Rail Operating Code

Code Supplement CS 4.8

Operating Instructions for DX Class Locomotives

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PICTURES OF DX CLASS LOCOMOTIVES

DXB Locomotive

DXC Locomotive

DXR Locomotive

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
BKT	Brake Transfer Switch
BKS	Battery Knife Switch
CCB	Battery Charge Circuit Breaker
CDC	Control Device Compartment
CK1 or CK2	Engine Cranking Contactors
COP	Crankcase Pressure Transducer
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
DSS	Diesel Engine Speed Sensor
EC	Engine Control Switch
ECP	Engine Control Panel
EFCB	Exciter Field Circuit Breaker
ESP	Engine Stop Switch
EST	Engine Start Switch
EWT	Engine Water Temperature Sensor
EXC	Exciter
FPB	Fuel Pump Circuit Breaker
FBRB	Fuel Pump Reset Switch
GF	Generator Field Contactor
GOV	Governor
GR	Ground Relay Switch
GRCO	Ground Relay Cut Out Switch
HLB	Headlight Circuit Breaker
LA	Load Ammeter
PDC	Power Device Compartment
P1 – P6	Power Contactor
LBS1 – LBS3	Load Test Contactors
LCCB	Local Control Circuit Breaker
LOT	Lube Oil Temperature Sensor
REV	Forward / Reverse Switch

3.0 GENERAL

These locomotives originally came in two models, referred to as “E Type” and “CHEC”. Both the “E” & “CHEC” models were fitted with the same prime mover and running equipment. The main differences were in the wheelslip control systems, drivers control stand, dynamic brake capacity and the engine pipe work.

Today all the DX class locomotives have been through an overhaul program and have been fitted with the “Brightstar” wheelslip control system. All have the high capacity dynamic braking package. Standardisation of the cab design, cab layout & driver control stand with the exception of the two “DXR” locomotives has been applied.

There are two variations of engine horsepower output across the DX class:

3300 GHP – 19 in total

2900 GHP – 29 in total

To achieve the higher GHP engine output there are some hardware changes required to the engine. The engine block must also be of the design able to withstand this additional power produced.

There are three classifications of the class as we now know it:

DXR – 2 in the class

DXB – 14 in the class

DXC – 32 in the class (Fitted with ducts on the Engine Air & Equipment Air Intakes)

These ducts are fitted to enable cool air to be drawn into the engine and equipment blower while operating in the Otira tunnel. This modification allows for cooler running when in the tunnel; without it the locomotives would de-rate on horsepower due to the high temperatures or shut down to protect the equipment.

The equipment air ducts are fitted with electro-pneumatic dampers which are controlled by GPS co-ordinates and operated via the Tranzlog vigilance data recording system. Under normal operating conditions the equipment air is drawn in though the top of the duct. Switching of the damper to “tunnel mode” only occurs when the locomotive reaches the prescribed GPS points.

3.1 Brightstar Control System & Associated Component Description

The Brightstar microprocessor wheelslip control system fitted to the DX 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 “E & CHEC” control systems.

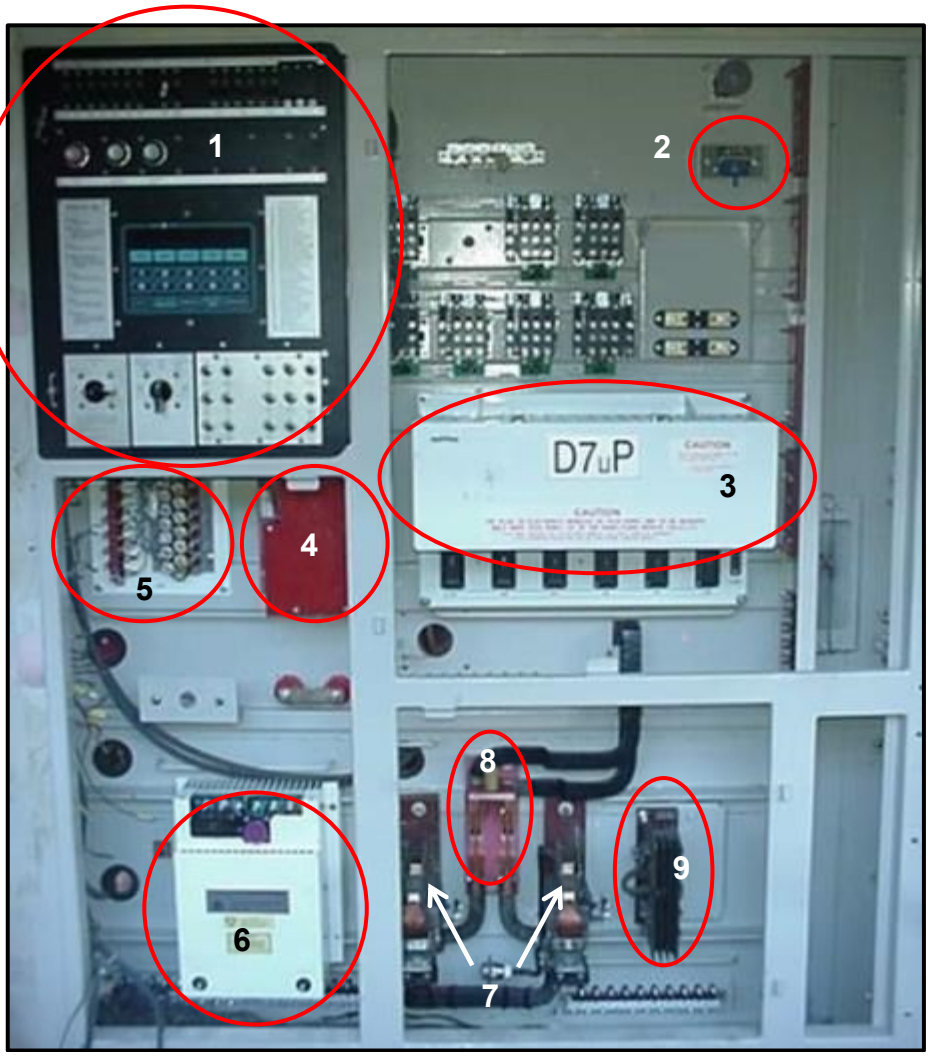
The system looks at individual traction motor current and voltage through current shunts on each traction motor circuit. It is able to determine from these readings if a wheel set is turning faster (slipping) or slower than another. Depending on the current / voltage differential and the time it took 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 is the engine / dynamic brake protection management that it carries out. Below is a description of the hardware employed to carry out these functions.

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 deg 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 deg C) where the locomotive will not produce any HP. It will still allow full engine RPM to help with the cooling of the water and oil.
Diesel Engine Speed (DSS):	A sensor is placed in the cam gear cover housing and the system monitors the speed of the engine. It has predetermined engine speeds loaded for each throttle notch position.
Engine Crankcase Pressure (COP):	A pressure transducer is placed in the COP / MAP box and is fed via a flexible hose connected to the cam gear cover housing above the DSS. This transducer detects if there is a “Positive” pressure developing in the engine crankcase.
Manifold Air Pressure (MAP):	A pressure transducer is placed in the COP / MAP box and is fed via a flexible hose connected to the engine air inlet manifold. This transducer reads the turbocharger output pressure.

Dynamic Brake Fan Speed: (BSS):	A sensor is placed in the DB fan and the system monitors the speed of the fan. Again there are predetermined fan speeds loaded and the system will take action if an incorrect speed is detected.
Main Reservoir Air Pressure (MR1):	A pressure transducer is placed in the main reservoir line, the system controls the cut-in and cut-out of the air compressor at predetermined pressures.
Barometric Pressure (BPT):	A pressure transducer is placed in the CDC; this is only used to display barometric pressure as we never run at high enough altitudes in New Zealand to require high altitude deration.
Ambient Air Temperature (AT):	A temperature sensor is located in the CDC; it monitors the ambient air temperature.
Driver / Loco Interface (DID):	The Diagnostic Information Display is the interface between the locomotive engineer and the loco control system. The DID will display loco faults if an abnormal operating condition is detected, 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 an error message displayed on the DID panel, restrictions being imposed on the locomotive to the engine shutting down and not being able to be restarted. Some faults will have an automatic reset function, others will be a manual reset carried out by the operator through the DID.
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.

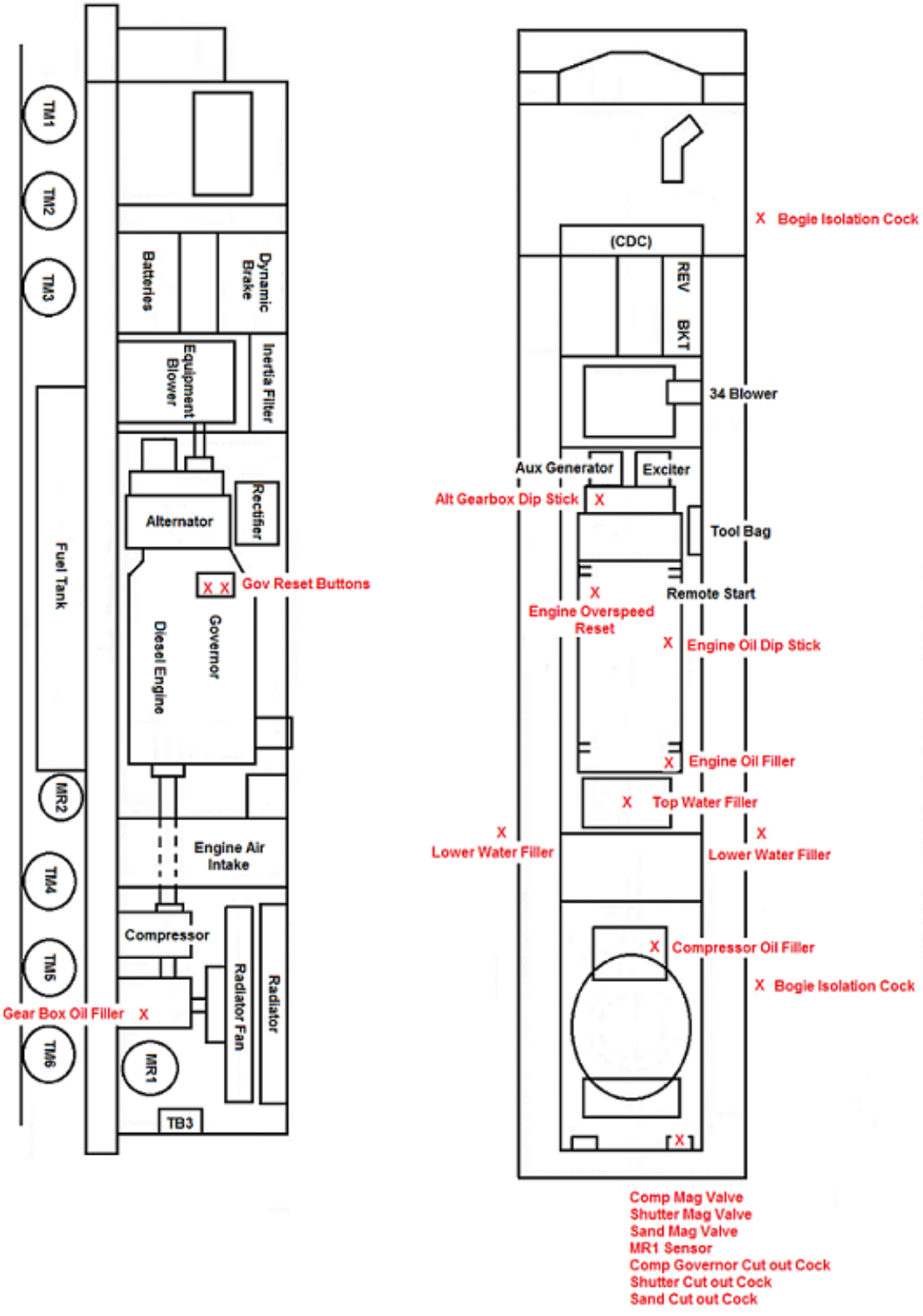
CDC Lay Out of Main Brightstar Components



1. ECP – Engine Control Panel
2. BPT – Barometric Pressure Transducer
3. D7uP – Microprocessor Panel
4. CPF – Computer Power Filter
5. TRP – Trainline Resistor Panel
6. CPS – Computer Power Supply
7. CK1 & CK2 – Cranking Contactors
8. BS – Battery Knife Switch
9. RCD – Reverse Current Diode

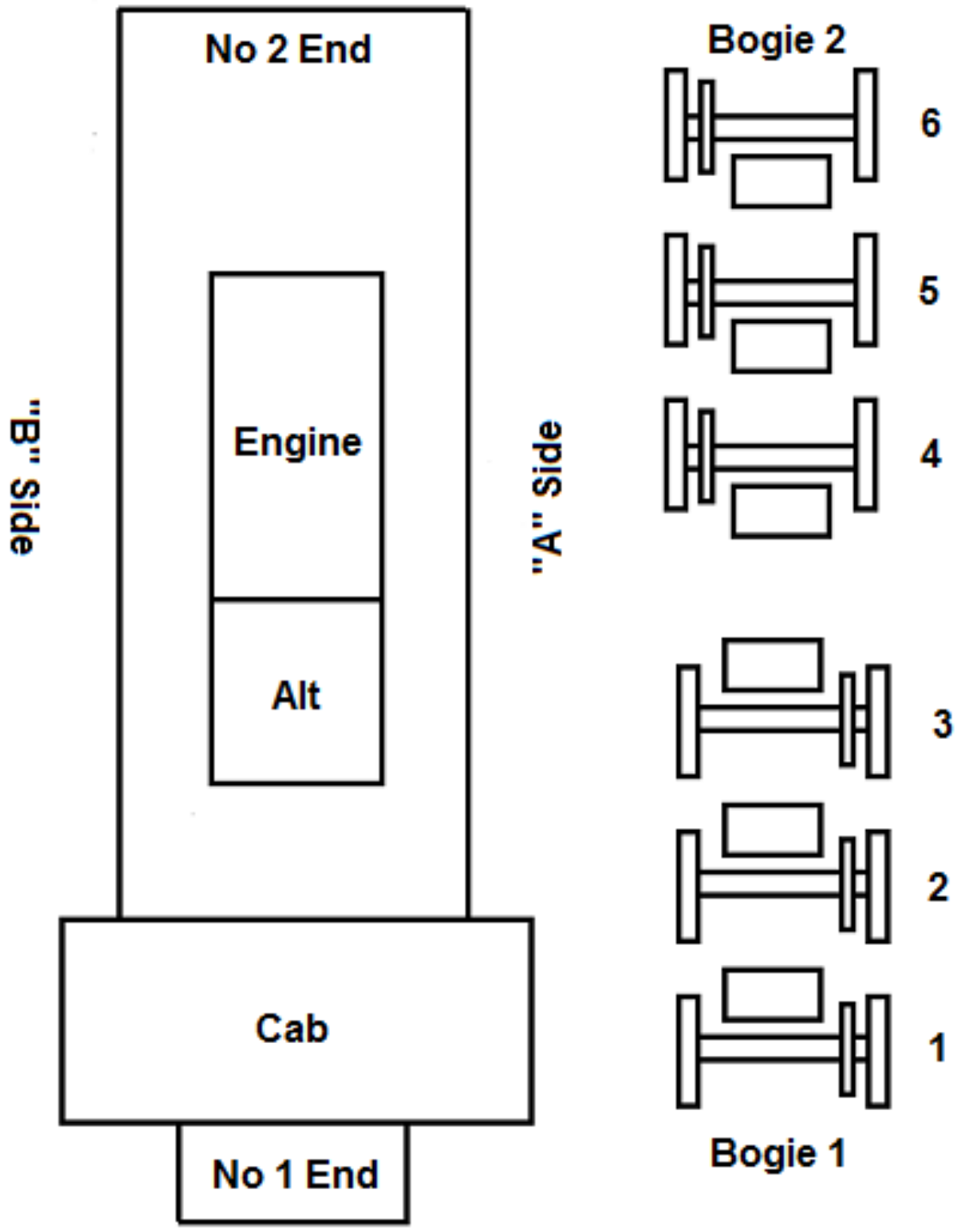
4.0 GENERAL DIAGRAMS

4.1 Arrangement of DX



4.2 Traction Motor Arrangement

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



5.0 CAB CONTROLS / LAYOUT

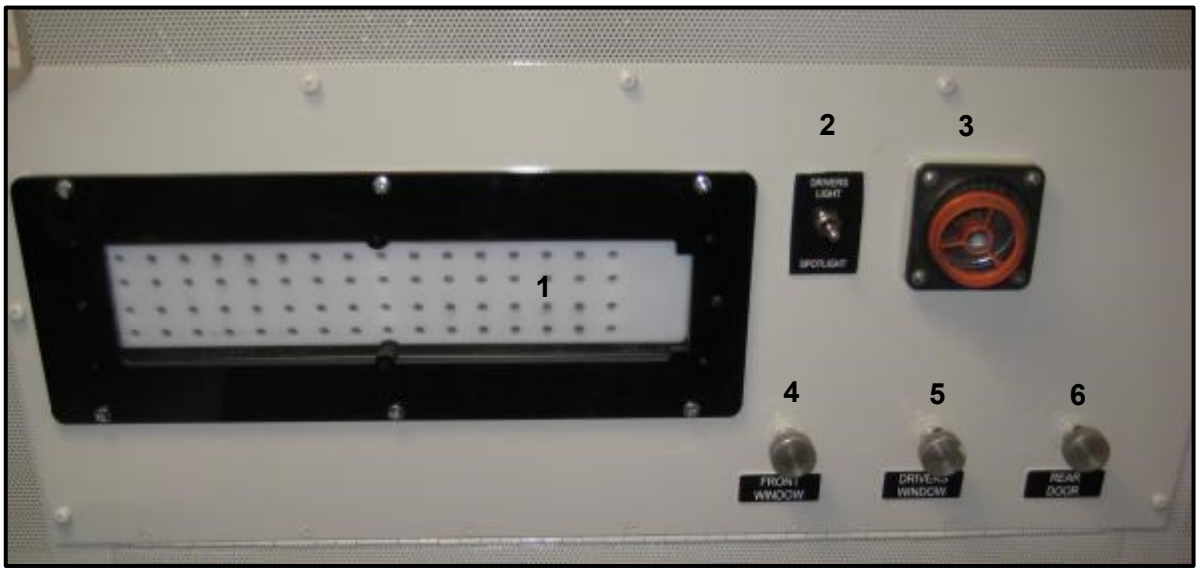
5.1 Control Stand Component Identification:

NOTE: Some locomotives vary slightly with the layout of a few items.The position of the ISRI Air Seat cut off valve & ditchlight push button can vary between locomotives. In this case it is located next to the manual sanding push button.

1.	26C Automatic Brake Valve	2.	SA26 Independent Brake Valve
3.	Warning Light Panel	4.	Wiper Control Valve
5.	Ditchlight Push Button	6.	Horn Valve
7.	Entertainment Radio	8.	Tait Radio (Broadcast)
9.	Emergency Secall 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

19. Vigilance Cancellation Button	20. Headlight Selector Switches
21. Dynamic Brake Control Handle	22. Throttle Control Handle
23. Forward / Reverse Selector Handle	24. Cab Heater Control Switch
25. Manual Sanding Push Button	26. Dome Light Toggle Switch
27. Dynamic Brake Cut Out (Trainline)	28. Gauge Light Toggle Switch & Dimmer
29. Vigilance Light Cut out switch	30. Window Demister Circuit Breaker
31. Vigilance Loudness Switch	32. Vigilance Light & On / Off Switch
33. Track Warrant Illuminated Board	ISRI Air Seat Cut Out Valve – Not In Shot

5.2 Drivers Light / Wiper Control Panel



1. Drivers LED Light	2. LED & Spot Light On / Off Switch
3. Drivers Spot Light	4. Front Window Wiper Control Valve
5. Drivers Window Wiper Control Valve	6. Rear Door Wiper Control Valve

5.3 Warning Indicating Lights

5.3.1 Wheelslip Light

Will operate in all locomotives as long as the jumper cable is fitted.

There is no warning buzzer indication for wheelslip or wheel slide.

5.3.2 PC Light (Pneumatic Control)

Operates only in the affected unit of the consist. The alarm bell will operate in all unit 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 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, the DB handle must be placed in OFF, and brake pipe pressure restored to above 350 kPa to extinguish the light.

5.3.3 Brake Warning Light

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

5.3.4 Fire Alarm Warning Light

The light operates only in the affected unit, the alarm bell will operate in all units of the consist as long as the jumper cable is fitted.

5.3.5 STAT-X Fire Detection

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

See section 17.2 for detail of the system

5.3.6 Vigilance Warning Lights

Will operate in the lead unit only

NOTE:
All other warnings / alarms are displayed on the DID panel.

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

5.4 Engine Control Switch (EC)

This is located at the bottom left of the engine control panel.

The positions of the switch moving clockwise are:

1. **Start** - All circuits that are necessary for engine fuel prime & cranking are completed.

2. **Isolate** - All circuits to obtain power, dynamic braking or self-load are “In Operative”

3. **Run** – The locomotive is able to be run in Power, Dynamic brake or Self Load.

5.5 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 systems thermal protection counters start to count. If the predetermined thermal limits for the traction motors are reached the control system will limit the amount of alternator output in order to protect the traction motors from overheating and damage.
The continuous rating for the traction motors when in power is 705 amps, motors can be exposed to higher currents but are limited to 1000 amps and only instantaneously.

When the locomotive is operated in dynamic brake there are two current limits in operation. Both the traction motor field and armature limits are set at 635 amps.

5.6 Battery Charging Volt Meter (BCV)

Located in right hand upper of CDC

Displays battery voltage, can also be viewed on the DID panel.

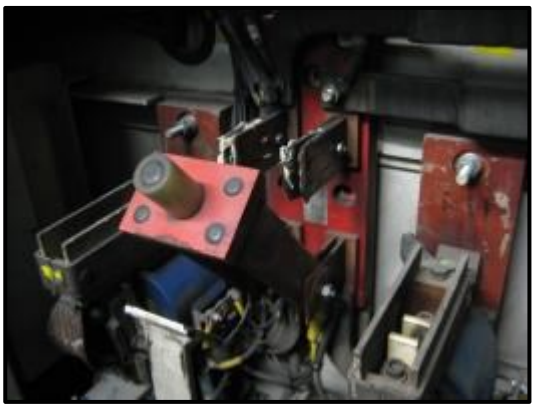
Under normal operating conditions with the engine running the voltage should be 74V.

This is regulated by the Brightstar control system.

5.7 Battery Knife Switch (BKS)

Located in the lower mid of CDC

Closing the battery knife switch allows power to be distributed to various electrical circuits.



Knife Switch Open

Knife Switch Closed

5.8 Engine Control Panel (ECP)

Engine control panel houses all the main control circuit breakers across the top of the panel.

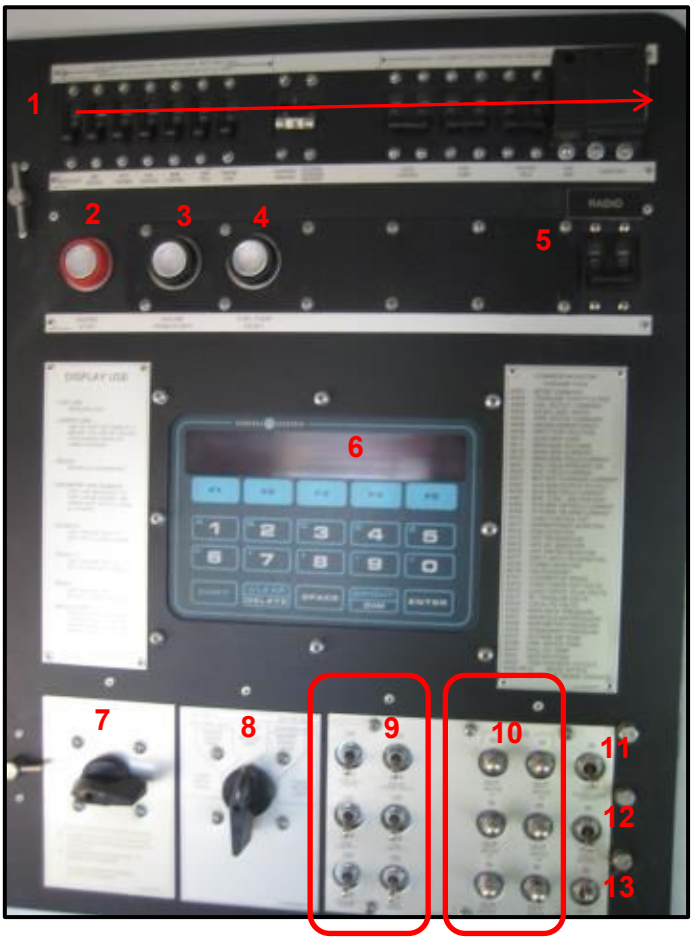
Engine Start & Stop push buttons along with the fuel pump reset button.

The DID panel is flush mounted in the middle of the panel.

Engine control switch is a three position switch mounted in the bottom left of the ECP.

Multiple headlight selector switch is mounted to the right of the EC switch.

Traction motor cut out switches, ground light, shunting light and tail light switches are also located on the panel.



Engine Control Panel Component Layout

1.	Control Circuit breakers	2.	Engine Stop Push Button
3.	Engine Start Push Button	4.	Fuel Pump Reset Push Button
5.	Radio Circuit Breaker	6.	Diagnostic Information Display
7.	Engine Control Switch	8.	MU Headlight Selector Switch
9.	Various Light Switches	10.	Traction Motor Cut Out Switches
11.	Locked Axle – Not Used	12.	Speed Sensor – Not Used
13.	Dynamic brake Cut Out Switch		

5.9 Load Test Switches (LBTS & LBSS)

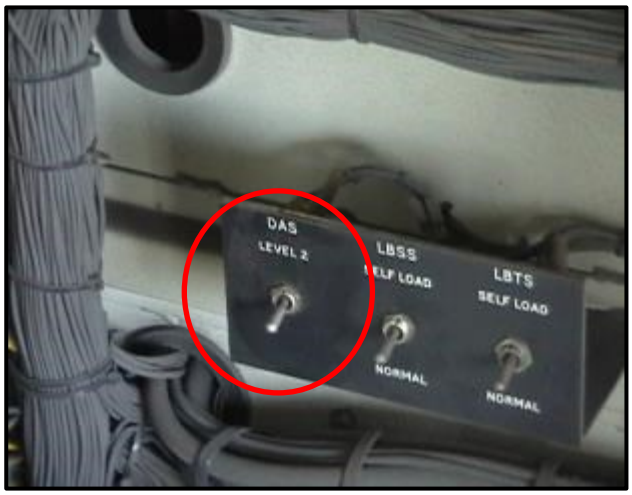
There are two load test switches (LBSS & LBTS), both these switches are a two position toggle switch. When both switches are placed into the “Self Load” position the locomotive can be run up to stationary to full load to check the engine is delivering the desired horsepower.

For normal operation both switches must be placed into the “Normal” position.

5.10 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 sec’s, this will put the DID panel into level 2.



5.11 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 “B” side on most engines. Some engines have the dipstick positioned in this location on the “A” side of the engine, some have it positioned beside the oil filler.

The oil filling point is at the front of the engine on “B” side below the turbocharger.

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 Alternator Gear Case

Check the level at engine idle speed. As long as the level on the dipstick is between the “Full” and “Add” marks, the level is satisfactory. Take care when reading the dip stick as there is a set of marks for running and stopped. Should the level need topping up, it must be booked in the Loco 54D book for maintenance staff as special oil is required.

The dipstick is located at the short hood end of the alternator “A Side” about halfway up the gear train.

6.1.4 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.

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 BKS.
4. Check the following Circuit Breakers on the ECP are closed:

Not Required to Start Engine			Required to Start Engine									
Headlight	Imm Heater	Foot Warmer	Aux Control	Main Control	Gen Field	Engine Run	Charging Breaker	Local Control	Fuel Pump	Exciter Field	Aux Gen	Computer
HLB	IHCB	FWCB	ACB	MCB	GFB	ERS	CCB	LCB	FPB	EF	AG	BC

Once the BKS & Computer (BC) circuit breaker is closed the Brightstar will power up. The full boot up time is around 90 sec’s 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” position. Check the forward / reverse selector handle is in “neutral” position. Check the throttle handle is in “Idle” position.	
Depress and hold the Fuel Pump Reset Button (FPRB) for 2 sec’s. Allow fuel pump to run and prime the fuel system for at least 10 sec’s. Depress and hold the Engine Start button (EST1) on ECP or (EST2) remote start.	
NOTE: It is preferable to use the remote start button on the engine so the fuel layshaft can be opened at the same time. This enables faster starting of the engine and is not such a drain on the locomotive starting batteries. Once the engine is started release the start button, Brightstar will automatically drop the cranking contactors out if the engine is running or if the cranking time exceeds 30 seconds and the engine has not started.	
Check the DID panel and ensure that the auxiliary generator is running and that the batteries are now charging. When ready to move the locomotive, turn EC switch to “Run” position.	

Display panel top line shows I = shows that the battery is charging, will normally show under I = 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” position.
4. Start each trail unit and leave EC switch in “Start” position.
5. With all engines running, insert all jumper cables.
6. Now place EC switches to “Run”.
7. Below is the circuit breaker set up for “Trail” locomotives

Not Required for Multiple Operation							Required for Multiple Operation					
Headlight	Imm Heater	Foot Warmer	Aux Control	Main Control	Gen Field	Engine Run	Charging Breaker	Local Control	Fuel Pump	Exciter Field	Aux Gen	Computer
HLB	IHCB	FWCB	ACB	MCB	GFB	ERS	CCB	LCB	FPB	EF	AG	BC

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”.

The procedure for coupling up should be as follows:

1. Bring the locomotives together and make the mechanical coupling, a coupling link must be used, and all the hoses on one side coupled up and the coupling cocks opened.
2. Ensure both engine control switches are in “Start”.
3. Set up brake equipment on all locomotives as per the Rail Operating Code, Section 4.
4. In all DX 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 on Line

After the diesel engines are started and inspected, units may be placed on line 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 on line.

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 in “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 throw 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” 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 BKS
7. Book any faults in the Loco 54D.
8. Remove jumper cable if necessary.

8.2.2 Lead Unit

1. Turn EC to “Start” position and leave it there.
2. Depress the “Engine Stop” button – this will shut the engine down.
3. Do not open the BKS or the CCB.
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 “idle” 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 Brighstar system has to 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 damping when wheel creep is lost, reducing the magnitude of wheelslip corrections so that tractive effort is improved.
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 in 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 wheel creep 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 wheelslip 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 amps 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” 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 Loco’s in Trailing Position

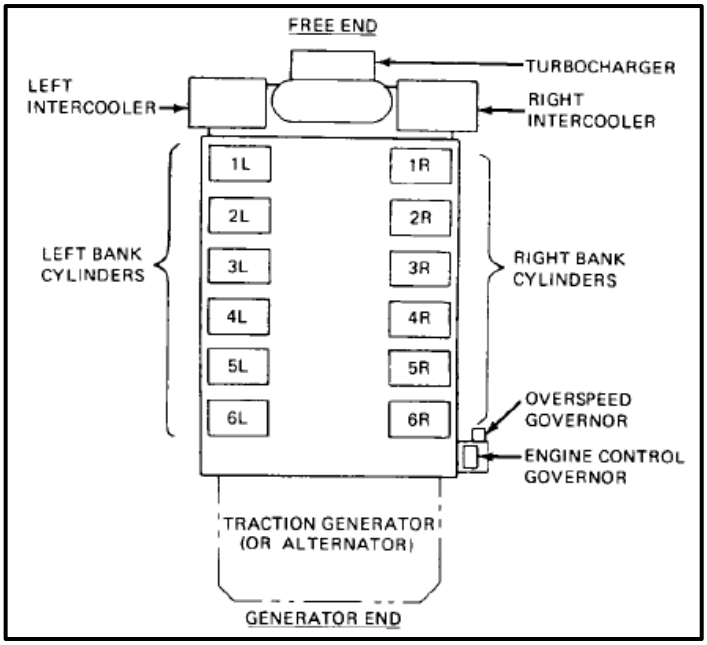
1. Place the “EC” switch to the “Start” position
2. Depress the “Engine Stop” switch (ESP)
3. Once the engine has stopped rotating “Engine Not Running” will be displayed on the DID panel.
4. Open the battery knife switch (BKS)

10.0 DIESEL ENGINE

10.1 Engine Specifications

Description	Model 7FDL12
Number of Cylinders	12
Stroke Cycle	4
Cylinder Arrangement	45 Degree “V”
Bore	228.6mm
Stroke	266.7mm
Turbocharger	Single
Weight Dry “Engine Only”	15,849kg

The engine is viewed from the “Generator End” at the cab end of the locomotive, when referring to the left & right bank. Power assemblies are number from the “Free End” back towards the generator.



10.2 Engine Speeds

The Brightstar controls the engine speed signals; it differs from the rest of the diesel locomotive fleet. Although the engine speed request may differ the trainline signal does not so any other locomotives in the trailing position will receive the correct throttle request. This throttle sequence is known as “Skip 3 Double 6”.

Lead Loco Throttle	Engine Notch Command	Engine RPM ± 10	Train Line Command
Idle	Idle	448	Idle
Notch 1	Notch 1	448	Notch 1
Notch 2	Notch 2	628	Notch 2
Notch 3	Notch 4	712	Notch 3
Notch 4	Notch 5	801	Notch 4
Notch 5	Notch 6	891	Notch 5
Notch 6	Notch 6	891	Notch 6
Notch 7	Notch 7	980	Notch 7
Notch 8	Notch 8	1056	Notch 8

10.2.1 Engine Speed Sensor

Located in the cam gear cover housing, left bank of engine on the “B” side of the locomotive.

The probe picks up off the cam gear and sends a signal back to the Brightstar control panel.

10.2.2 Engine Over Speed Reset

Engine overspeed governor is set to operate at and shut the engine down at 1155 ± 10 rpm

2900 GHP Engine

Located “A” side attached to the governor drive gear box.

Trip operation identified by a visible Red line showing, once tripped it will need to be manually reset before the engine will start. To reset depress in the direction of the arrow so the Red line is no longer visible. The reset will latch and stay in.

3300 GHP Engine

Located “A” side attached to the governor drive gear box is the over-speed governor. There is no trip indication on the actual governor as is the case with the 2900 set up.

The indication is on the over-speed link (1) and a red band will be visible if it has tripped.
To reset, lift and hold the layshaft until the trip indicator disappears for three seconds. Release the layshaft and check the link has reset.

10.3 Crankcase Over Pressure (COP) & Manifold Air Pressure Device (MAP)

The crankcase pressure is monitored by the Brightstar control system. A pressure transducer is used to send a signal to the controller and is located in the COP / MAP box on the engine. Brightstar carries out a test on the sensor every time it is powered up, if it detects an issue it will log the fault and display " COP Sensor Bad" on the DID panel.

If a COP shutdown occurs a fault message will be displayed on the DID panel of the affected locomotive only, the alarm bell will ring on all locomotives in the consist.

Brightstar will shut the engine down for crankcase over pressure under three conditions:

1.	**In Power** and the system sees a value of 2 inches of water over 10 seconds. The DID panel will display **EOB6 – COP Trip.**	This will instigate an engine shut down and can be reset by the operator. It is a level two reset so the DID panel must first be placed into level 2. This can be done by toggling the DAS switch located in the left bottom of the CDC for two seconds. The corresponding DID panel key "Reset" can now be depressed to reset the fault. The locomotive can now be started using the Start sequence outline in Section 7.
2.	**In Power** and the system sees a value of 10 inches of water for 1 second. The DID panel will display **EOB7 – Instantaneous COP Trip.**	This will instigate an engine shut down and cannot be reset by the operator. This type of shut down indicates that something serious has happened within the engine and it must go to the nearest maintenance depot for inspection before being started again.
3.	**In Dynamic Brake** and the system sees a value of 4 inches of water over 10 seconds. The DID panel will display **EOB6 – COP Trip.**	This will instigate an engine shut down and can be reset by the operator. It is a level two reset so the DID panel must first be placed into level 2. This can be done by toggling the DAS switch located in the left bottom of the CDC for two seconds. The corresponding DID panel key "Reset" can now be depressed to reset the fault. The locomotive can now be started using the Start sequence outline in Section 7.

The crankcase covers are spring-loaded and any explosion within the crankcase will force the cover(s) out against spring tension. The spring in the cover will pull the cover back into place.

CAUTION: Under no circumstance remove any of the crankcase inspection covers, this can cause an explosion of any hot oil vapour in the crankcase.

If there is any sign of an explosion, **the engine must not be restarted.** Book the fault in the Loco 54D book.

The crankcase overpressure device will stop the engine in case of a crankcase explosion.

If all appears to be correct, restart the engine and check the oil level in the engine oil pan. If the oil is above the “Full” mark, it may cause the engine to stop.

10.3.1 Crankcase Overpressure Transducer

Measures the pressure inside the engine crankcase.

The transducer is located inside the MAP / COP box above the remote start station. This has a flexible hose connected to the cam gear cover housing.

Brightstar carries out a test on the sensor every time it is powered up, if it detects a issue it will log the fault and display “COP Sensor Bad” on the DID panel.

Crankcase over pressure and resets are outlined in Section 10.3.

10.3.2 Manifold Pressure Transducer

Measures the pressure inside the engine air intake manifold (Turbo Pressure)

The transducer is located inside the MAP / COP box above the remote start station. This has a flexible hose connected to the engine air intake manifold.

Brightstar carries out a test on the sensor every time it is powered up, if it detects an issue it will log the fault and display " MAP Sensor Bad" on the DID panel.

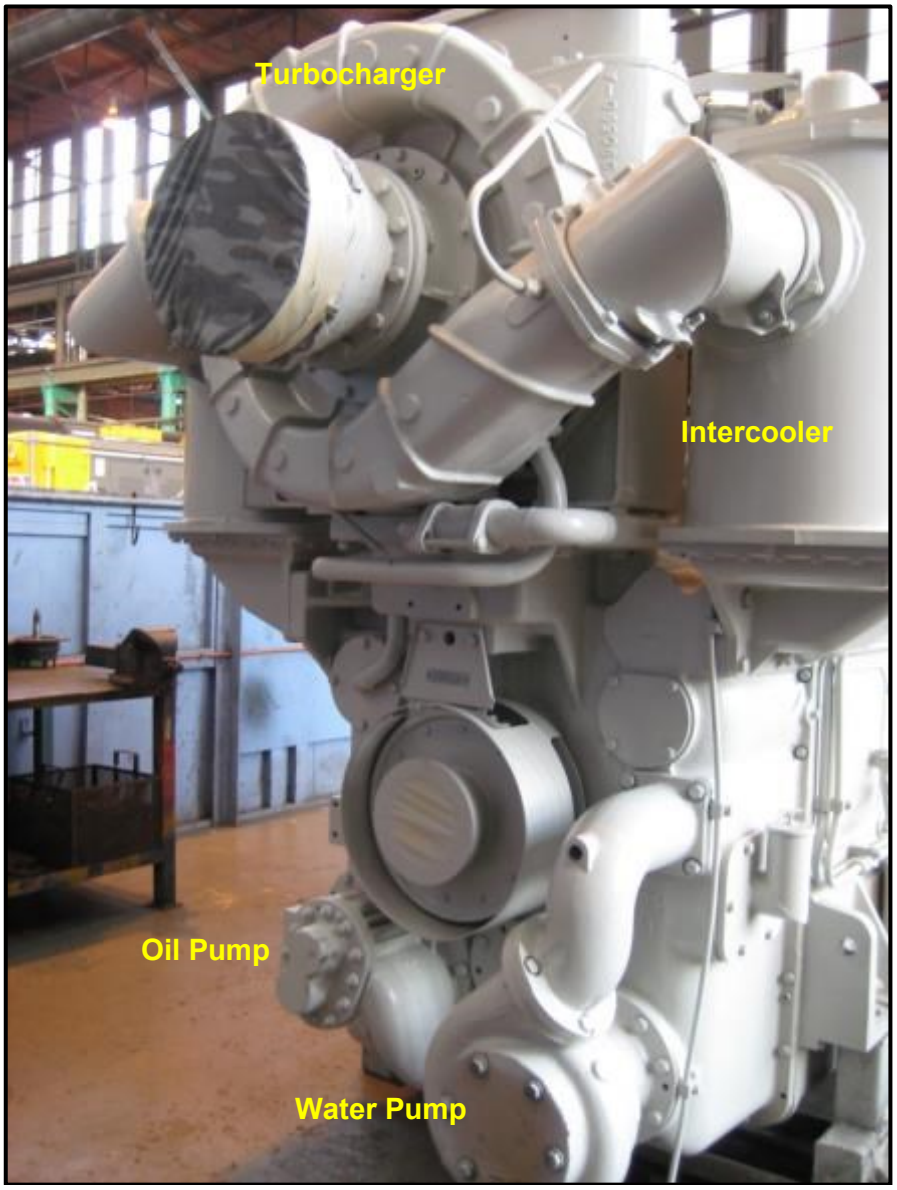
10.4 Turbocharger

This supplies air to the engine air intake manifold at up to 34psi depending on the gross horsepower output of the engine and the throttle notch position.

The turbochargers for the 2900 GHP & 3300 GHP engine are different and cannot be intermixed. The main difference is in the diameter in the turbochargers compressor wheel, the 2900 GHP turbo has a 14” wheel compared to the 16” wheel of the 3300 GHP turbo.

Turbo pressure can be viewed through the DID panel using monitoring parameter MP6327.

Turbo speed is monitored by the Brightstar via a magnetic pick-up probe this can be viewed through the DID panel using monitor parameter MP6081.



10.5 Cooling System

This is pressurised to approximately 90kPa, pressure being controlled by a pressure cap mounted in the lid of the header tank. Because the system is pressurised it raises the boiling point of the cooling water thus the engine can run at a much higher temperature than it would do otherwise.

Brightstar controls the operation of the radiator shutters and the speed of the radiator fan. The system has a water temperature sensor fitted into the engine water outlet pipe. Brightstar carries out a test on the sensor every time it is powered up, if it detects an issue it will log the fault and display " EWT Sensor Bad" on the DID panel.

10.5.1 Horsepower Deration

Horsepower deration will occur if the water or oil temperature reaches 110 degrees Celsius, if the temperature continues to rise the Brighstar will cut all engine output at 114 degrees Celsius. It will 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 KR 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 the corrosion of bare metal within the cooling system.
3. Protects against sludge and mineral scale formation.

Header Tank Sight Glass

NOTE: Should the cooling water become discoloured in the sight glass (oily), the engine **must be shut down.**

If the engine is stopped, it must not be started without special authority from locomotive maintenance staff.

The locomotive should be towed dead to the nearest mechanical depot.

Always book the fault in the Loco 54D book and advise the nearest Mechanical Depot promptly.

10.5.3 Radiator Fan & Shutters

The radiator fan is driven by compressor which is driven by an extension of the engine crankshaft through the engine to compressor driveshaft. The radiator fan or “speed increaser” is operated via a magnetic clutch. The clutch is controlled by Brightstar through two relays. The relays are known as ECR1 & ECR2 one is for half speed the other full speed. The Brightstar will operate the relays depending on the cooling system water temperature.

The fan speed is dependent on two things:

1. Water temperature
2. Engine speed

The radiator shutters are mounted on the top of the radiators. They are operated by the Brightstar via the shutter magnet valve. Should the shutters fail to open, the engine may overheat depending on the work it is doing. First check the air supply cock located inside the door at the rear of the long hood at the bottom right hand side is open. Secondly, obtain the pipe located just inside the rear door to the left and place it on the manual operating lever at head level. Remove the pin, push the lever over and reinsert the pin. The shutters are now blocked open. Remove the pipe and replace in the holder. Book action taken in the Loco 54D book

Extension Pipe

Shutter Lever:
Normal Position

Shutter Lever:
Blocked Open Position

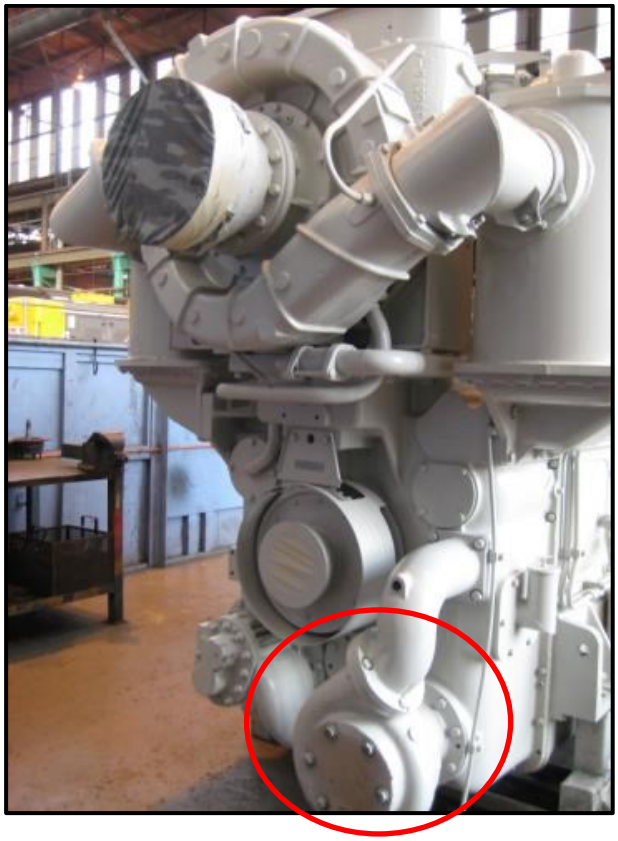
10.5.4 Engine Water Temperature Sensor

Located on the “A” side of the locomotive at the turbo end of the engine.
Measures engine water outlet temperature, the signal is sent back to the Brightstar control panel from which it will then control the shutters and radiator fan.

10.5.5 Water Pump

The cooling system is fitted with a gear-driven pump at the free end of the engine below the turbocharger.

Should water pressure in the engine fall below a pre-set value (as would be the case with a defective water pump) the low water pressure button on the engine governor will “pop” out and the engine will shut down. The alarm bell will ring in all units of the consist while the low water pressure fault will be displayed on the DID panel of the effected locomotive.



10.6 Lubricating System

Oil pressure at idle 140 kPa
Oil pressure at Notch 8 450 – 525 kPa

Oil pump is located on the “A” side at the free end of the engine.

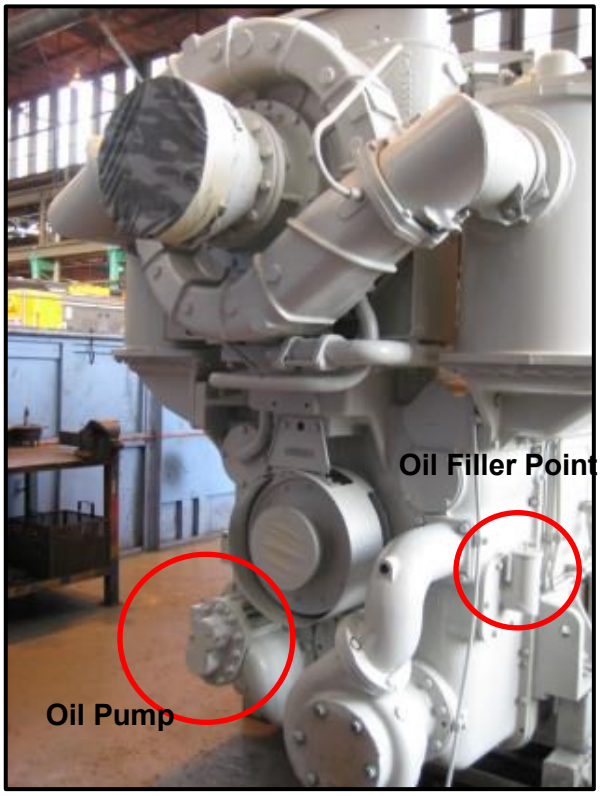
The engine oil level must never go above the “full” mark or below the “add” mark.

Oil is cooled in a heat exchanger located on the floor at the rear of the engine room and lying across the car body. Above the oil cooler is the oil filter housing, this contains a number of paper filters for removing any debris from the oil system to prevent it from entering the engine.

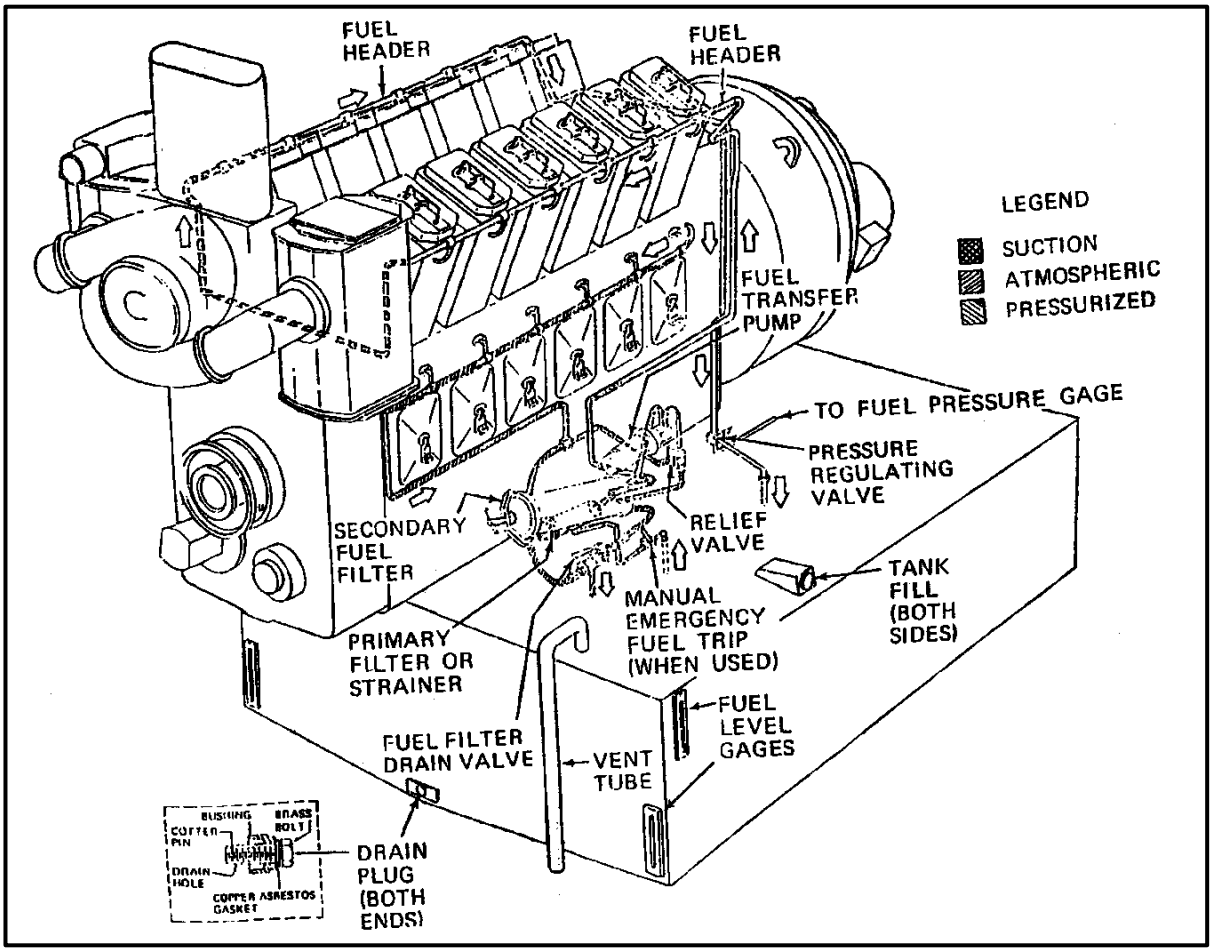
The engine oil temperature is monitored by Brightstar using a temperature sensor, this is mounted in the oil outlet pipe located on “B” side below the turbocharger.

Horsepower deration will occur if the engine oil temperature gets to high – see Section 10.5.1 in the Cooling system for more detail.

The dipstick is located about halfway along the engine on “B” side on most engines whilst the engine oil pan filler cap is placed on the side of the engine on the “B” side below the turbocharger.



10.7 Fuel System



The tank contains 4,500 litres (DXR 6,000 litres). The tank is fitted with two fuel level gauges at different heights on each side at the front end of the tank. The third sight glass in the bottom mid position of the tank has been blanked off due to track debris damaging it.

2900 GHP Engines
The fuel transfer pump is located on “B” side close to the engine oil pan dipstick, the older DC motor and transfer pump are being replaced with a new AC maintenance free unit.

3300 GHP Engines
The fuel transfer pump is located on “A” side towards the generator end of the engine, the older DC motor and transfer pump are being replaced with a new AC maintenance free unit.

2900 GHP Pump Location

3300 GHP Pump Location

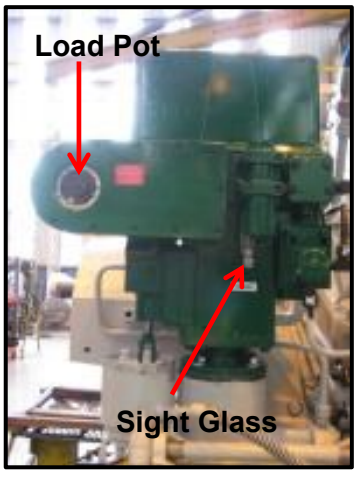
10.8 Engine Governor

This is a Woodward type governor and is fitted to all DX 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 low oil & low water pressure shut down devices

Front view of governor

- Sight Glass – Indicates the position of the governor oil level sight glass.
- Load Pot – Indicates the “Load Pot”. The load pot is in the excitation circuit and can limit excitation is case the diesel engine cannot meet the demand of the electrical load placed on it.



Rear view of governor

- Upper Button – Low Engine Oil Pressure
- Lower Button – Low Engine Water Pressure

If either of these buttons trip the engine will shut down, a fault message will be displayed on the DID panel in the cab. To reset this condition the governor button must be reset. This will automatically reset the Brightstar and the engine can be restarted.

10.8.1 Trip Indicator

When either button has tripped the red indicator will be visible. The position of the reset buttons is such that it is not easily visible.

NOTE: Care must be taken when resetting the buttons as the engine and pipe work will be hot if the engine has been operating.

10.8.2 Governor Functions

- To detect the engine oil pressure when it falls to a dangerous level and stop the engine.
- To detect cooling water pressure and to stop the engine when pressure falls below a predetermined level.
- To increase or decrease engine speeds in response to throttle commands.
- To stop the engine whenever signalled to do so by the emergency stop switch / throttle in ‘stop’.
- To stop the engine whenever signalled to do so by the Brightstar control system
- To ensure the engine operates at its fully rated kW for the throttle notch in use and to ensure that the engine is never overloaded.

11.0 AIR INTAKE SYSTEMS

11.1 Equipment Air

In the compartment at the rear of the PDC (Power Device Compartment) is the equipment blower. This is driven from the alternator gear train though a driveshaft. The function of the equipment blower is to supply a very high volume of cooling air at low pressure to the following equipment:

- Each of the six traction motors to keep their temperatures at a safe level and to exclude dust and other foreign bodies from entering them.
- To cool the main alternator silicon rectifiers and to maintain their temperatures at a safe level.
- Maintain the temperature of equipment in the electrical cabinet at a safe level.
- Provides some cooling for the locomotive batteries.

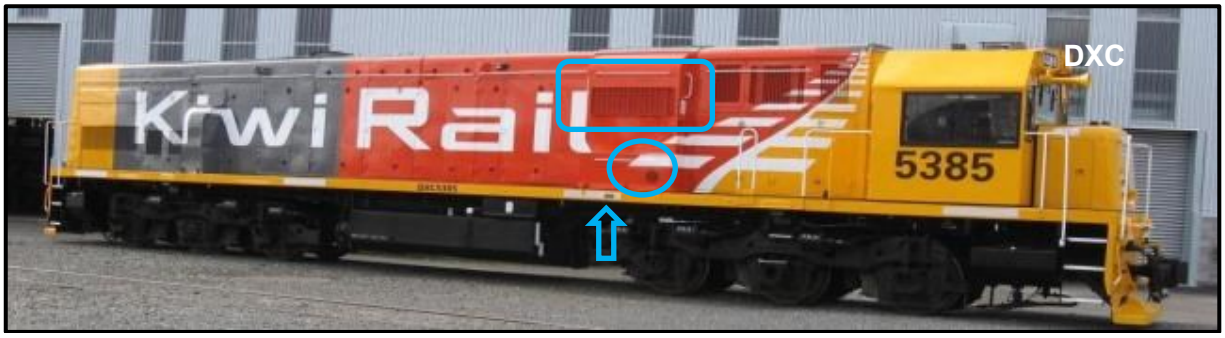
Air is drawn through inertial filters which cause the air to spin, drop off any solids and enter the equipment blower as “clean” air.

The solids are drawn off a belt-driven extractor blower on “B” side at the front of the equipment blower.

The belts are tensioned by a jockey pulley which may seize on its shaft if not greased regularly. This condition can be easily detected by a loud “howling” noise coming from the blower compartment.

DXB & DXC Equipment air intakes and inertia filter extractor outlets.

NOTE: On DXC locos the air intake will be from below the running board when the locomotive is in “Tunnel Mode”



11.2 Engine Air

Engine combustion air is drawn through inertial filters to remove any large dirt particles, then through a large bank of paper filters (located in the compartment at rear of the engine room). This air then passes through a large tubular duct which is connected to the air intake side of the turbocharger. The air is compressed in the turbocharger before being passed through intercoolers to cool the compressed air. It is then blown into the engine intake manifolds.

The air passing through the inertial filters is cleaned whilst the solids are drawn off by an extractor blower mounted near the front of the engine on “A” side. The drive belts are driven off the engine to compressor driveshaft. The belts are best checked from ground level as they are concealed by a sheet metal guard.

If the paper filters get blocked and trip the engine paper filter vacuum switch (EFPS) the Brightstar will drop the horsepower to 62.5% of the nominated throttle notch setting.

The DID will log the fault and display the message “Load Limited” Dirty Engine Air Filter. This fault will automatically reset if the throttle handle is retuned to idle and the fault is no longer present. Automatic resets are limited to 3 within 60 minutes, manual resets can be carried out through the DID panel in level 1.

DXB & DXR engine air intake is through the side of the car body.

DXC engine air intake is drawn from beneath the running board to help with engine cooling while operating in tunnels.

12.0 ELECTRICAL

12.1 Low Voltage

On all DXC & DXB locomotive's a set of 8 batteries are stored inside the carbody at the rear of the electrical cabinet on "A" side. The main purpose of the batteries is for cranking the engine when starting.
DXR locomotives have the batteries on "A" side but near the fuel tank.

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

An analogue battery voltmeter is provided in the CDC. 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.

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 & is converted to DC for traction purposes in a bank of silicon diodes (rectifiers). This power is used to power the traction motors for locomotive propulsion or braking.

In the auxiliary electrical cabinet placed immediately behind the cab on "B" side and accessed via the two pairs of short double doors are two high voltage switches. These are electro-pneumatic switches operated from the EP control reservoir whenever the appropriate controls are operated by the Locomotive Engineer.

Both these switches are floor mounted and run lengthwise to the car body. The switch nearest the cab is the reverser, the furthest from the cab being the brake transfer switch.
The function of the reverser is to allow the traction motors to operate in the direction signalled to do so by the reverser handle in the cab. The function of the brake transfer switch is to select power or dynamic operations as signalled to do so by the cab controls.

Immediately above the auxiliary electrical cabinet is located the dynamic brake fan and dynamic brake resistance grids. When the brake is operating, high voltage power runs the blower which draws cooling air through the intake grills on "B" side. The fan blows the cool air through the resistance grids to prevent them from melting.

13.0 BRAKES

13.1 Brake System

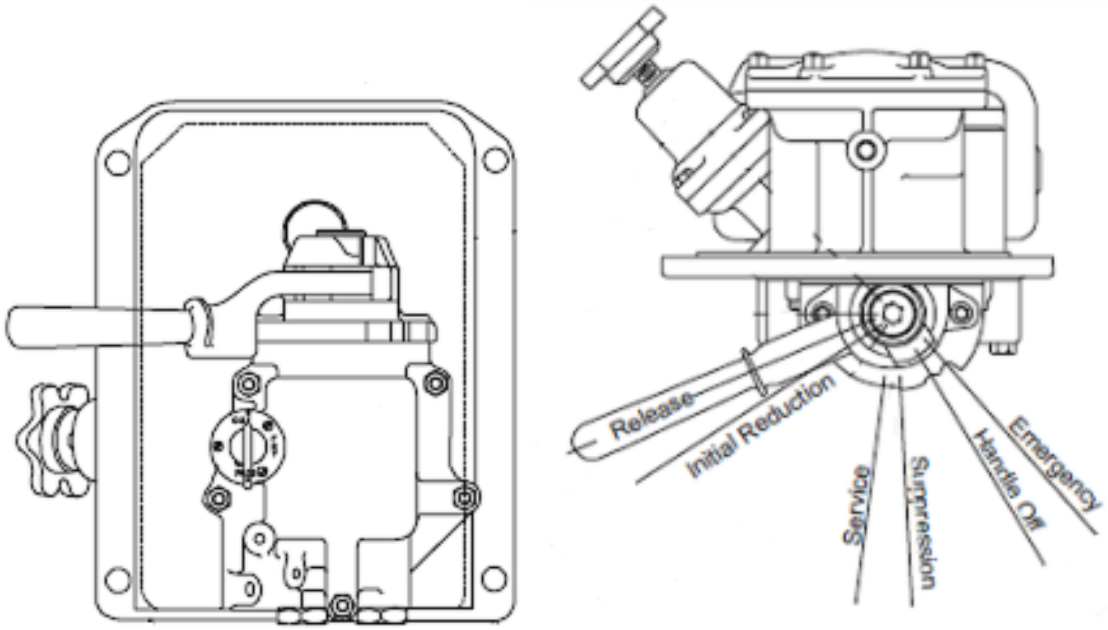
The brake system is a 26L air brake system. Air for the brake system is sourced from the locomotive air compressor. There are two main air reservoirs, No1 reservoir is located in the radiator hood compartment and the No2 reservoir is attached to the back of the fuel tank.

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



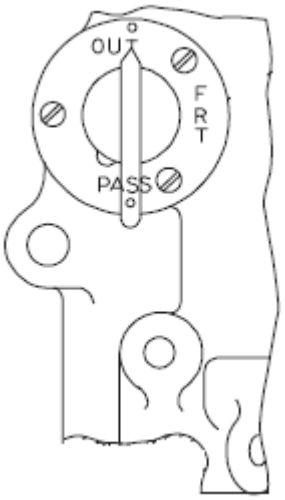
The service zone is between “Minimum Service” and “Handle Off” positions.

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



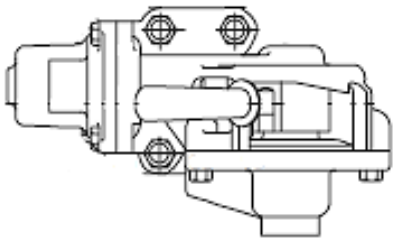
The function of the brake valve with the cut-off valve handle in “FREIGHT” or “IN” position is identical. This position is used to set the 26C brake valve to operate in the “Direct Release” mode when the locomotive is being used to haul a freight train.

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

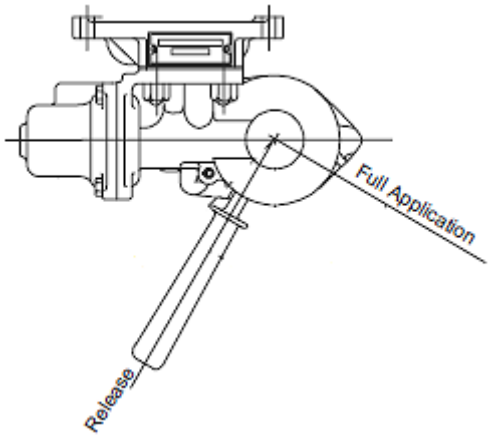
13.3 SA26 – Independent Brake Valve

This brake valve handle has two positions:

1. Release
2. Full Application



Front View

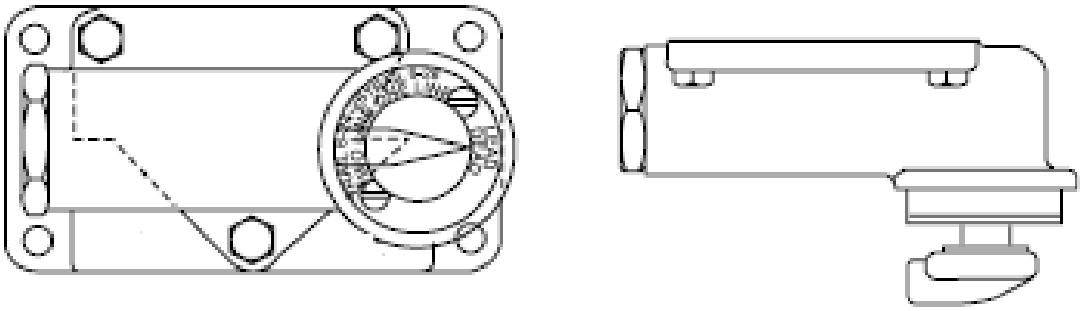


The “Release” position is closest to the operator, an application zone is located between these positions the further the handle is moved towards the “Full Application” the greater the independent brake pressure until the full application pressure is obtained.

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 drivers control stand



MU2A valve has 3 positions:

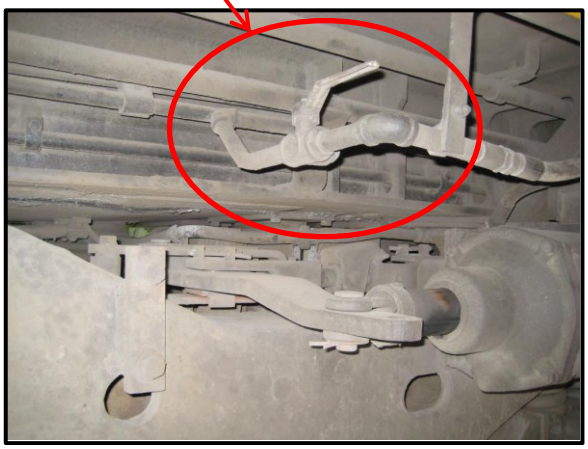
- Lead or Dead
- Trail 6 – 26
- Trail 24

The various positions are indicated on the escutcheon plate

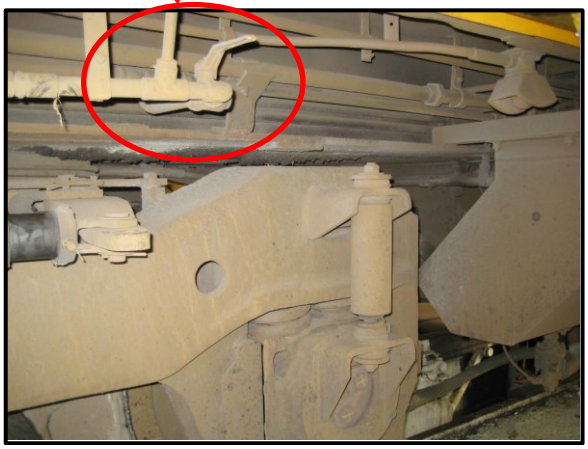
14.0 CUT OUT COCKS

14.1 Bogie Isolation Cocks

Both the No.1 & No.2 bogie isolation cocks are located under the running board on the “B” side of the locomotive.



Rear Bogie



Front Bogie

14.2 Vigilance Isolation Cocks

Located in the short hood and accessed through the “A” side door.

14.3 Front Sander & Dead Engine Cut Out

Located in the short hood and accessed through the “B” side door.

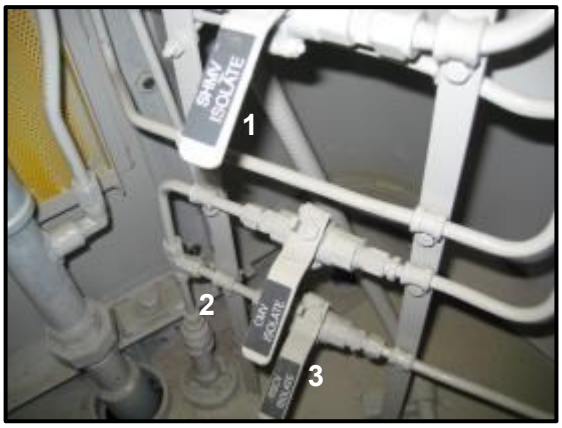
The handle of the dead engine device is painted orange.

1. Front Sander Cut-out
2. Dead Engine Device Cut-out

14.4 Rear Sander, Radiator Shutter & Compressor Unloader

These three cut out cocks are located in the radiator hood compartment and are accessed through the rear door of the compartment.

1. Radiator Shutter Cut-out
2. Compressor Unloader Cut-out
3. Rear Sander Cut-out



14.5 Coal Damper Cut Out (DXC Only)

In the cab above the heater there is a damper control valve, this valve is a two position valve and can be set to “Automatic” or “Manual”.

When in the automatic position the dampers will operate via the Tranzlog GPS way points.

The manual position is a manual override.

There are also air cut out cocks underneath the running board below the equipment air intake ducts both “A & B” side of the locomotive.

14.6 ISRI Air Seat Cut Out

Air supply cut off valve is located on the driver’s control stand.

15.0 EMERGENCY EQUIPMENT

15.1 Location of Emergency Equipment

15.1.1 Emergency Tool Kit

The tool kit is located on “B” side of the locomotive and is mounted on the floor of the Alternator compartment.

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 half door next to the alternator compartment.

15.1.3 Chocks

DXCs

All DXC locomotives have six hardwood chocks stored in each of the lockers below the running board at the front end of the fuel tank.

DXBs

All DXB locomotives have six hardwood chocks stored in a bag and located on “B” side of the locomotive and are located on the floor of the alternator compartment next to the tool bag.

15.1.4 Locomotive Cab Storage Bins

There are two storage bins in each main line locomotive cab. Details of contents are included in the Rail Operation 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 Tranzlog access door.

15.1.6 Emergency Selcall Button

Located in the upper section of the drivers control stand next to the entertainment radio. (Red mushroom button)

16.0 EVENT RECORDER / VIGILANCE SYSTEM

16.1 Tranzlog

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

For all DXB & DXC locos the system is located in the short hood on the “A” side and is accessible through the access door in the locomotive cab. On DXR locomotives it is located behind the cab on the “A” side.

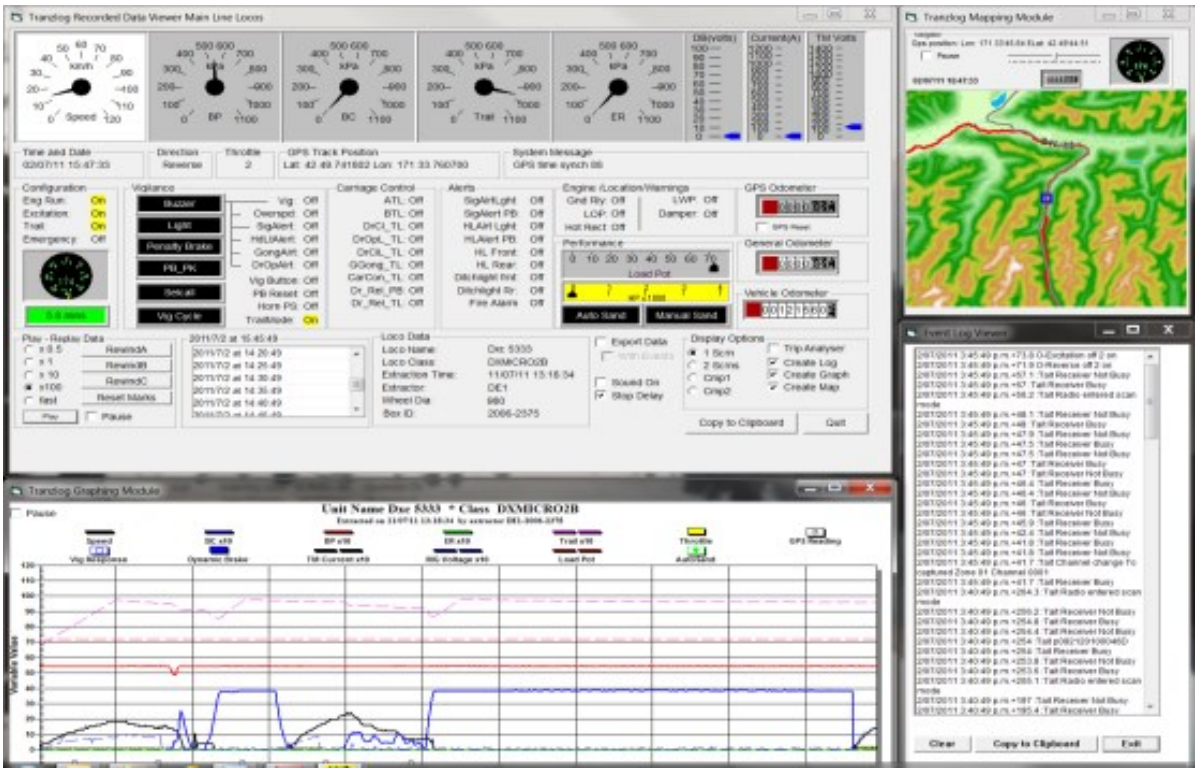
A variable vigilance cycle is employed to ensure the locomotive engineer must perform a function to cancel the cycle. If for some reason the LE does not cancel the cycle the emergency brakes will automatically apply, power is dropped and the train will come to a stop.

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.

Coal Chute Dampers: The damper operation is activated through the Tranzlog via GPS co-ordinates. (Only applicable to DXC class).

Tranzlog interface showing play back of data recording:



17.0 PROTECTIVE DEVICES

17.1 Fire Detection - where fitted

Fire detection is being fitted to the DXC fleet as they pass through for overhaul. In the case of a fire the fire wire will melt tripping a relay and shut down the engine.

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

A fire suppression system is being fitted to DXC locomotives. The system consists of 4 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 control module immediately shuts down the engine, the train line bell is sounded, the red alarm and shut-down LED's are illuminated on the cab display panel, and the alarm buzzer sounds once every 10 seconds.
30 seconds after the engine shut down is initiated the 4 aerosol generators will discharge for 23 seconds. These will flood the engine bay with an ultra-fine potassium-based aerosol. 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 the aerosol has dispersed with the doors open.

Cab Fire Suppression Equipment

Cab Equipment:

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 10 seconds).
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 enroute, 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.

Cab Equipment Continued:

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 LEDs illuminated. Fitted in back wall and only the pin / knob will be visible 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.	

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

If a Fire Condition occurs enroute, 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

Reserved for future use.

19.0 DXR LOCOMOTIVE SPECIFIC

19.1 General Changes

As the DXR locomotives is much larger than any other diesel locomotive, special care is needed when entering depots or servicing buildings.

19.1.1 General Layout Changes

Auxiliary Electrical Compartment (AEC)

- Located in old battery box compartment
- Contains Dynamic Brake contactors and ancillary electrical systems.

WARNING: Contains LIVE Busbars.
"DO NOT" enter this area with the locomotive running.

19.1.2 Battery Box

Located below the underframe at the rear of the fuel tank on the locomotive A-side.

19.1.3 Tranzlog

Located in AEC together with air isolating cocks. Vigilance cut-out cocks are under cut-out switch box.

19.1.4 Ventilation Module

Housed in the A side of the short hood

- Face grill directs air flow to the face and two large outlets at knee level supply all cab air.
- Central grill on the front wall returns (filtered) cab air to the ventilation unit.

19.1.5 Sludge Tank

150 litre capacity compartment is built into rear B-side corner of fuel tank.

19.1.6 Cab Bins

Located under bench unit

19.1.7 Water Container

Located in the AEC mounted to the door

19.1.8 Cab Interior

19.1.9 Control Stand

Radio CB
Located on the backdoor of the control stand and also feeds TEM receiver

Ventilation System
Three control switches located under Brake valve handles

Foot Warmers
Individual control switches for each unit just below ventilation controls.

19.1.10 Headlights / Ditch Lights

Four positions switch:

SHUNT	Headlights DIM, Ditch Lights OFF (prevents glare during shunting).
OFF	All lights OFF
DIM	All lights DIM
BRIGHT	All light BRIGHT

Both front and rear headlights have individual CBs
Front headlight switch controls both the headlight and ditch lights.

19.1.11 Horn

Direct acting pushbutton horn valve is located on “A” side of the cab. The horn isolating cock is located inside the control stand.

Horn units are located behind the front and rear headstocks.

19.1.12 Window Demisters

All windows except the side sliding ones are electrically heated. Control switch is located on the gauge console.

19.1.13 Window Wiper / Washer System

Two speed front wipers (speeds not adjustable) have self-park and wash features.

The control knob provides:

ONE NOTCH BACK	SLOW
ONE NOTCH FORWARD	FAST
TWO NOTCH FORWARD	FAST AND WASH

Rear wiper same controller but speed set by valve in roof locker.
Washer refill bottle (1) is located in the short hood immediately in front of the driver. Refills should include commercial windscreen cleaner.

19.1.14 Rear View Mirror

Designed for two positions;

1. Swung away against the wall for Dual Crew operation.
2. Swung out for Single Crew operation.

NOTE: Once a driver sets up his mirror it can be opened out or closed up by use of the frame hoop without disturbing the setting.

19.1.15 Ventilation System

Control knob:

OFF	
VENT	Systems start and draws in some outside air
ON	System heating is started
RECIRC	Outside air is cut off
CONTROL KNOB	Slow or high fan speed control

NOTE: A 30 second time delay prevents startup of heater whenever engine is started or CHCB is closed.

20.0 DOOR OPERATION

Reserved for future use

21.0 RADIO / PUBLIC ADDRESS SYSTEM

21.1 Tait 8260 Radio

Fitted to all mainline freight locomotives and shunts.

Refer *to the Radio Systems Manual.*

22.0 TRAIN ATTENDANTS

Reserved for future use

23.0 TOWING

1. Set brakes as per 26L brake instructions for Dead Locomotives 3 pipe or BP only.
2. Ensure throttle and DB handle are “off” and reverser selector handle removed.
3. Ensure the EC switch is in the “Start” position.
4. Manually centre the REV contactor in the power compartment
5. Open all circuit breakers.
6. Open knife switch.
7. Book locomotive “prepared for towing” in the Loco 54D book

24.0 FAULTS

Any fault that is displayed on the DID panel is also stored in the “Fault Log”, the operator may view all the 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.

24.1 Level of Faults

The faults that the Brightstar will detect have a programmed “Priority” list, depending on the fault 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 is in the message “Unable to Reset Fault at this Level” will be displayed on the DID.

24.1.1 Automatic Resets

The 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 auto reset if the condition disappears.

24.1.2 Manual Resets

Manual resets are carried out through the DID panel except for “Low Oil & Low Water Pressure” shutdowns.
Both the LOP & LWP governor shut downs are reset by manually resetting the buttons on the governor. Once the governor buttons are reset the Brightstar will then automatically reset the DID and the engine can be restarted.

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.

24.2 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 of a fault that does activate the alarm bell it maybe "Silenced" by pressing the soft key (F3).

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

24.3 Resetting Serious Faults

24.3.1 Low Oil & Low Water Pressure

Logging of these conditions 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.
Both faults need to be reset at the engine governor, the system will reset automatically once the governor button/s are reset.

24.3.2 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.

24.3.3 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 Switches.

To manually cut out a traction motor:

1. Place EC switch to “Isolate”
2. The switches are sprung loaded and must be pulled outwards before being switched and then released.
3. Place EC switch back to “Run”

NOTE: When a traction motor is cut out there will be no “Dynamic Brake” available in the locomotive.

Full horsepower can still be obtained with two traction motors cut out.

24.3.4 Crankcase Overpressure

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

24.3.5 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.

De-ration of the engine will start to occur when either the lube oil or the water temperature reaches 110 degrees Celsius.

If the temperatures continue to rise the horsepower output will become less to a point at 114 degrees Celsius 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 is section 10.5.3.

24.3.6 Hot Diodes

The system will cut all power output if it detects “Hot Diodes”. Each rectifier panel has a temperature switch fitted, all are wired in series.

The fault will reset automatically if it sees the throttle returned to idle and the fault condition no longer present.

Limited to 3 automatic resets within 60 minutes, then it becomes a manual reset (DID Panel)

24.4 Booking of Faults

From a maintainer’s 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, both these items will aid maintenance staff in isolating and repairing the fault.