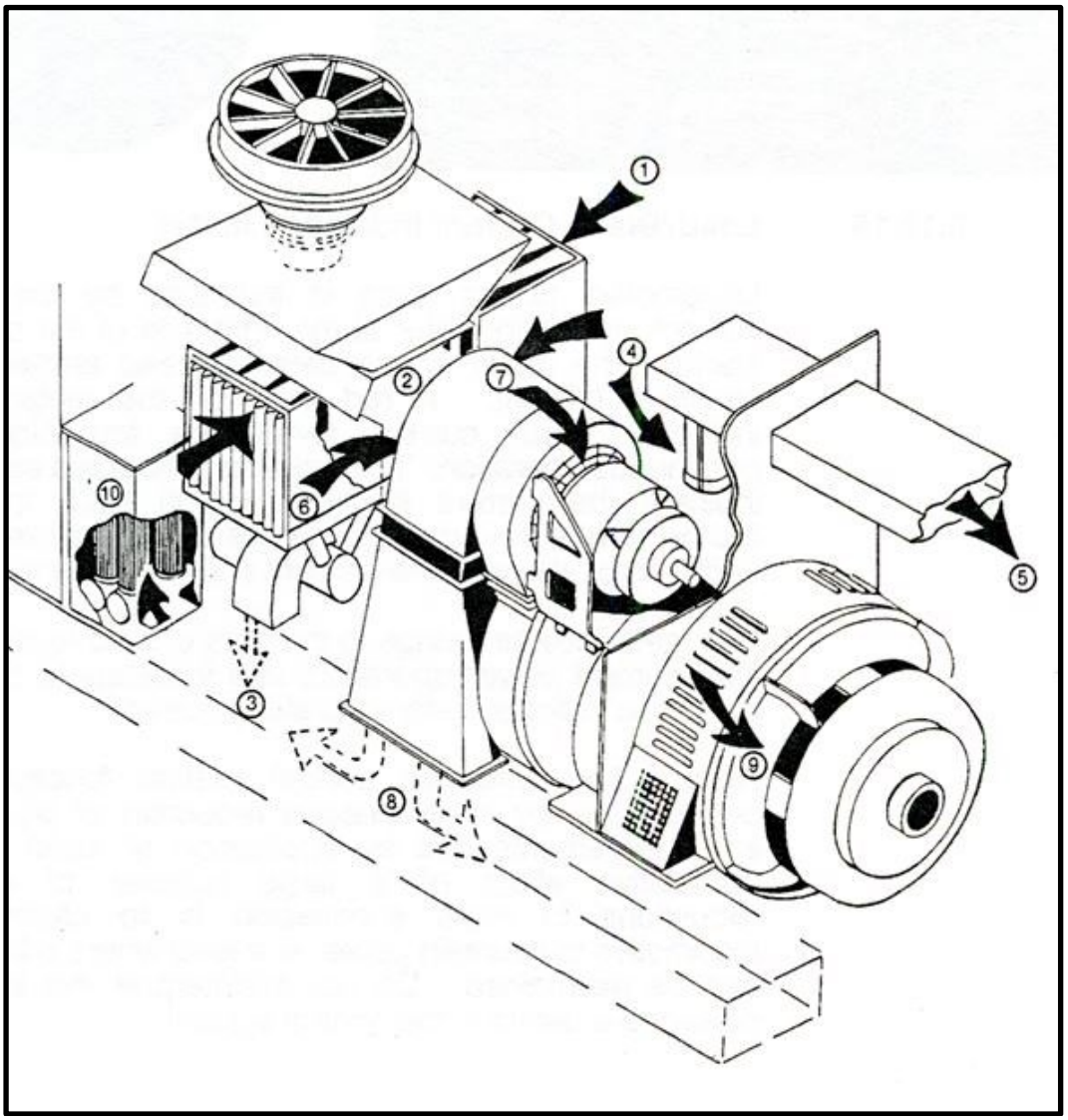


10.8.1 Governor Functions: DFB

- To detect the engine oil pressure and stop the engine should the pressure fall to a dangerous level.
- To receive shut down signals from the COP/LWP detector switch and shut down the engine using the LOP button should LWP/COP pressures fall outside the switch operating ranges.
- To increase or decrease engine speeds in response to throttle commands.
- To stop the engine whenever signalled to do so by the stop switch or controller throttle moved to the ‘stop’ position.
- To stop the engine whenever signalled to do so by the Brightstar control system.
- To ensure the engine operates at its fully rated power for the throttle notch in use.
- To maintain a constant engine speed for each given throttle notch and adjust the fuel to the engine to match the applied load.
- To protect the engine against overloading using a hydraulically actuated vane rheostat to inhibit main alternator output.

11.0 AIR INTAKE SYSTEMS

1. Outside Air Intake to Inertial Filters
2. Clean Air in Sealed Compartment
3. Dust Bin Blower exhausting dirty air
4. Intake for Engine Air Filter
5. Clean Air to Engine
6. Intake to Traction Motor Blower
7. Intake to Generator Blower
8. Cooling Air to Traction Motors
9. Generator Cooling Air to Pressurize Engine Room
10. Electrical Cabinet Air Filter



Air is taken into the hood of the locomotive to supply three separate systems:

1. Radiator cooling.
2. Dynamic brake grid cooling.
3. Central air system for traction motor and generator cooling, engine fuel combustion and compartment pressurization.

The central system air contains the “Clean Air Room”. Air coming into this area must first pass through a filter screen and then the inertial filter units. In the inertial filters, dirt is separated and then exhausted from the locomotive using the dustbin blower. Clean air is then blown through the traction motors and main generator for cooling. Also located in the clean air room is the engine air filter box. Additional oil impregnated bag filters clean the air further before it is used by the diesel engine.

Approximately two thirds of the filtered air goes to the generator and traction motors and is ducted to the traction motors by means of the running board on the "A" side and then through flexible bellows to each traction motor. Some air is bled off the traction motor ducting and is further filtered then supplied to the electrical cabinet for pressurization and device cooling.

There is a filter vacuum sensor connected to the engine air intake filter housing. Should the engine air filters become blocked the filter vacuum sensor will activate and bring up a fault message on the DID panel.

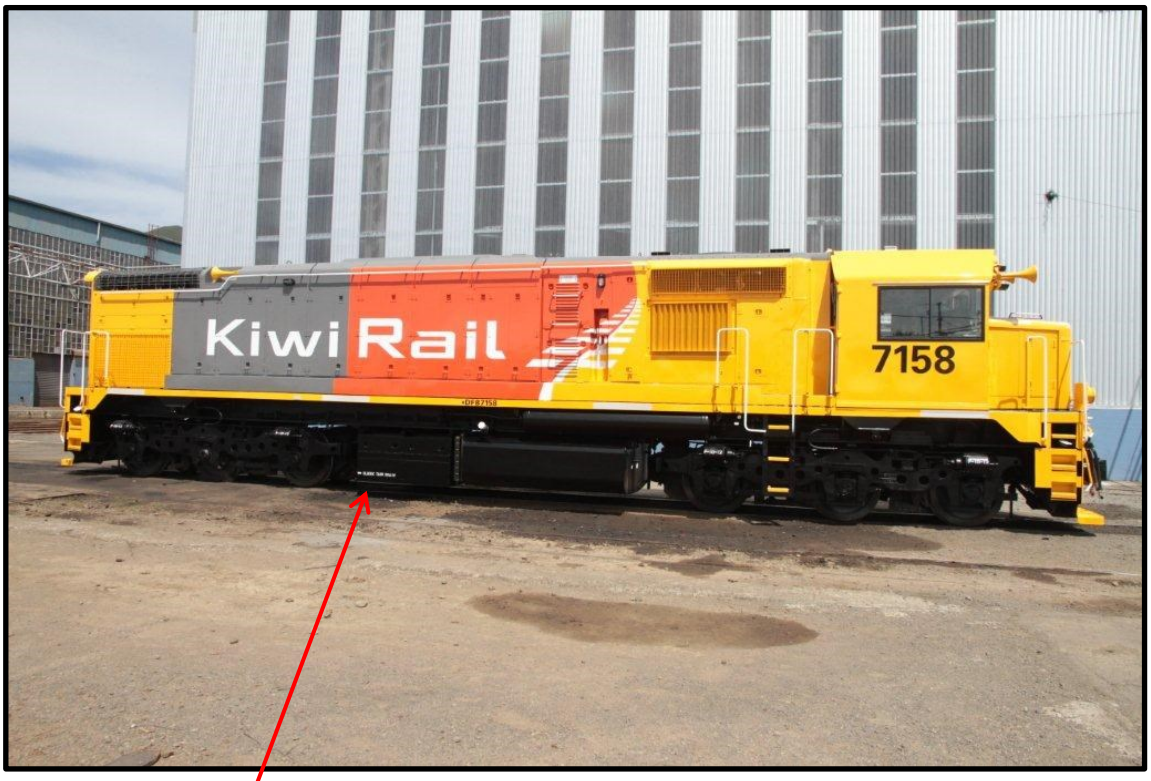
12.0 ELECTRICAL

12.1 Low Voltage

On all DFB locomotives a set of 8 batteries are stored behind the fuel tank in two battery boxes (4 per box). The main purpose of the batteries is for cranking the engine when starting up the locomotive.

When the engine is running and provided there is battery charging, the auxiliary generator output is regulated by Brightstar and provides power at 74 volts for battery charging, control circuits, lighting etc.

An analogue battery voltmeter is provided on the EC panel. This gives a visual readout of the battery voltage once the battery knife switch is closed. Once the engine is running the voltage is also displayed on the DID panel. Should battery charging fail for any reason, “No Battery Charge” will be displayed on the DID panel and the alarm bell will ring.



Battery box (one each side of locomotive)

12.2 High Voltage

Alternator output will vary depending on the request for load from the operator via the throttle handle. The alternator produces AC power and is converted to DC for traction purposes in three internal banks of silicon diodes (rectifiers). This power is used to power the traction motors for locomotive propulsion or braking.

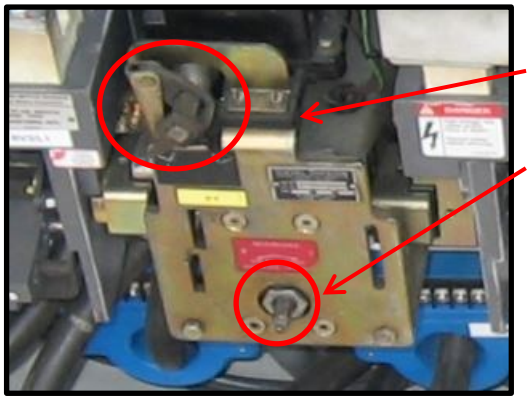
In the left side of the electrical cabinet are two high voltage switches. These are driven with electric motors. The top switch assembly is the power / dynamic brake switch and the lower is the forward / reverse switch. They motor to positions dictated by the appropriate controls operated by the Locomotive Engineer.

Power / Dynamic brake transfer switch

Motors

Forward / Reverse transfer switch

Each motor has an indicator arm that when correctly thrown, aligns to a faceplate diagram showing the switch is positioned correctly. There is facility to manually wind the switch using a crescent or similar.



Indicator arm and switch set marking.

Manual winding shaft

13.0 BRAKES

13.1 Brake System

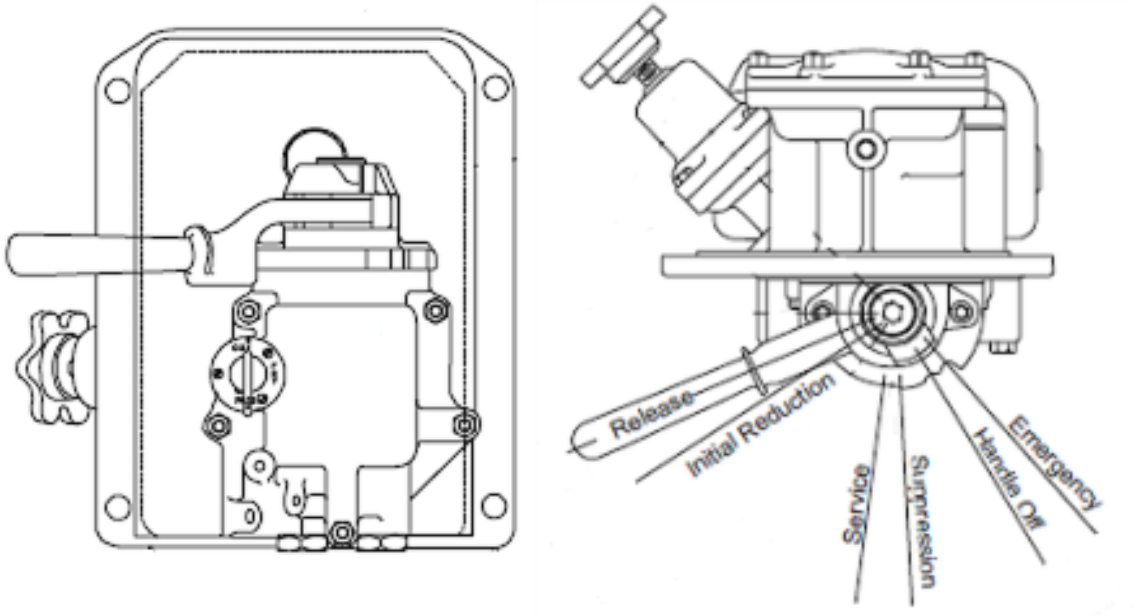
The brake system is a 26L air brake system. Air for the brake system is sourced from the locomotive air compressor. There are two main air reservoirs, No.1 reservoir is located under the “A” side running board and the No.2 reservoir is located under the “B” side running board.

The locomotive is equipped with an air brake rack that is located in the short hood. The locomotive is designed so that the air brake and dynamic brake are interlocked.

13.2 26C – Automatic Brake Valve

This brake valve handle operates through six positions:

1. Release
2. Minimum Service
3. Full Service
4. Suppression
5. Handle Off
6. Emergency



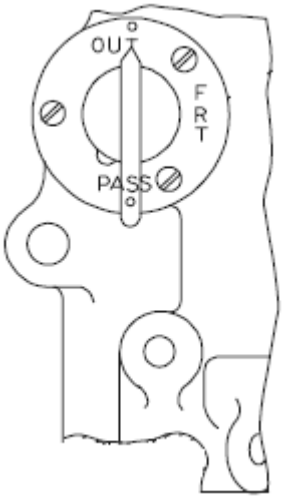
The service zone is between “Minimum Service” and “Handle Off” positions.

13.2.1 Cut Out Portion

The manually operated cut-off valve handle is used for:

- Freight services have two positions, “IN” and “OUT”.
- Passenger services have three positions, “OUT”, “FRT” and “PASS”.

The “OUT” position is used to cut-out the brake valve to set the brake equipment for “TRAIL” or “DEAD” operation. The handle position also allows for the measurement of brake pipe leakage from the lead cab.



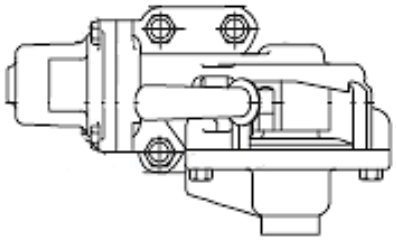
The function of the brake valve with the cut-off valve handle in “FREIGHT” or “IN” position is identical. This position is used to set the 26C brake valve to operate in the “Direct Release” mode when the locomotive is being used to haul a freight train.

The “PASS” position is used to set the 26C brake valve to operate in the "Graduated Release” mode.

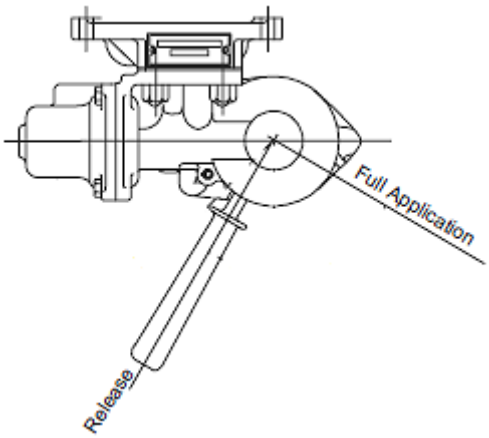
13.3 SA26 – Independent Brake Valve

This brake valve handle has two positions:

1. Release
2. Full Application



Front View

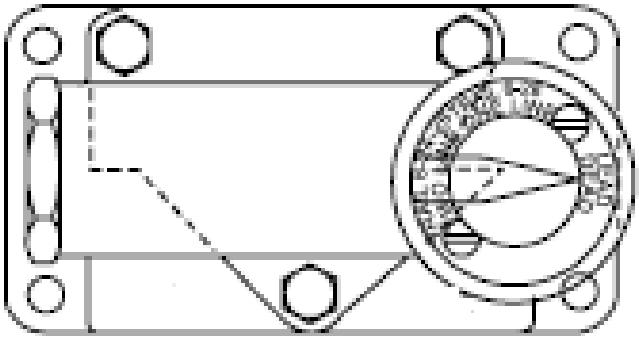


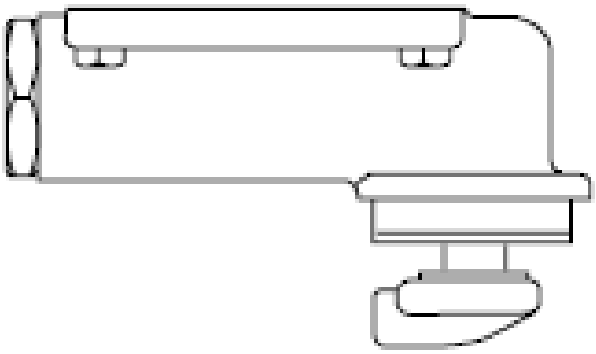
The “Release” position is closest to the operator and an application zone is located between both positions. The closer the handle is moved towards the “Full Application” the greater the independent brake pressure increases until the full application pressure is obtained.

Depressing the handle in a downward motion will initiate the release of any automatic brake application existing on the locomotive and a spring action will return the handle to its original position when released.

13.4 MU2A Valve

Located on the lower back end of the driver's control stand.





MU2A valve has 3 positions:

- Lead or Dead
- Trail 6 – 26
- Trail 24

The various positions are indicated on the escutcheon plate.

13.5 Park Brake

Carriages are fitted with park brakes that are applied / released from the locomotive cab.

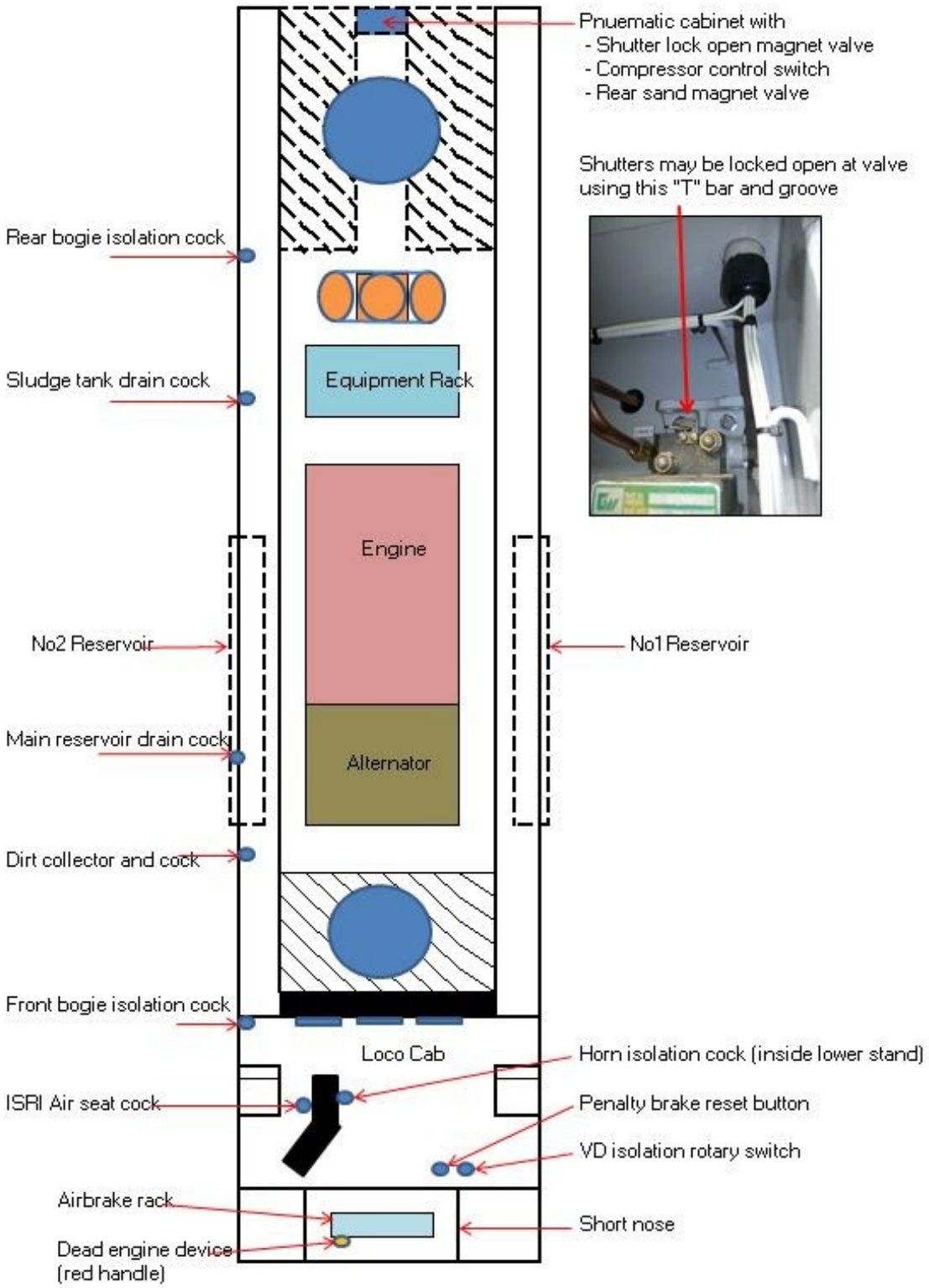
13.5.1 Apply Park Brake

Step	Action
1.	When asked to apply park brakes, press the PB apply button
When at least one of the park brakes are applied, the apply button will illuminate red	

13.5.2 Release Park Brake

Step	Action
1.	When asked to release park brakes, press the green PB release button
When the park brakes are release, the red apply button will extinguish	

14.0 LOCATION OF CUT OUT / DRAIN COCKS



15.0 EMERGENCY EQUIPMENT

15.1 Location of Emergency Equipment

15.1.1 Emergency Tool Kit

The tool kit is located in the air compressor compartment on “B” side of the locomotive. The tool kit contains:

Description	Quantity
Hose 1-1/4”	2
Hose 3/4”	2
Plug, Hardwood type A	2
Plug, Hardwood type B	2
Plug, Hardwood type C	2
Plug, Hardwood type D	2
Pin, Drawbar, Drop tail with chain	1
Lineman Pliers	1
Screwdriver – Flat blade	1
Screwdriver – Phillips	1
Adjustable spanner (200mm)	1
Pipe wrench (350mm)	1
Alloy pipe (500mm x 38ID)	1
Assorted cable ties	4
Electrical tape	1
Ball pein hammer	1
Paint, dazzle pink	1

15.1.2 Detonators

A minimum of two tubes of detonators are located on the “B” side of the locomotive. They are stored in a detonator tube which is padlocked, a “100” key will open the lock. The detonator tube is attached to the inside of the clean air room access door on the “B” side of the locomotive.

CLEAN AIR ROOM ACCESS DOOR ON THE LOCOMOTIVE “B” SIDE.

15.1.3 Chocks

A bag of six hardwood chocks is stored in the air compressor compartment.

15.1.4 Locomotive Cab Storage Bins

There is one storage bin in each main line locomotive cab. Details of contents are included in the Rail Operating Code Section 4.1.

Main safety equipment in the sealed bin:

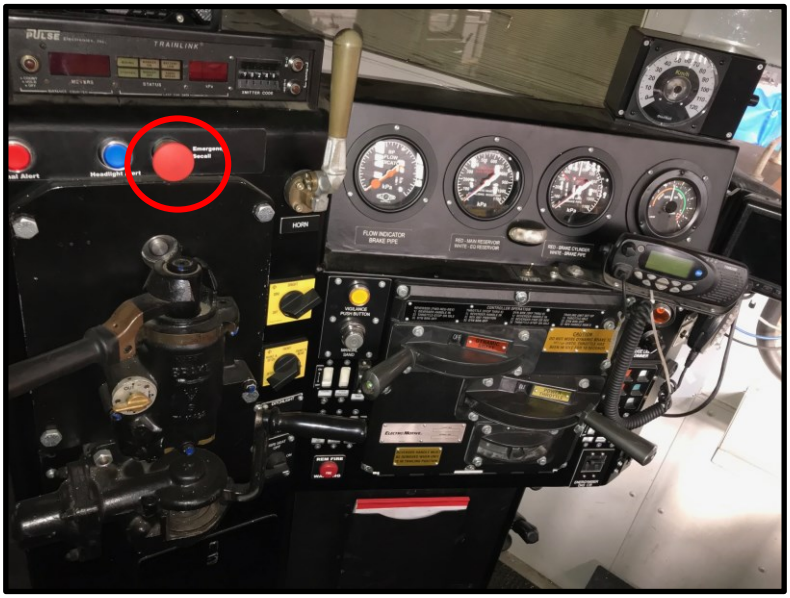
- First Aid Kit
- Gas Masks
- Gas Filters

15.1.5 Fire Extinguisher

Located in the cab of the locomotive, attached to the control stand rear panel.

15.1.6 Emergency Selcall Button

Located above the 26c brake valve and below the HEM unit. (Red mushroom button).



15.2 Passenger Emergency Brake (PEB)

In older carriages the PEB vented the brake pipe in the carriage.
These carriages are fitted with a new type of PEB that when activated by a passenger, sends an electrical signal to the locomotive.

If the Locomotive Engineer does not acknowledge the alarm within 10 seconds, it vents the brake pipe from the locomotive.

Step	Action	
1.	PEB activated in carriage	
2.	PEB button illuminates red and warning buzzer sounds	
3.	**If**	**Then**
	The location is a safe place to stop a passenger train	1. Stop the train. 2. Contact the Train Manager to gain more information
	The location is an unsafe place to stop a passenger train	1. Press the red override button by the speedometer within 10 seconds of the alarm sounding. 2. The PEB override light illuminates red. 3. Contact the Train Manager to gain more information. 4. Continue to a place where it is safe to stop the train. 5. Once the train has stopped, twist the PED override button to reset the alarm

NOTE: The PEB button will stay illuminated red until the train crew locate and reset the carriage PEB switch

15.3 Traction Override Button

The locomotive cannot get traction power when the passenger doors are open.

If the electronics should fail, this button will allow the locomotive to gain traction power.

If	Then
Door Closed blue light illuminated	1. Press the Traction Override button. 2. Record the fault in the 54D book
Door Closed blue light **not** illuminated	1. Contact the Train Manager and get them to open and close all the doors. 2. If the Door Closed blue light does not illuminate, physically check that the electrical jumper between the locomotive and carriage is secure at both ends. 3. Get the Train Manager to visually check that all doors are closed. If the above checks find all equipment is normal: 4. Press the Traction Override button. 5. Record the fault in the 54D book

The Traction Override button can be cancelled by twisting anti-clockwise.

15.4 Locomotive Front Window Emergency Egress

In locomotives where forward opening loco cab doors are not available, provision is being made for emergency egress through the front wall and side windows. The width of the window is wider than the doorway.

Description:
DFT locomotive cab side wall sliding windows are either:

- Gilbert - two pane sliding window or,
- OEM - fixed pane and single sliding window

Front wall side windows are being progressively fitted with pull-tabs on the rubber key-strips to allow removal of the key-strip; the window glass can then be pushed or knocked out.

The Train Operator's side (*Fig. 1*) provides more space for a person to exit through window.
The Locomotive Engineer's front wall side window (*Fig. 2*) is more restricted due to the control stand and driver's dash.

A handrail has been installed on the short hood for use in conjunction with the walkway handrail to assist in exiting through the window.

15.4.1 Cab with Gilberts Sliding Windows

The front wall side window rubber key-strips have been fitted with top and bottom pull-tabs (*Fig.1 & 2*), with a label affixed to the inside of the window glass indicating the pull tab position (*Fig. 3 & 4*).

Fig. 1 Rail Operator's side

Fig. 2 Locomotive Engineer's Side

Fig. 3

Fig. 4

Open the sliding window (*Fig. 5*). Reach around front pillar, grab pull-tab and pull-out key-strip from window rubber (*Fig. 6*). Removing the key-strip allows the window glass to be knocked or kicked out.

Fig. 5

Fig. 6

Bend wipers arms clear of window opening.
Seat covers can be used to cover edge of window openings.
Use locomotive handrails to assist in exiting through the window (*Fig. 7*).
Handrails have been fitted to the short hood to assist in egress from window (*Fig. 8*).

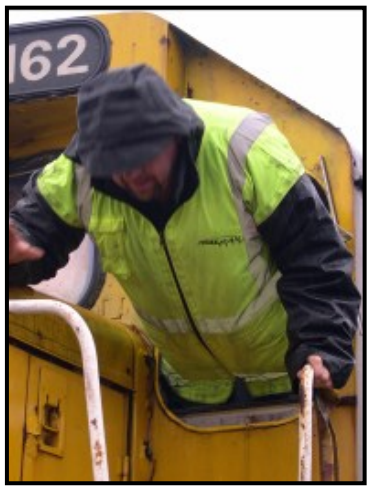


Fig. 7

Fig. 8

15.4.2 Cab with OEM Fixed Pane and One Sliding Window

Both the fixed pane of the sidewall sliding windows and the front-wall side window are fitted with rubber locking key-strips. Rubber key-strips are fitted with top and bottom pull-tabs. (*Fig 9 & 10*)

Fig. 9 Train Operator's side

Fig. 10 Locomotive Engineer's side

Pull-tab position labels on the inside of the window glass indicate the pull-tab positions (*Fig. 11 & 12*).

Fig. 11

Fig. 12

Remove the key-strip from side window allowing the window glass to be knocked or kicked out. After removing the side window glass, reach around to the front window and grab the pull-tab to pull out the key-strip. Knock or kick out the front window (*Fig. 13*).

Fig. 13

Bend wipers arms clear of window opening. Seat covers can be used to cover the bottom edge of the window opening.

Use locomotive handrails to assist in exiting through the window (*Fig. 14*).
Handrails have been fitted to the short hood to assist in egress from window (*Fig. 15)*

Fig. 14

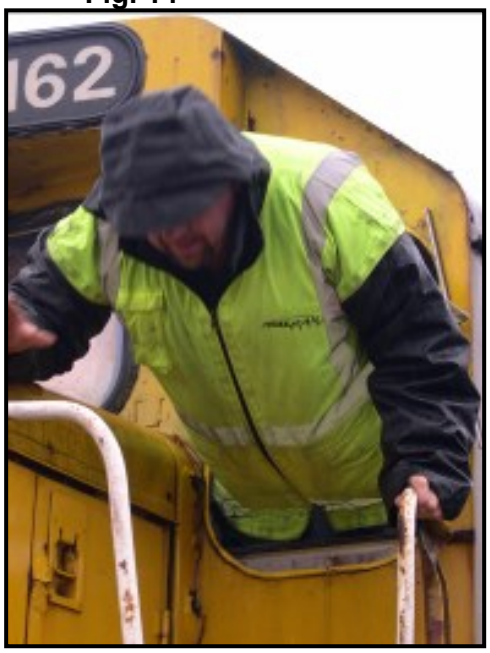


Fig. 15

16.0 EVENT RECORDER / VIGILANCE SYSTEM

16.1 Tranzlog

All DFB class locomotives are fitted with the Tranzlog event recorder / vigilance system.

The system is located on the air brake rack in the short hood of the locomotive. It is accessible through the “A” side short nose access door.

A variable vigilance cycle is employed to ensure the Locomotive Engineer must perform a function to cancel the cycle. If for some reason the LE does not cancel the cycle the emergency brakes will automatically apply, power is dropped, and the train will come to a stop.

The recorder will record specific functions carried out on the locomotive by the LE, it also captures all radio transmissions. Recordings can be downloaded and viewed in real time to see what occurrences have taken place.

Tranzlog is also employed to drive the locomotive speedometer, a signal is sent to the Tranzlog via a radar mounted to the underframe. The Tranzlog then sends a signal to the speedo head to display the locomotive speed.

17.0 PROTECTIVE DEVICES

17.1 Fire Detection & Suppression System (STAT-X) where fitted.

A fire suppression system is being fitted to DFB locomotives. The system consists of STAT-X aerosol generators and a linear heat detection wire that are located in the engine bay. A control module located in the electrical cabinet continually monitors the state of the linear heat detection wire and in the event of a fire the detection circuit is activated. The system works as follows.

- If a fire is detected the system will provide an alarm for 30 seconds without initiating the engine shutdown and fire suppression sequence.
- If the LE doesn't opt to override, the system will initiate an engine shutdown and stop the fuel transfer pump after the initial 30 second alarm period. All STAT-X suppression units are activated 30 seconds after shutdown.

- If the LE overrides the alarm in the initial 30 seconds, one set of STAT-X generators will be actuated immediately, pumping enough suppressant into the engine bay to prevent flames occurring. The engine and fuel transfer pump will remain running for a further 60 seconds.
- The override can be repeated multiple times to keep the engine running incrementally until the loco/train has cleared any danger zone.
- The override can be repeated any time during the 60 second countdown. The alarm tone will change in the last 10 seconds to indicate the approach of time out.
- After the last override period has timed out, the system will shut down the engine and stop the fuel transfer pump. A second set of STAT-X generators is actuated 30 seconds after engine shutdown.
- If the engine suffers an uncontrolled shut down during the override period, the system will stop the fuel transfer pump when the last override has timed out. Thirty seconds after the fuel pump has stopped the second set of STAT-X generators is actuated.
- Manual activation is available at any time. If used the engine is immediately shutdown and all STAT-X generators are immediately discharged.
- The push button to initiate hold off is located on the locomotive control stand in easy reach of the LE. In the event of a fire in a trail unit or a single/lead unit where hold off isn't used, the engine will be shut down 30 seconds after the initial alarm. 30 seconds after engine shutdown all STAT-X fire suppressions generators will be actuated.

In the event of the fire suppression system operating - the engine bay doors are not to be opened for at least 15 minutes, and when doing so a portable fire extinguisher must be on hand.

WARNING: Do not enter the engine bay until all of the aerosol has dispersed with the doors open.

Cab Fire Suppression Equipment

Manual Activation Switch:
This is used to manually activate the STAT-X fire suppression system in the engine bay at any time. The engine will be shut down, the buzzer will sound, and the alarm and shutdown LED's illuminated.

To operate, remove pin and push in the RED knob

Audible Alarm:
This is used to sound a fire alarm once every second, and fault conditions once every 10 seconds.

Cab Display Panel:

Warning Indicators and Buzzer
1. POWER:
Green – Normal condition
Amber – Fault condition (alarm will sound every 10 seconds).
2. ALARM:
Red – Fire condition (alarm will sound every second).
3. DISCHARGED:
Red – Not used.
4. SHUTDOWN:
Red – Engine shutdown initiated.
5. FAULT:
Amber – System circuit fault (alarm will sound every 10 seconds).
6. ISOLATED:
Amber – Panel has been isolated for maintenance purposes.

Dim Button: Toggle operation for adjustment of display LED's intensity to suit daylight conditions.

Delay Button: Not used.

Test Button: Provides manual test of all visual indicators and audible alarms.

Delay / Test Button: – If a fault occurs en route, these can be acknowledged by pressing the DELAY and TEST buttons at the same time. This will silence the audible alarm for 45 minutes but does not clear the fault.

NOTES:
Locomotives may only enter service when the POWER (Green) LED is illuminated, and all other LEDs are extinguished.

If a Fire Condition occurs en route, the alarm will sound until the system is reset (by maintenance personnel), and the locomotive will need to be towed dead to a depot for repairs.

18.0 SAFETY INSTRUCTIONS

18.1 Carriage Airbag deflated.

Step	Action	
1.	**If** 1. If train is moving 2. Yellow airbag deflated light illuminates. 3. Warning tone heard	**Then** • Slow the train immediately. • Contact the Train Manager. If unable to make contact, **stop** the train.
2.	**If**	**Then**
	Speed is above 52 km/h	Tranzlog audible alarm will sound with a solid tone to indicate a road over speed condition.
	Speed is below 48 km/h	Tranzlog audible alarm will stop
	If no action is taken to apply the brakes	The overspeed condition will apply the penalty brake after 10 seconds
	If the train brake is applied during the 10 second alarm period to slow the train down	The penalty brake application will be suppressed
3.	Stop the train at a location where both sides of the train can be safely inspected. If the issue is not fixable, the bogie with the damaged / deflated airbags must have the airbags cut out. Leave the opposite end inflated. Shut off the airbag isolating cock to stop air supply to the airbags of that bogie. **IMPORTANT:** If this is not done, pressure may continue to be lost via the ruptured airbag	
4.	Travel to desination, maximum speed 50 km/h	

18.2 HVAC Dampers

Used to close / open the fresh air intake in the passenger cars.

If	Then
Train about to enter a tunnel or travel through smoke (e.g. caused by track side fire)	Press the HVAC Dampers closed button. The button will illuminate red
Train exited tunnel, or in clean air again	Press the HVAC Dampers closed button. The red light will extinguish.

18.3 Carriage Smoke Alarms

Carriages are fitted with smoke alarms monitored by the TMS and an alarm light / sounder is in the locomotive cab.

When an alarm has activated in the carriage it indicates internal smoke in the carriage

18.3.1 Smoke Alarm Activates

Step	Action
1.	Red Smoke Alarm light illuminates, sounder activates
2.	Get the train to a place where it is safe to evacuate all passengers, then slow the train immediately
3.	Contact the Train Manager. If unable to make contact **stop** the train
4.	Send an emergency base call to Train Control
5.	Take a fire extinguisher back to the carriages and try to contact the train crew

19.0 RADIO / PUBLIC ADDRESS SYSTEM

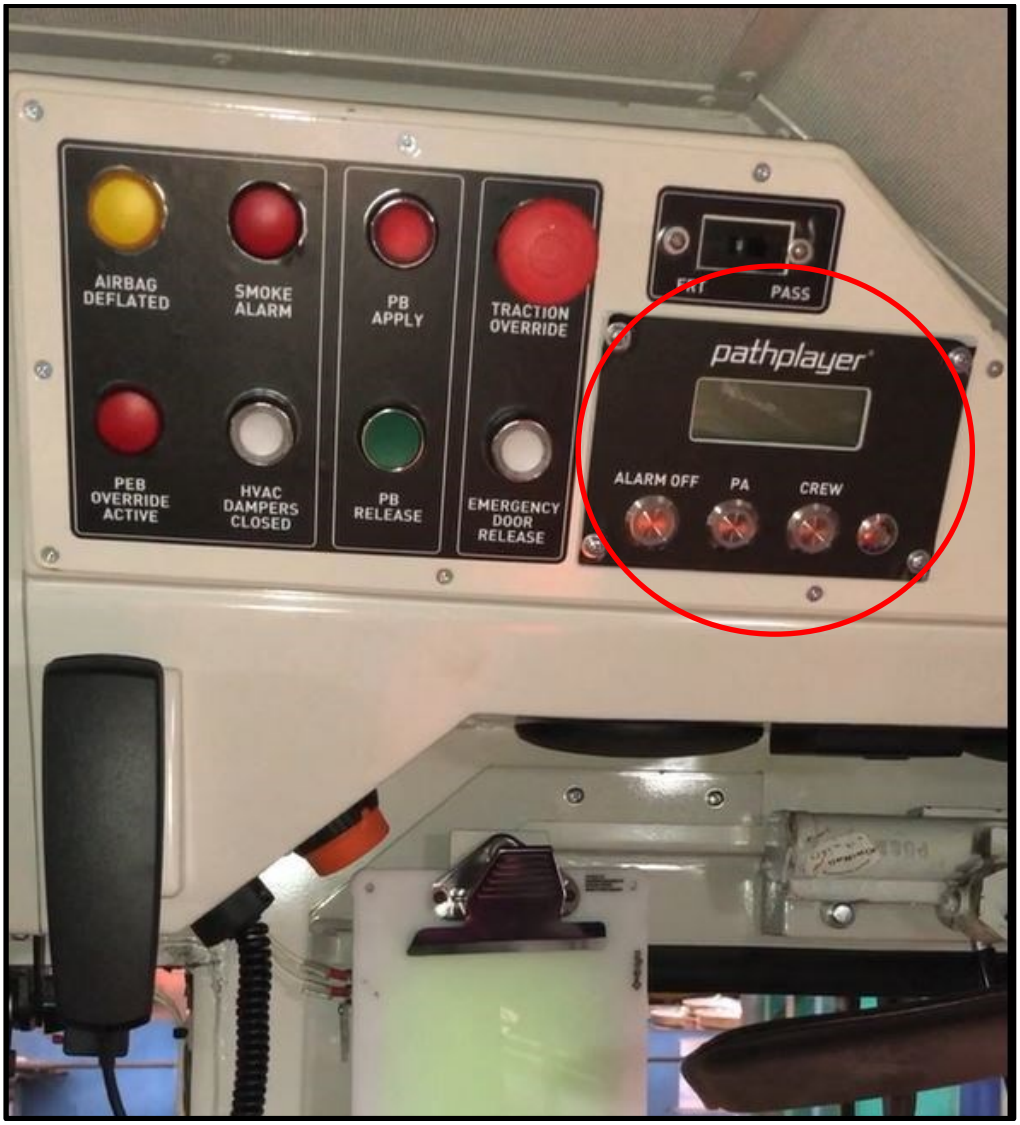
19.1 Tait 8260 Radio

Fitted to all mainline freight locomotives and shunts.

Refer *to the Radio Systems Manual.*

19.2 Train Management System (TMS)

The “alarm off” button on the TMS panel cancels the alert tone of an incoming call.



19.2.1 Answer a call from crew.

Step	Action
1.	In the locomotive a buzzer will sound, and the “CREW” button will illuminate. LCD will show “Driver Call” message. • Locomotive Engineer presses “CREW” button to acknowledge the call. • Remove handset from cradle. • Communication between Crew and Locomotive Engineer can begin. • Use “Push to Talk” orange button on the handset to speak
To finish making a crew call	
2.	Return the handset to the cradle top side first and press “CREW” button again. • The LED in the “CREW” button will extinguish and the LCD will go to default mode

19.2.2 Making a call to the crew.

Step	Action
1.	Press the “CREW” button and remove handset from the cradle. • “CREW” button will illuminate, and LCD will show “Driver Call” message.
2.	In the carriages a buzzer will sound, and “CREW” button will illuminate. LCD will show “Driver Call” message. • Crew press “CREW” button to acknowledge call. • Remove handset from cradle. • Communication between Locomotive Engineer and Crew can begin. • Use “Push to Talk” orange button on the handset to speak
To finish making a crew call	
2.	Return the handset to the cradle top side first and press “CREW” button again. • The LED in the “CREW” button will extinguish and the LCD will go to default mode

19.2.3 Making a PA call to the train.

Step	Action
1.	1. Press PA button and remove handset from cradle 2. PA button will illuminate, and LCD will show PA Call message.
2.	Press and hold the orange button and talk, in the carriages they will hear what you say. Only use the PA if you cannot contact the train crew. Example "*This is a staff announcement; can the train crew please contact the Locomotive Engineer."* It is not expected that the Locomotive Engineer will be required to make PA announcements. If the train crew make an announcement, the PA call light in the locomotive cab will flash, however you will not hear the announcement.

20.0 PASSENGER DOORS

20.1 Door Controls

The master door control is with the Locomotive Engineer

The Train Manager cannot operate the doors until the Locomotive Engineer gives release.

IMPORTANT: The locomotive cannot get traction power when the doors are open.

20.2 Gong (Bell) codes

The Train Manager communicates certain messages with gongs that are heard in the locomotive cab and responded by the train movements.

Gong signal	Train Action
One	Right of Way
Three (given quickly)	Stop the train
Six	Fire onboard
Continuous	Release doors

20.3 Doors release (at a passenger stop)

Step	Action	
1.	**If** 1. Train stopped at a platform. 2. Independent brakes fully applied	**Then** Press the door release button
2.	Door release button will illuminate with a white light.	
3.	When the Train Manager releases the train doors for passengers to use, the blue door light will extinguish.	
4.	The gong will be heard when this light extinguishes once the Train Manager has cleared the train to move.	

20.4 Doors closed (at a passenger stop)

Step	Action
1.	When the Train Manager closes the doors, the blue door light will illuminate.
2.	When the Train Manager gongs “Right of Way”, a tone is heard, and the door release light extinguishes
3.	Train can proceed when signalled to do so.

20.5 Emergency Door Release

Step	Action	
1.	**If** The train is stopped, and independent brakes fully applied. The door release button does not release the doors	**Then** Press the emergency door release button. This button and the door release button will illuminate with a white light.
2.	After passenger work is completed, the Train Manager closes the doors and gongs “Right of Way”, a tone is heard.	
3.	Press the emergency door release button to cancel the light.	

20.6 Door Light extinguishes while train moving.

Potentially the passenger doors are open.

Action	
If	**Then**
1. Train moving 2. Blue door light extinguishes. 3. Warning tone heard	1. Slow the train immediately. 2. Contact the Train Manager. If unable to contact, **stop** the train.

Once the train has stopped, the Train manager will inspect the doors and report back to the Locomotive Engineer on what was found.

21.0 TOWING

Set brakes as per 26L brake instructions for Dead Locomotives 3 pipe or BP only.
Ensure throttle and DB handle are “off” and reverser selector handle removed.
Ensure the EC switch is in the “Start / Stop / Isolate” position.
Open all circuit breakers.
Open knife switch.
Book locomotive “prepared for towing” in the Loco 54D book.

21.1 Locomotive Set-Up

SR train towed by another locomotive:

1. **Fitted** with “Running Capability” features (Scenario #1), or
2. **Not fitted** with “Running Capability” features (Scenario #2)

Scenario #1

26L Brake	**Relief Locomotive (now lead loco)**	**Dead Loco - 3 Pipe coupled to SR Train**
Automatic Brake Valve	Release	Handle Off
Brake Valve Cut-Off Valve	PASS	Cut Out
Independent Brake Valve	Applied	Release
MU2A	Lead or Dead	Trail 6 / 26
Running Capability Features		
FRT / Pass Switch	PASS	FRT
Trainline Jumper Cable	Coupled to dead locomotive	Coupled to train consist and live locomotive
Battery Knife Switch	In	Out
Locomotive Engineer	Lead Cab	Lead Cab

Scenario #2

26L Brake / 26LA Brake (CCBIIP Brake)	**Relief Locomotive (now Lead Loco)**	**Dead Loco - 3 Pipe coupled to SR Train**
Automatic Brake Valve	Release	Handle Off
Brake Valve Cut-Off Valve	PASS (PA)	Cut Out
Independent Brake Valve	Applied	Release
MU2A	Lead or Dead (PA)	Trail 6 / 26
Running Capability Features		
FRT / Pass Switch	Not fitted	FRT
Trainline Jumper Cable	No coupling ability	Coupled to train
Battery Knife Switch	In	In
Locomotive Engineer	Lead Cab	Second LE in cab to give door release

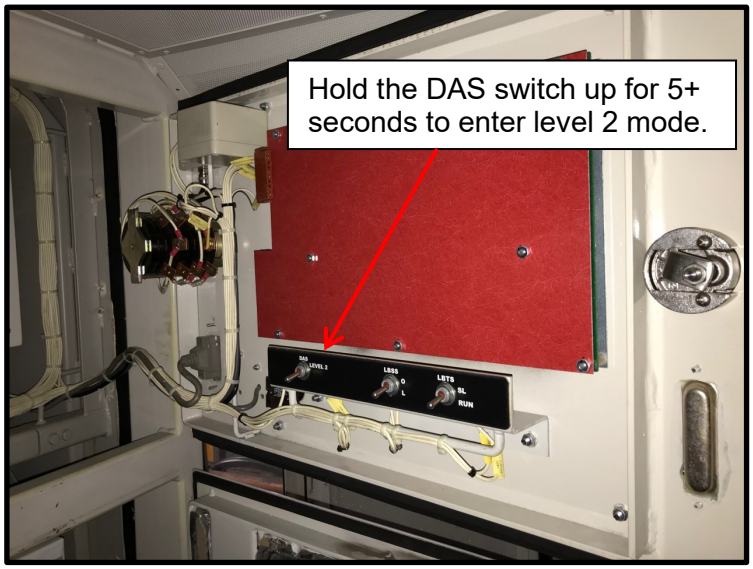
22.0 FAULTS

Any fault that is displayed on the DID panel is also stored in the “Fault Log”. The operator may view all logged faults by placing the DID into level 2 and entering the “History” (Soft Key F4). When in the “History” you may scroll back through all faults logged. It will always display the newest / active fault logged first.

22.1 Level of Faults

The faults that Brightstar will detect have a programmed “Priority” list. Depending on the type of fault that is logged will determine the following:

1. Reset of the fault – Automatic or Manual
2. Level of Access for the reset – Three levels of access
3. Restrictions Imposed



If a manual reset is being carried out and the level of reset is greater than the DID panel allows, the message “Unable to Reset Fault at this Level” will be displayed on the DID.

In the event that the fault requests for level 2 DAS to reset the fault, this is achieved by opening the top right-hand cabinet door and holding up the DAS toggle switch on the inside of the door for 5 seconds.

This will allow you to reset a Level 2 DAS fault.

22.1.1 Automatic Resets

Brightstar will automatically reset some faults for the operator; generally, these automatic resets are limited to 3 resets within 60 minutes. This fault would then become a manual reset. The fault will only automatically reset if the condition disappears.

22.1.2 Manual Resets

Manual resets are carried out through the DID panel except for:

- Low Oil pressure,
- Low Water pressure, and
- Crankcase overpressure shutdowns.

The LOP governor shutdowns are reset by manually resetting the button on the governor. Once the governor button is reset, Brightstar will then automatically reset the DID and the engine can be restarted. COP and LWP faults need to be reset on the engine protector first then the governor.

NOTE: If the seriousness of the fault detected is too great the system will not allow the operator to reset the fault. The locomotive must be returned to the nearest maintenance depot for investigation.

22.2 Alarm Bell

The alarm bell will not always ring when the system detects a fault, some faults will be displayed and logged without the operator's knowledge.

In the event a fault does activate the alarm bell, it maybe "Silenced" by pressing the F3 soft key.

The alarm bell can also be silenced by moving the EC switch back to the "Start" position.

22.3 Resetting Serious Faults

22.3.1 Low Oil Pressure

Logging this condition takes 30 – 40 seconds for the DID panel to display the fault. During this time the diesel engine will shut down. Before carrying out the reset, investigate the possible cause of the failure. Reset the LOP button at the governor.

22.3.2 Ground Relay

Message Displayed – **"E045 Won't Load: Power Circuit Ground"**
Alarm Bell – Will ring for 30 seconds.
Reset – Automatic if throttle returned to idle position (Limited to 3 within 60 minutes)

NOTE: The system does not know where in the electrical circuit the ground fault has occurred. Traction Motor cutout is fitted to the locomotive so individual traction motors can be cut out if the ground fault persists.

22.3.3 Traction Motor Cut Out

As above, the system cannot tell which traction motor is at fault, so it is trial and error as to which motor maybe causing issues by using the Motor Cutout Switch. The traction motor cut out will allow a locomotive to become mobile again at reduced load in the event of the wheelslip faults and for some ground relay faults while en route.

A locomotive that has had a seized traction motor attended to in the field by fitting staff will also be able to return to a depot under its own power and if required to do so, haul a reduced load.

A traction motor cut out switch is fitted to the A side upper electrical cabinet door.

The motor cut out switch has four positions:

- All motors IN (normal position)
- 1 and 6 cut out.
- 2 and 5 cut out.
- 3 and 4 cut out.

Each of the cut-out positions cuts out two traction motors, immobilizes dynamic brake and limits engine output to notch 6. Dynamic brake control of other units in multiple is still possible with traction motors cut out. When the locomotive is leading with traction motors cut out, notches 7 and 8 will still work normally on other locomotives in the consist.

It should be noted that when a locomotive is run with 2 and 5 cut out there will be no indication on the driving ammeter.

After ground relay lock out or if the locomotive becomes immobilized due to a wheelslip fault proceed as follows:

- Locomotive stopped; brakes applied.
- Throttle to idle.
- Reverser handle to neutral.
- Isolation switch to 'Stop / Start / Isolate.'
- Reset the ground relay, if required.
- Select one of the cut-out positions on the motor cut out switch.
- Bring the locomotive back online and attempt to move the train.
- If the fault recurs, repeat the procedure with another pair of motors cut out.

DO NOT ATTEMPT TO SWITCH THE MOTOR CUT OUT SWITCH WHILE THE LOCOMOTIVE IS IN MOTION AND / OR A THROTTLE NOTCH IS SELECTED.

ISOLATE A UNIT (LOCOMOTIVE) IF THE RELAY DETECTION UNIT LOCKS OUT CONTINUALLY.

22.3.4 Crankcase Overpressure

Refer to Section 10.3 of this document for information regarding the reset of COP faults.

22.3.5 Hot Engine

The system will look after the engine by derating the horsepower output of the engine in order to create less heat and cool the engine.

Deration of the engine will start to occur when either the lube oil or the water temperature reaches 98°C.

If the temperatures continue to rise the horsepower output will reduce to a point that if 114°C is reached, all horsepower will be lost. Engine rpm will still be available to help drive the cooling fan. Horsepower will return as the temperature of the system decreases.

Manual locking of the radiator shutters is covered in Section 10.5.

22.3.6 Loss of Compressed Air

In the event of the loss of main reservoir air pressure check that the air compressor is operating. If the compressor is found not to be pumping and the MR air pressure is low, disconnect the electrical plug from the compressor control switch (CCS).
The compressor control switch is located in the **Pneumatic compartment** at the rear of the locomotive long hood. (Radiator hood)
Disconnection of the electrical plug will force the compressor to load. Continue to destination with this plug disconnected and book the fault in the Loco 54D book. Note that with the plug disconnected, the air compressor cannot unload at the normal cut-off setting. The main reservoir safety valve will blow off to relieve excess air pressure. Disconnection of the compressor control switch plug is only to be used as a “Get Home” feature as continual operation of the main reservoir safety valve is not desirable.

DO NOT isolate the air supply cock. This will cause the engine to overheat.

Disconnect plug at the CCS to make the compressor pump continuously.

Do not cut the isolation switch out as this will cut the air feed to the radiator shutters which will result in the engine overheating.

22.4 Booking of Faults

From a maintainers point of view, it is essential that the booking of faults is clear and precise.

It is important that the initial message and the error code number on the DID panel are recorded in the repair book. Please try to give as much detail as possible about what was happening at the time the fault occurred as both items will aid maintenance staff in isolating and repairing the fault.

22.5 Degraded Mode

22.5.1 TMS Jumper Cable Failure

If	Then
Jumper cable falls out or is damaged	The “PEB” will light up and the sounder will also alert. If the “PEB” is not by-passed or the “FRT” mode selected within 10 seconds the brakes will apply. Door control release will not work. If a jumper cable issue occurs, switch to “FRT” position, and advise the Train Manager. The Train Manager can obtain the Locomotive Engineer’s door release by using the “SRV Cab Door release” push button.  The doors will only release on carriages that are TMS jumper cable connected to the SRV.

	On other carriages that are not jumper cable connected: 1. Move passengers internally between the carriages that the doors are still capable of being used. 2. Train Crew will use the internal emergency door release switch (on the door control panel) to detrain passengers.