Rail Operating Code

Code Supplement CS 4.3

Operating Instructions for DSC Class Locomotives

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Original	-	Ron Mail	28 Feb, 1998	-
1	Gary Hutchins (A) Bernard Yap (R)	D. Robin Head of Systems Standards and Governance	21 Jun 2024	-

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PICTURE OF DSC LOCOMOTIVE

1.0 TRAINING AND CERTIFICATION

The training for existing Shunt Class Operators shall consist of a two-hour conversion course.

If not already done so, the operator must also meet the other certification criteria as detailed in *the Competency Management manual*.

2.0 COMMONLY USED ABBREVIATIONS

Abbreviation:	Description:
CB	Circuit Breaker
CCB	Control Circuit Breaker
CCG	Control Circuit Governor
DCA	Direct Cooling Additive
EFR	Earth Fault Relay
EO	Engine Only
LOP	Low Oil Pressure
M/STOP	Manager / Supervisor, Training & Operating Practices
RMS	Remote Manual Switch
RSC	Rotary Screw Compressor

3.0 GENERAL

3.1 Introduction

This locomotive is equipped with two diesel engines, each of which drives a DC generator which supplies current to two traction motors connected in parallel.

If one engine is shutdown, the remaining generator will continue to supply its two traction motors, thus the maximum tractive effort and the power of the locomotive is halved.

Type	(Bo-Bo)
Horsepower (nominal)	1,000
Diesel Engine Model No. of Cylinders Cylinder Arrangement Piston Displacement Compression Ratio Power Output Turbocharger	 Cummins Series NT855, Model L3 or L4 6 x 2 In-line 14 litres 17.5: 1 2 x 298 kW at 2,100 rpm Cummins Type ST.50 lubricated by oil pressure from engine
Compressor Piston Type Rotary Screw Type	 2xAC41 – Capacity 37 CFM AC41+UD160 – Capacity 160 CFM @2000rpm
Lubricating System	Oil pan capacity 34 litres. (To be checked at idle speed)
Cooling System	Thermostatic, pressurised to 105 kPa. Thermostat opens at 92°C to allow full engine cooling.
Fuel System	Tank capacity 1,125 litres. Pressure / Time fuel pump. Unit injectors operate from the engine camshaft.

Maximum Speed	60 km/h
Maximum Driving Amps	600 for 30 minutes
Weight On Rails	41 tonne

3.2 Locomotive

The locomotive is arranged with a central cab with each end having one engine generator set together with a radiator and a portion of the brake equipment.

The control equipment is housed in a cabinet at each end of the cab.

Each cabinet houses equipment associated with the adjacent engine and generator, but items of control gear which are not duplicated on the locomotive, are shared between the two cabinets.

Two compressors are provided; each compressor is mounted in a section of the hood adjacent to the cab bulkhead and driven from the free end of its associated generator by V-belt.

Two blowers are provided to force ventilate the traction motors. Each blower is directly mounted on the main generator and supplies air to two traction motors, the air passing through the centre section of the underframe.

The maximum output of the diesel engine is determined by a fixed stop on the fuel injection equipment. As the generator increases its loading upon the engine, fuel use is increased by the governor until the maximum is reached, after which further loading of the engine causes a reduction in engine speed. This reduction in speed, rapidly reduces the generator voltage and its loading upon the engine until a balance point is reached.

By reducing the engine speed to idle, the output of the generator is automatically reduced to a very low value.

A continuous smooth variation of locomotive speed and tractive effort between standstill and full horsepower is obtained by varying the engine speed.

The action of the driver’s controller is arranged so that when moved into “first point”, the motor contactors close and the generator excitation circuits are completed.

Further movement of the driver's controller increases the engine speed through a pneumatic servo system.

Traction motor field shunting occurs automatically when the generator voltage reaches a predetermined value; similarly if generator voltage falls, full field running is restored.

The traction motors will only operate in weak field at speeds above about 25 km/h and with the driver's controller near the "full on" position.

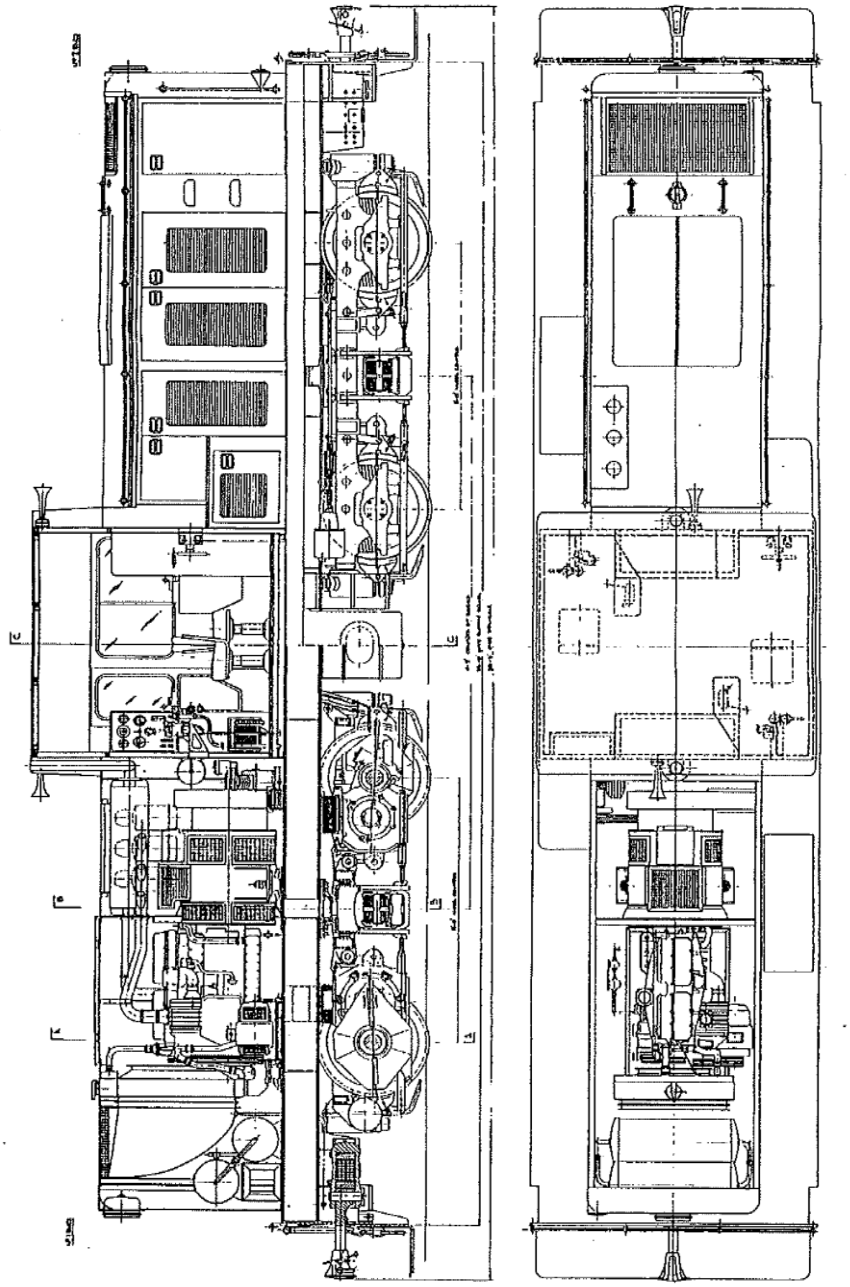
'Authorised personnel' noted in these instructions refers to personnel certified to work in asbestos containing areas with the appropriate training, PPE and site preparation as required.

Entrance to electrical cabinets and engine / generator / compressor compartments is prohibited unless authorised to do so. This therefore will restrict access to switches / relays and other equipment contained within these compartments.

4.0 GENERAL DIAGRAMS

4.1 Arrangement of DSC

(Refuges have not been shown)

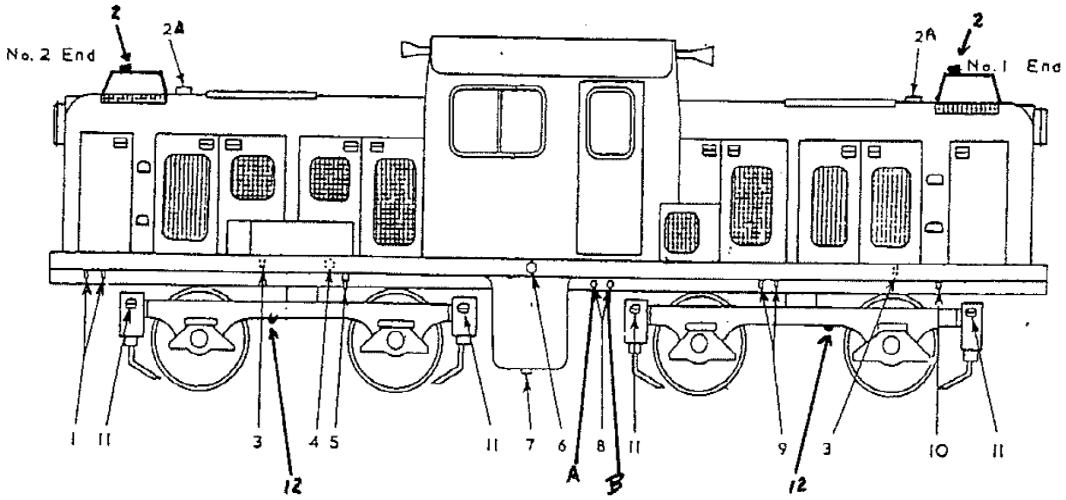


4.2 Location of Equipment

1. Main Air Reservoir Drain Cock (4)
2. Header Tank (2)
2A. Radiator Cap (2)
3. Engine Sump Drain (4)
4. Reservoir Isolating Cock (1)
5. Centrifugal Dirt Collector Drain Cock (1)
6. Fuel Tank Filler Cap (2)
7. Fuel Tank Drain Plug (3)
8.* Bogie Isolating Cock (4) 2 on each side
10. Radiator Drain (2 cocks inside compartment)
11. Sand Box Filler Cap
12. Triple Valve Bleed Wire (2)

* Cocks on end concerned behind steps.

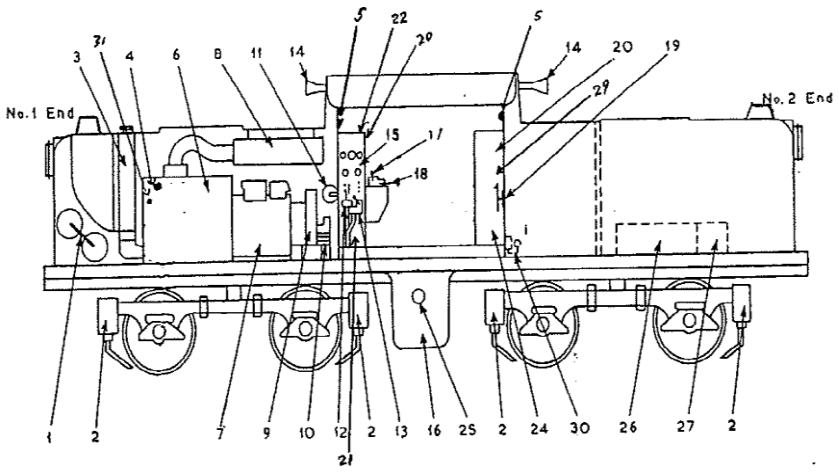
A. Cock closest to cab isolates independent brake on that bogie.
B. Cock furthest from cab isolates automatic brake on that bogie.



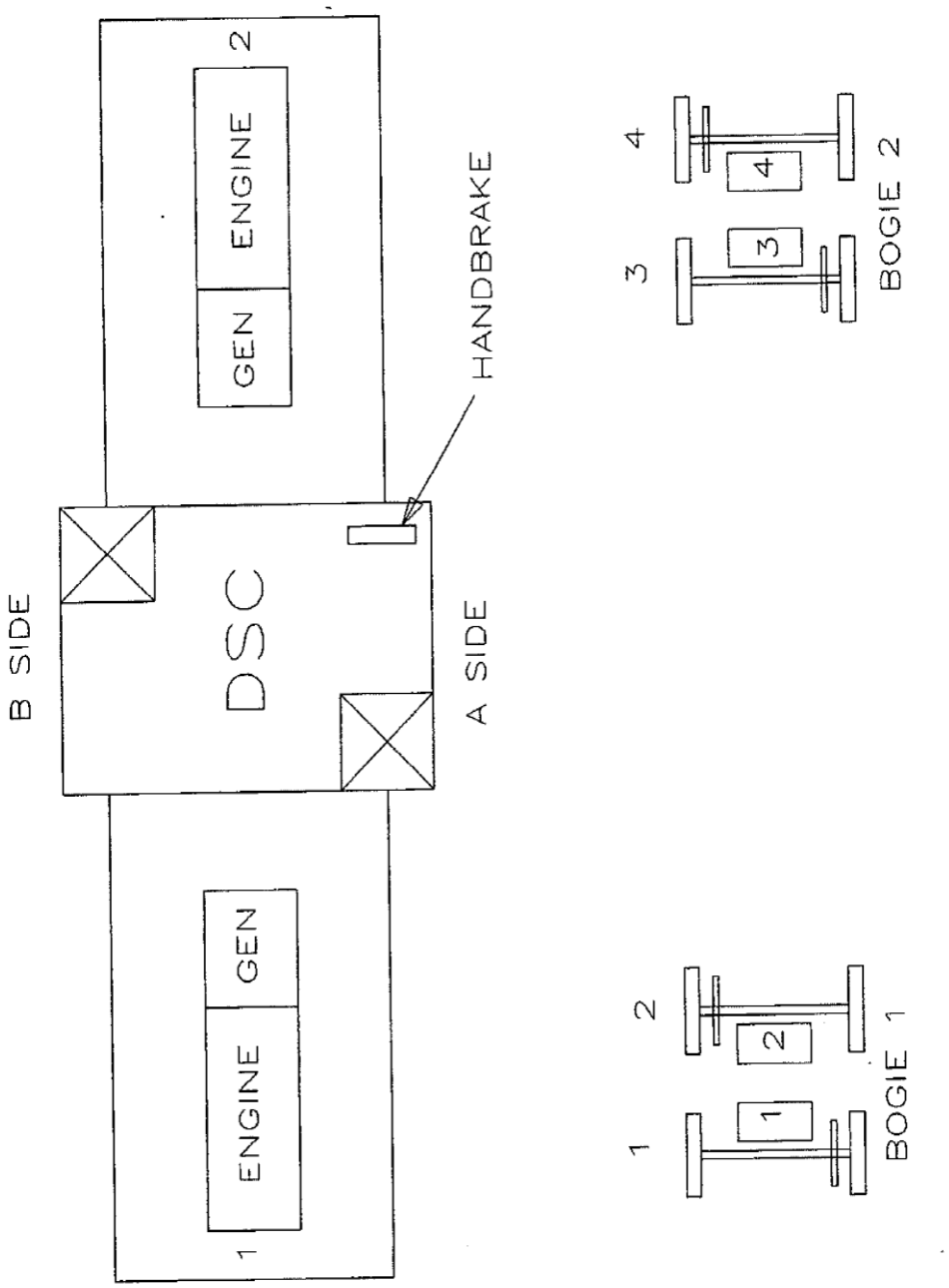
Elevation (From right hand side)

1 Air reservoirs.
2. Sander boxes.
3. Radiator.
4. Turbocharger (far side of engine).
5. Horn cut-out cocks.
6. Diesel engine.
7. Main generator.
8. Engine silencer
9. Traction motor blower.
10. Compressor.
11. Equalising reservoir.
12. Straight air brake handle.
13. Auto brake handle.
14. Horns.
15. Driver's instrument panel.
16. Fuel tank.
17. Power handle.
18. Forward-Reverser Handle.
19. Handbrake wheel.
20. Control cubicles.
21. Cab heater.
22. Fuse panel. (Inside control cubicle No.1 End)
24. Clothes locker
25. Fuel gauges (one each side).
26. Battery box (one each end).
27. Battery isolating switch (one each end)
29. Immersion heater socket (one each side).
30. Control governor and pressure gauge
31. Engine overspeed reset

Location of Equipment on Locomotive



4.3 Bogie Arrangement



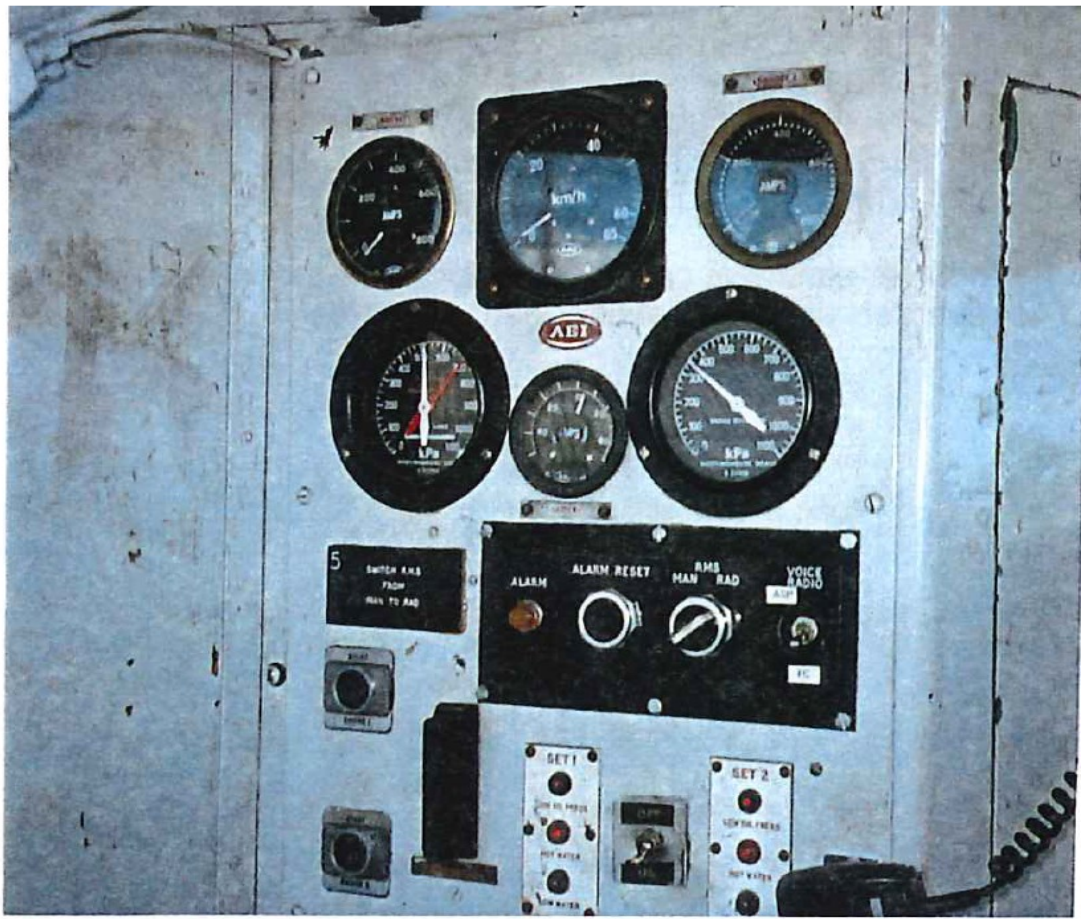
5.0 CAB CONTROLS / LAYOUT

5.1 Instrument Panel in Cab

The driver's position includes a controller with power and reverser levers and an instrument panel mounted with air brake gauges, speedometer, load ammeters for both generators, battery ammeter, engine "stop / start" switch, switches for the appropriate head, tail, step and instrument lights, engine start buttons and an engine warning light oil, water, low / hot.

The engine start pushbuttons are located on the instrument panel together with a control CB and the cab light switch.

There are sockets for immersion heaters and inspection lamps and cab heaters with electrically driven fans.



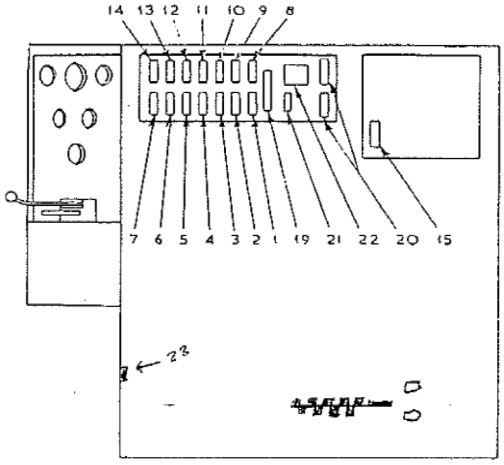
Select DSC locomotives (including DSC2406, DSC2652, DSC2693) have been modified to a relayed brake system that will maintain against BP leakage when shunting AK carriages. This modification replaces the No.1 end BC gauge with a duplex BC / BP gauge.

5.2 Control Cabinet

No.1 End

1. F.1, inspection lamp sockets fuse, 5 amp.
2. F.2, cab heater fans fuse, 5 amp.
3. F.3, instrument panel lights, cab lights, shunter's step lights fuse, 5 amp.
4. F.5, red light fuse No.1 end, 5 amp.
5. F.6, red light fuse No.1 end, 5 amp.
6. F.7, red light fuse No.2 end, 5 amp.
7. F.8, red light fuse No.2 end, 5 amp.
8. Spare fuse, 15 amp.
9. F.11, immersion heater fuse, 15 amp.
10. F.12, immersion heater fuse, 15 amp.
11. F.9, alarms and stops fuse, 5 amp.
12. Spare fuse, 5 amp.
13. Radio.
14. F.13, field shunt relay fuse, 5 amp.
15. F.14, No.1 auxiliary generator field fuse, 5 amp.
19. F.10, external battery charge fuse, 60 amp.
20. Fuse tester.
21. F.4, headlights fuse (Nos. 1 and 2 ends), 15 amp.
22. Fuse test lamp.
23. Motor cut out/in set 1 and 2 (MC1).

In lower electrical cabinets are air operated magnet valves (for reverser) and manual change for reverser



No 1 End

5.3 Driver's Controller

This has two handles "Power" and "Reverser".

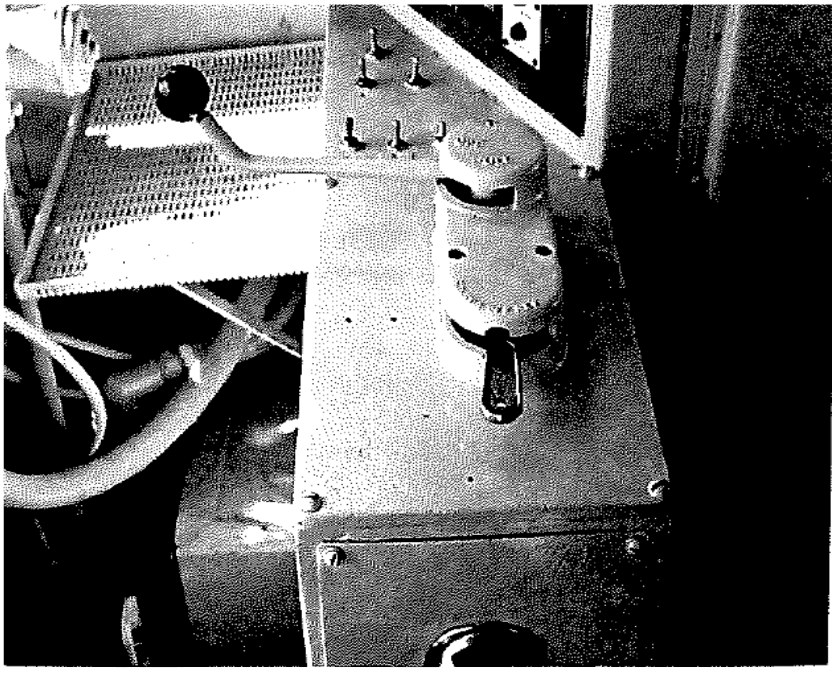
The reverser handle has four positions:

- Engine Only (EO)
- Forward
- Off
- Reverse

And is interlocked with the power handle so that the power handle cannot be moved unless the reverser handle is in the "EO", "Forward" or "Reverse" positions.
The reverser handle cannot be moved unless the power handle is in the "off" position. The reverser handle is a key which can be removed in the "off" position to prevent interface with the controller.

The power handle operates electrical contacts and the air control valve for the engine speed, movement of the handle controlling air pressure from 0 – 350 kPa.

With the reverser in the "EO" position, the power handle can be moved to increase engine speed without the motor contactors closing. This enables the compressor to be speeded up and the main reservoirs charged quickly, whilst the locomotive is stationary.



5.4 Alarms

Each diesel engine is provided with automatic warning alarms for failure of lubricating oil pressure, loss of cooling water or high-water temperature. Three indicating lights are provided at the driver's position for each engine. One indicates loss of cooling water, one low lubricating oil pressure, and one high water temperature. The lights normally glow dimly to prove that the bulbs are sound, but glow brightly in the event of a fault developing.

In bright sunshine it may be necessary to cup your hand around the alarm lights to check that they are in fact glowing dimly. These alarms must be carefully observed since there are no oil pressure or water temperature gauges in the cab and the lights are the only indication of abnormal conditions.

The engine should not be left running if the alarm lights fail to glow dimly.

5.5 Fuses

All fuses are mounted on a panel located in the desk. Spare fuses are also mounted on the panel together with a fuse tester.

The CCB is mounted on the instrument panel. This CB protects traction motor operation and also serves as a controller isolating switch.

6.0 PRE-START PROCEDURES

6.1 Outside Checks

- Check fuel level in the tank by the gauge on either side adjacent to the cab steps.
- Check sand boxes are full.
- Check for leakage of fuel, oil, and water.
- Check both sets of reservoir drains at No.1 and No.2 ends.
- Check brake block thickness is sufficient for the shift.
- Check the bogie isolating cocks are in the cut-in position.
- Check brake cylinder piston travel and if necessary adjust the brakes (provided the locomotive is fitted with the hand adjustable type brake adjusters like those fitted on some main line locomotives). If any other type of brake adjuster is fitted, than any adjustments must be carried out by Maintenance personnel.
- Check for loose, missing, broken, or dragging parts.
- Check engine and contactor compartments to ensure there are no flammable material present. As well as being a fire hazard, the lighter material may be drawn into cooling ducts reducing air circulation and causing overheating in generators and traction motors, with consequent risk of breakdown.
- Check radiator recovery tank water levels at both ends. If low advise Maintenance personnel

  NOTE: This check must not be carried out under Overhead Wires
- Check drive belts to radiator fan, auxiliary generator, fuel transfer pump and compressor at each end of the locomotive.
- Check compressor oil levels. Top up if required and record in Loco 54D book.
- Close BKS in each battery box.

Due to asbestos issues, the following Pre-Start checks are to be carried out by authorised personnel only on locomotives with ACM.

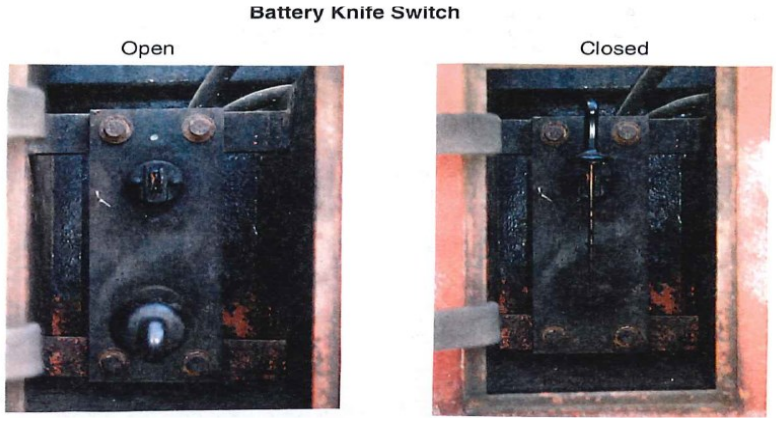
On a weekly basis, authorised through training and site preparation as per the DSC ACM Management Plan.

- Check engine and contactor compartments to ensure there is no flammable material present. As well as being a fire hazard, the lighter material may be drawn into cooling ducts reducing air circulation and causing overheating in generators and traction motors, with consequent risk of breakdown.
- Check drive belts to radiator fan, auxiliary generator, fuel transfer pump and compressor at each end of the locomotive.

7.0 START UP PROCEDURES

7.1 Starting the Engine

1. Check the Loco 54D book for any open bookings.
2. Ensure handbrake is “on”.
3. Check that the push down throttle and brake remote transfer cocks are down.
4. Check that the RMS is in the “MAN” position.



5. Check that the isolation switch is “on”. This switch is on the wall of the cabinet next to the Loco 54D book.

6. Check the throttle and reverser are both “off”.
7. Ensure the local control switch is “on” (large black switch marked 1). Usually this switch is left “on”.
8. Turn Stop / Start switch to run No.2 end. Warning lights come on and the buzzer sounds.
9. Ensure headlights are “off”.
10. At the control panel, push the start button for the No.2 end and hold in until the ammeter shows a charge. Once the engine is running the buzzer will cancel; if the buzzer does not cancel then repeat the procedure.

11. At the control panel turn the Run / Stop switch to “run” and push the start button for No.1 end. Hold in until the ammeter shows a charge and the engine is running. Once the engine is running the buzzer will cancel, if the buzzer does not cancel then repeat the procedure.

    NOTE: The engine must fire within 30 seconds otherwise a cooling down period for the starter motor must be allowed before attempting a restart.

12. Check alarm lights, which should glow dimly providing everything has been checked properly. If any alarm light stays bright, the engine should be stopped, and fault checked and rectified.
13. Wait until the main reservoir is fully charged.
14. Carry out a brake valve leakage test.
15. Check for adequate oil in engine oil sump (the engine must be idling). Top up if required.

16. Check both engines for fuel, oil and water leaks, if unable to rectify, enter in the Loco 54D book and if necessary, advise Maintenance personnel.
17. When there is sufficient air, check operation of BOTH brake valves which are to be tested in ALL POSITIONS.
18. Air pressure may be increased more rapidly if the throttle is opened NO MORE than halfway with the reverser key placed in “EO” position.
19. There should be at least 550 kPa in the main reservoir before moving the locomotive.

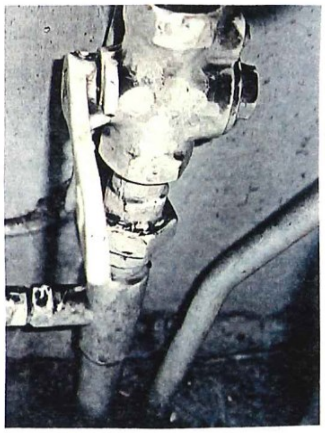
    IMPORTANT: To protect the turbocharger bearings, the engine must be allowed to idle for at least 3 minutes before increasing speed.

7.2 Changing to Remote

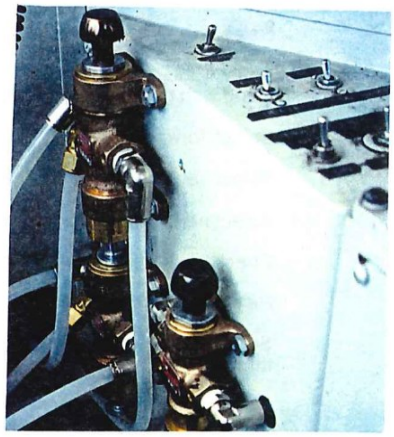
With the engine running and main reservoir pressure fully charged, the locomotive is now ready to be switched to radio operation:
The following instructions relate to the Arataki equipment.

1. Straight Air Brake Valve to “Full Service”.
2. Train Brake Valve handle to “Running” position.
3. Turn “on” external warning beeper and lights.
4. Cut-out both isolating cocks for the train brake (one on each side of the central stand)

Train Brake Isolating Cock



Throttle and Brake Transfer Cocks



5. Pull “up” the throttle and brake remote transfer cocks and remove the forward reverser key.
6. Switch “on” the RMS to the “RAD” (radio) position
7. Check the alarm lights is not illuminated, if it is on, press the alarm reset button, the light should extinguish. If it stays illuminated, check:
   - Main reservoir air
   - Water – May be low or hot.
   - Low oil pressure
8. With the controller off, check brake cylinders for air pressure indicating locomotive brakes are applied.
9. Turn controller “on” with the key (do not hold down the PTO switch while turning on).
10. Hold down the PTO switch.
11. Switch the ES override to “off”.
12. Sound the horn to verify operation of the remote.
13. Release the hand brake.

8.0 OPERATING

8.1 Throttle

The throttle is air operated works similarly to a self-lapping air brake valve. When the throttle is opened, compressed air is sent from the throttle to the throttle actuator on the engines which in turn moves the fuel rakes to the required setting to increase the speed in each engine.

The throttle actuator is a Westinghouse air operated diaphragm type, engine mounted and connected to the governor operating lever by adjustable linkage.

8.2 Reversing

The locomotive must be stopped.

The locomotive must NOT be reversed whilst it is in motion as severe damage to reversers and traction motors will result.

8.3 Moving

1. The CCB must be “closed”.
2. There must be at least 550 kPa in the main reservoirs.
3. Release hand and air brakes.
4. Place reverser in desired direction of travel.
5. Engage throttle in first position and watch both ammeters.
6. Advance throttle to setting necessary to move the locomotive or train.
7. Maximum amperage must not exceed 600.

8.4 Maximum Speed

Maximum speed must not exceed 60 km/h.

8.5 Maximum Driving Amperage

The maximum generator current when running a train must not exceed 600 amps. This current may be exceeded momentarily only when starting and accelerating.

To avoid damage to motor contactors and wiring, the controller must not be shut off completely when the locomotive is moving at a low speed with driving amps high. In this case the controller should be returned to first point and then a pause made until driving amps drop to approximately 200 and then return the controller to the “off” position. The air brake can be gradually applied during this time to prevent severe run out or in of slack.

9.0 SHUT DOWN PROCEDURE

9.1 Stopping the Locomotive

1. Return the throttle to first point position.
2. Apply the brake when amps are below 200.
3. Close the throttle.

This method will reduce the slack action to a minimum as well as reducing arcing from the motor contactors.

9.1.1 Changing from Remote to Manual

1. Stop the locomotive.
2. Switch the ES Override switch to “on” and release the PTO.
3. Switch the transmitter “off” by using the key on the side of the remote pack.
4. Inside the locomotive, apply the handbrake.
5. Push down the throttle and brake transfer cock.
6. Switch the RMS to “MAN” position.
7. Turn off the strobe and external warning beeper switches.

9.2 Shutting Down the Diesel Engine

1. Place throttle lever and reverser handle to “off” position.

   IMPORTANT: Engine must not be shut down unless it has been at idle speed for at least 5 minutes. This is to enable the turbocharger to run down. If this precaution is not taken, severe damage may occur to the turbocharger bearings through lack of lubrication.
2. Book all repairs necessary in the Loco 54D book and advise Maintenance personnel.
3. Place both Stop switches in the “stop” position to stop the engines.
4. Remove the reverser.
5. Switch off all CB’s.
6. Turn “off” all lights.
7. Open the BKS in each battery box.

9.3 Precautions When One Engine Isolated

Should a fault develop on one end, and it is necessary to stop the engine, the motor cut-out switch on the end with the engine stopped must be placed in the cut-out position before the locomotive is again operated.

10.0 DIESEL ENGINE

10.2 Radiator Coolant Recovery Tank

Water is expelled from the radiator into the coolant recovery tank due to expansion as the engine warms up. Subsequently the water will return from the tank to the radiator when the engine cools down. The tank also provides treated water to the radiator if a small leak is present. A leak can be detected by the falling water level in the coolant recovery tank.

The water in the tank is treated with “DCA” radiator inhibitor. If fresh water only is added, the “DCA” concentration will be diluted with possible serious damage to the engine.

The following check is to be made at the beginning of each shift or at changeover.

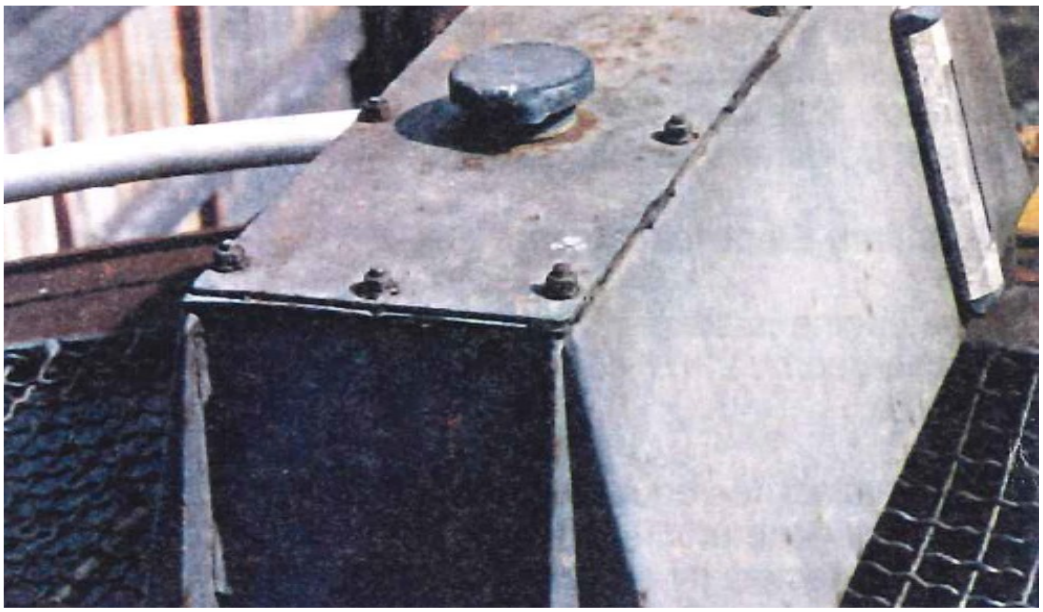
WARNING: Never carry out this check when under the Overhead Wire

Check coolant is visible in the sight glass of the recovery tank. When the engine is cold the level may be low, but no action is required if coolant is visible.

If coolant is lost during a shift and the level falls below the sight glass on the coolant recovery tank, then the locomotive must be returned to the depot for attention and refilling as a significant leak will be present in the cooling system.

NOTE: Should it ever ne necessary to top up the system, this must be entered in the Loco 54D book so that depot staff can add the necessary chemical treatment at the earliest opportunity.

If the cooling water is allowed to become too low, the low water sensor will become uncovered by water surging (particularly during shunting) and the engine will stop.



11.0 AIR SYSTEMS

11.1 Compressors

Piston Compressor
The original compressor arrangement is two Broomwade AC41 air compressors, one on each side of the locomotive and mounted in a separate section of the hood adjacent to the cab bulkhead and driven from the free end of its associated generator by V-belts.

The operation of the compressors is controlled by a governor which in conjunction with the unloader, ensures the air pressure in the main reservoir is maintained between 650 and 725 kPa when the locomotive is working.

The compressors should require no attention except a daily check of oil levels in the sump and an examination of the belts to ensure that they are tensioned correctly.

Rotary Screw Compressor
Select DSC locomotives (including DSC2406, DSC2340, DSC2379, DSC2665) replaced one of the AC41 compressors with one Rotary Screw Compressor UD160 to ensure adequate air supply for controlling long rakes of wagons.

The UD160 compressor is mounted at No.1 end, in a modular cabinet on the running board and driven from the generator by V-belts. Locomotives fitted with one rotary screw compressor still retain one piston compressor on the diagonally opposite end of the locomotive. Normal operation of the one reciprocating compressor applies.

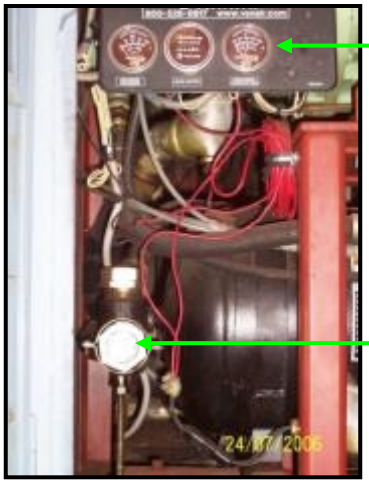
WARNING:
DO NOT REMOVE CAPS, PLUGS AND / OR OTHER COMPONENTS WHEN THE COMPRESSOR IS RUNNING OR PRESSURISED.
THE COMPRESSOR MUST BE STOPPED AND RELIEVE PRESSURE BEFORE COMMENCING ANY WORK.

11.2 Governor and Unloader

When the pressure in the main reservoir reaches 725 kPa the governor allows air to flow to the unloader which is connected to the compressor delivery pipes. The unloader then opens and allows the compressor to pump to atmosphere, the compressors thus running light until the main reservoir pressure drops to 650 kPa.
At this point the governor cuts off the air supply to the unloader, the valve closes and allows the compressors to again deliver air to the main reservoir.

11.3 Daily Operation

Prior to starting the compressor, it is necessary to check the fluid level in the sump.
Should the level be low contact Maintenance personnel to add the necessary amount of fluid and record in the Loco 54D book.
If the addition of fluid becomes frequent, a problem has developed which is causing this excessive fluid loss. Contact Maintenance personnel and record in Loco 54D book.



Refer to the Troubleshooting Chart (Section 24) under Excessive Fluid Consumption for a probable cause and remedy.

Check belt tension of compressor drive. Belt deflection no greater than 10mm, if greater than 10mm deflection, record in Loco 54D book for attention.

After a routine start has been made, observe the instrument panel gauge and be sure it indicates the correct reading (within the operating zones) for each particular phase of the operation. After the compressor has warmed up, it is recommended that a general check on the overall compressor and instrument panel be made to assure that the compressor is running properly. Undue noise and vibration are to be recorded for further investigation.

NOTE: When the compressor is operating at the full supply air a relief valve will exhaust to atmosphere. This can be heard from the exterior of the locomotive. This exhaust is not a fault or air leak.

11.3.1 Lubricating Oil

Refer to the M2000 Lubricating Schedule.

WARNING: ONLY THE RECOMMENDED OIL IS TO BE USED.

11.3.2 Instrument and Safety Devices

The standard instrument panel contains the following:

- Pressure Switch Gauge.
- Temperature Switch Gauge.
- Hour Meter.
- Shutdown Relay.

11.3.3 Pressure Switch Gauge

Indicates compressor system air pressure and also an over-pressure switch set at 170 PSIG.

11.3.4 Temperature Switch Gauge

Indicates compressor discharge air temperature from the compressor and also contains an over-temperature switch set at 240^{o} F.

11.3.5 Hour Meter

Records ongoing hours the compressor is operated. It can be used for scheduled maintenance purposes etc.

11.3.6 Shutdown Relay

Responds to over-pressure and / or over-temperature conditions to trip the relay which will shut down the engine.

11.3.7 Pressure Relief Valve

Fitted to the receiver tank, is set to relieve at 175 PSIG. This backs up the electric shutdown on over pressure mentioned above.

11.3.8 Oil Fill Plug

Has a safety relief vent hold, which will start to relieve pressure if any attempt is made to remove the fill plug without first ensuring that all system pressure is vented to atmosphere.

11.3.9 Blowdown Valve

Automatically vents compressor system pressure upon shut-down for normal compressor shut-down and in the event of an emergency over-pressure / over-temperature shut-down condition.

11.4 Troubleshooting

The system has been designed to protect the compressor from several forms of failure. Should the locomotive shut down (engine stop running), the locomotive cannot restart until the fault on the compressor has been investigated. Depending on the failure mode the locomotive engine will continue to shut down until a corrective action has occurred.

The Rotary Screw Compressor has NO RESET BUTTONS on the gauge panel. Should the locomotive shut down due to compressor over-temperature or pressure the locomotive cannot be restarted until the cause has been remedied or the temperature / pressure has reduced to a safe operating level.

The information contained in the Troubleshooting Chart (Section 24) has been compiled from field report data and factory experience. It contains symptoms and usual causes from the described problems. However, DO NOT assume that these are the only problems that may occur. All available data concerning the trouble should be systematically analysed before undertaking any repairs or component replacement procedure.

A detailed visual inspection is worth performing for almost all problems Doing so may prevent damage to the compressor.

Always remember to:

- Check for loose wiring.
- Check for damaged piping.
- Check for parts damaged by heat or an electrical short circuit, usually noticeable by discolouration or a burnt odour.

Should the problem persist after making the recommended check, record the fault in the Loco 54D book and notify Maintenance personnel.

12.0 ELECTRICAL

12.1 Control Circuit Interlocking

The control circuits are electrically interlocked to prevent incorrect operation.

The engine start pushbuttons are connected so that only one engine can be started at a time. The starting contactors are also interlocked with the motor contactors so that the start contactors will not close if a motor contactor has remained closed; similarly, the motor contactor will not close if the starting contactor has remained closed.

The battery contactors are also controlled by an interlock on the starting contactor of the opposite set so there is no possibility of the auxiliary generator on the first set to be started, trying to supply starting current to the second set.

A further contact on the battery contactor is fitted in the alarm light circuit so that these lights only light up when the set is running correctly, i.e., when one engine is shut down its alarm lights are extinguished.

The supply to the master controller is fed through the earth leakage relay contact and through the control governor. This ensures that the traction circuit is interrupted in the event of an earth fault and that the locomotive cannot be moved unless there is sufficient compressed air available for safe operation of the brake.

When starting a locomotive, the initial movement of the driver's controller from the "off" position will energise the reverser circuit and move the reverser to the correct position. The motor contactors cannot close until the reverser has thrown to the same position as the driver's reverser handle.

12.2 Auxiliary Electrical System

The engine is started from a 36-cell lead acid battery. This battery is charged by 2 kW auxiliary generators, one belt driven from each engine.

The system is regulated automatically at 74 volts whenever one auxiliary generator is running. The electronic voltage regulators are interconnected to ensure load sharing when both generators are operating in parallel.

This auxiliary system also supplies control, excitation, and lighting current.

13.0 BRAKES

13.1 Straight Air Brake Valve

This is a self-lapping type “W” valve with which the degree of braking is proportioned to the arc of movement of the brake valve handle.

13.2 Reducing Valve

A type C.M.6 reducing valve is fitted in the pipe leading from the main reservoir to the brake valve and is set to limit the air pressure at the brake valve to 400 kPa. This limits the brake cylinder pressure minimising wheel slide.

13.3 Equalising Brake Valve No.4

This brake valve has these positions:

- Release
- Running
- Lap
- Service
- Emergency

13.3.1 Release Position

This position is used to release the train brakes and / or recharge the brake pipe.

It allows main reservoir air flow to direct into the brake pipe.
Care must be taken not to have the brake valve handle in this position for too long a period otherwise the brake pipe pressure will increase above 550 kPa, causing the brakes to remain applied.

13.3.2 Running Position

This is the normal position of the brake valve handle. In this position the brake valve pressure is maintained at 550 kPa.
Do not use this position to release the brakes as the brakes may not release fully causing dragging brakes.

13.3.3 Lap Position

The brake valve handle is placed in this position after a service application of the brakes has been made. It stops any further loss of brake pipe air to atmosphere (other than for brake pipe leakage). This position holds the brakes applied.

13.3.4 Service Position

This position is used to apply the brakes. Once the required brake pipe pressure reduction has been made, place the brake valve handle in “Lap”.

The initial reduction of brake pipe pressure should be between 50 – 60 kPa. Further reductions can be made to stop the train as required. After the train has come to a stop the brake pipe reduction should be increased to 100 kPa before releasing the brakes. This greater reduction allows a better release of the train brakes. Do not make a reduction of greater than 157 kPa. The brakes are fully applied at this stage and will not go on any harder.

13.3.5 Emergency Position

This position is only used un an emergency. It will dump the brake pipe air directly to atmosphere; the brakes will apply rapidly and with full force.

Do not release the brakes until the train comes to a stop, otherwise the locomotive may run out causing the train to break in two.

13.4 Testing Brakes

1. Straight air brake fully applied.
2. Ensure that all pressures are correct.
   - Brake pipe pressure 550 kPa
   - Main reservoir pressure between 650 and 725 kPa
3. Make a 75 kPa brake pipe reduction, then place the brake valve handle in “Lap”. Close the brake valve isolating cock.
4. Place the brake valve handle in “Running”.
5. Check that the brake pipe pressure does not fall more than 20 kPa per minute.
6. If all is correct cut-in the brake valve isolating cock and release the brakes.

13.5 Overcharged Brake Pipe

Make a series of brake pipe reductions and releases as per the following:

1. Make a 100 kPa reduction.
2. Place the brake valve handle in “Lap”.
3. Wait until the pressures have equalised and the main reservoir pressure is between 650 and 725 kPa, the higher the pressure the better the release.
4. Place the brake valve handle momentarily in the “release: position, then move the handle back to the “running” position.
5. Wait until the pressures have again equalised before making another brake pipe reduction as above.
6. Repeat this sequence approximately 4 or 5 times.
7. If the brakes still do not release it will then be necessary to release the brakes by hand by operating the triple valve release wires.

13.6 Brake Valve Isolating Cock

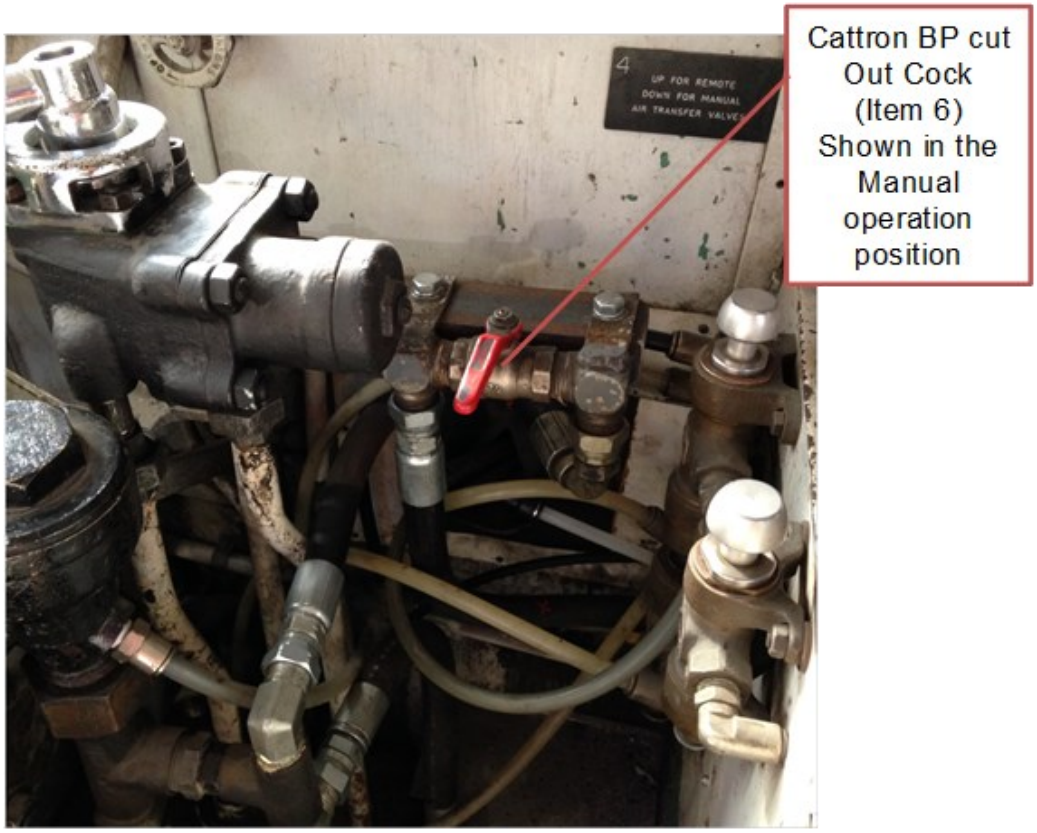
This is for cutting in or cutting out the No.4 brake valve. When cut-out, No.4 brake valve handle should be in full release position.

13.7 Brake Piston Travel

On locomotives fitted with manual slack adjusters, the piston travel is between 64 and 90 mm.

14.0 CUT OUT COCKS

A BP cut-out cock has been added to the Cattron brake control setup, directly behind the No.1 end brake valves. This is labelled as ‘Item 6’ for the remote-control set-up.
Monitor the BP pressure on the BP / BC gauge for one minute



Brake Pipe Leakage Tests for Mainline Operation in Remote:

1. Make a 2-step train brake application.
2. Close the Cattron BP isolation cock 900 to the pipe.
3. Monitor the BP pressure on the BP / BC gauge for one minute. BP pressure (white hand) must not drop more than 50 kPa in one minute.
4. On completion of the BP leakage test, open the Cattron BP isolation cock so it is in line with the pipe.

In Manual:

1. Working from the NO.1 end control desk, move the No.4 brake valve from running to application, to reduce the BP pressure to 475 kPa.
2. Monitor the BP pressure on the BP / BC gauge for one minute. BP pressure (white hand) must drop more than 50 kPa in one minute.
3. Return the No.4 brake valve to the running position on completion of the test.

15.0 EMERGENCY EQUIPMENT

Reserved for future use.

16.0 EVENT RECORDER / VIGILANCE SYSTEM

Reserved for future use.

17.0 PROTECTIVE DEVICES

Reserved for future use.

18.0 SAFETY INSTRUCTIONS

Reserved for future use.

19.0 MISCELLANEOUS

Reserved for future use.

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 *the Radio Systems manual.*

22.0 TRAIN ATTENDANTS

Reserved for future use.

23.0 TOWING

1. Shut down both engines.
2. Close both brake valve isolating cocks.
3. Place the Automatic Brake Valve handle in the “Full Release” position.
4. Place the reverser to the “Off” position, remove key and place in appropriate position.
5. Open both traction motor isolation switches (one in each electrical cabinet).
6. Turn CCB “off”.
7. Apply the handbrake if not attached to another locomotive or rake of wagons.
8. Release the straight air brake.
9. Open both BKS (one in each battery box).
10. Book in the Loco 54D book.

Due to the DSC asbestos issue, it is currently not possible to enter the electrical cabinets to operate the traction motor cut-out switches in locomotives with ACM.

The following process must be followed when a DSC locomotive with ACM is required to be towed dead:

1. Brakes cut-out as per ROC instructions.
2. Open both battery knife switches.

24.0 FAULTS

24.1 General

Fault:	Action:
No lights.	• Battery Isolating switch “open”. • Fuse F.3 blown or not inserted. • Fuses F.4 – 8 blown or not inserted.
Engines will not stop when stop button(s) or switches operated.	• Fuse F.9 blown or not inserted. • BKS “open”.
Engine will not rotate when starting.	• BKS “open”. • CCB “open”. • Battery flat or partially flat. Check water levels and rest battery for 10 minutes. • Battery terminals loose.

Engine rotates but will not fire.	• Does not fully rotate.
	  ○ possible obstruction in cylinder, e.g. water. Do not attempt to start engine again. Report the problem to Maintenance personnel.
	• Does not rotate fast enough.
	  ○ Check the water levels in the battery and top up if necessary – both engines may be affected).
	  Allow battery to rest for 10 minutes and try again.
	• Rotates normally.
	  ○ Check fuel supply (Both engines may be affected).
	  ○ Check cooling water level.
	  ○ Check all fuel lines.
	  ○ Check that the overspeed has not tripped.
	  ○ Check the “on / off” switch is properly “on”.

Fault:	Action:
Engine fires during starting but stops shortly afterwards.	• Wait 1 minute then try again. • Each engine must be started individually. Start first engine and allow it to settle down, before starting second engine. • Start switch may have been knocked “off”. • Check engine overspeed has not tripped.
Engine does not increase speed when throttle advanced.	• Check control reservoir gauge is showing 515 kPa. • Check CCG has “closed”. • Check throttle valve isolating cock is “open” and for broken air pipes. • Check throttle linkage from actuator is intact. • Check both engines are operating.
Locomotive does not produce power to move.	• Brake pipe pressure too low. • Reverser handle in “EO” or “off”. • Throttle not properly engaged, pause longer in first position. • MC1, MC2, MC3 or MC4 “open”. • Control air pressure correct and isolating cock “open”. • CCB may have tripped. • EFR may have tripped.
Locomotive brakes will not release.	• Auxiliary reservoirs overcharged. • CCB tripped.
Warning lights fail to light.	• Check that globe is intact by replacing it with a known good one. • Fuse F.9 blown or not inserted.
No battery charging.	• Fuse F.14 No.1 end blown or not inserted. • Fuse F.15 No.2 end blown or not inserted. • Voltage regulator faulty. • Check red light in cabinet is illuminated, if not book in Loco 54D book (Electronic unit).

Fault:	Action:
Excessive battery charging.	• Shut one engine down and check ammeter and if charge normal isolate this end and operate on one end only. • If charge still excessive start engine and shut other engine down and check ammeters; if charge then normal, leave this end isolated. • If charge still excessive no matter which engine is shut down, the locomotive must be taken out of service.
Locomotive power output fails to increase when throttle advanced.	• Check auxiliary field fuse not blown. • Fuse F.13 (shunt field) blown or not inserted.
Locomotive sluggish.	• Check both engines are operating, watch ammeter. • Check all brakes (including handbrake) are fully released. • Check traction motors are cut-in for each end.
EFR tripping.	• Reset no more than TWO TIMES. • If EFR still operates, try a motor cut-out test, cutting No.1 group out, testing the controls. If EFR still operates cut-out No.2 group and operate controls. When defective group found, leave isolated and book fault. Proceed at reduced power and reduced load if necessary.
Alarm lights.	• On these locomotives there are three alarm lights for the engine, as follows: o Red light – Low oil pressure. o Red light – Low cooling water level. o Red light – High engine cooling water temperature. All the above lights are normally dimly illuminated when the “on / off” switch is “on”.

Fault:	Action:

Low water level light illuminated.	• Minor or no leaks found:
	  ○ The cooling system is to be topped up by Maintenance personnel with coolant chemically treated to prevent serious internal engine corrosion.
	  Under exceptional circumstances when it is necessary to use untreated water, this must be entered in the Loco 54D book, and the necessary chemical treatment added by Maintenance personnel at the earliest opportunity.
	• Serious leak found:
	  ○ If the leak cannot be rectified, stop engine, and isolate it.
	  NOTE: Before operating the locomotive check that there is coolant visible in the sight glass of locomotives fitted with a recovery tank (header). If no coolant is visible, the cooling system is to be topped up with treated coolant by Maintenance personnel. Should it be necessary to top up with untreated water, this must be entered in the Loco 54D book for attention.

Hot water temperature light illuminated.	• Do not stop engine unless damage is going to be caused by keeping it running, such as high temperature being caused by the loss of cooling water through a serious leak which cannot be stopped. • Check radiator fins are clean and that the belt driven fan is operating correctly. • If all correct, place reverser key in “EO” or on locomotives not fitted with this position, open CCB and increase engine revs to allow engine to cool down. • If high water temperature again occurs, try with a lower throttle opening.

Fault:	Action:
Low oil pressure light illuminated.	• If lubricating oil pressure fails, the light will glow brightly, and the engine will stop. However the LOP light will glow at any time the engine stops. If a low oil pressure shutdown us suspected, check the oil level in the sump and, if correct restart. If the oil pressure light stays brightly lit and the engine dies when the starter is released, isolate that end. **NOTE:** These locomotives are fitted with 3 automatic shutdown devices: 1. Low water level. 2. Low oil pressure. 3. Engine overspeed trips. These are coupled to the respective warning lights and low oil pressure buzzer in the cab where appropriate.
Shortage of main reservoir pressure.	• Stop the locomotive, and secure. o Place reverser key to “EO” position and increase engine speed to no more than half. This may be done when pumping up the train. o Close reservoir drain cocks. o Check hose connect to bogie. o Check condition of bogie air hoses and piping. o Check for any other air leaks. o Carry out a main reservoir leakage test. o Carry out a brake pipe leakage test on the locomotive. o Carry out a brake pipe leakage test on the train. o If unable to rectify the fault, DO NOT proceed, call for assistance

Fault:	Action:
Faulty reverser.	• Occasionally reversers will not throw and when this occurs each end of the locomotive will attempt to move in opposite directions. This can be identified by observing the position of each reverser in its cabinet. ROC Section 4 applies.
Engine fails to start but continues to rotate after start switch has been released.	• Starting contactors have stuck in the closed position. Open BKS. Take extreme care as high voltage is flowing through the BKS. Call for assistance

24.2 Compressor

Fault:	Cause:	Remedy:
Compressor shuts down with air demand present.	Compressor discharge temperature switch is “open”.	• Cooling air flow is insufficient, clean cooler and check for proper ventilation. • Low fluid sump level, add fluid. • Dirty compressor fluid filter, change element. • Defective discharge temperature switch, check for a short or open circuit to the fuel solenoid.
	Control relay tripped on instrument panel.	• Reset relay and check for causes of tripping, over-temperature, or pressure.
Compressor will not build up full discharge pressure.	Air demand is too great.	• Check service lines for leaks or open valves.
	Dirty air filter.	• Check the filter and change the element if required.
	Pressure regulator out of adjustment.	• Adjust regulator to control adjustment instructions in the maintenance manual.
	Defective pressure regulator.	• Check diaphragm and replace if necessary.
	Incorrect compressor speed.	• Check engine RPM’s

Fault:	Cause:	Remedy:
Improper unloading with an excessive pressure build-up causing pressure relief valve to open.	Pressure regulating valve is set to high.	• Re-adjust.
	Leak in control system causing loss of pressure signal.	• Check control lines.
	Inlet valve jammed.	• Replace inlet valve.
	Defective pressure relief valve.	• Replace pressure relief valve.
	Plugged element.	• Replace separator element.
Insufficient air delivery.	Plugged air filter.	• Replace.
	Plugged air / separator filter.	• Change separator element and compressor oil.
	Defective pressure regulator.	• Adjust or repair.
	Engine speed to low.	• Adjust engine speed.
Excessive fluid consumption.	Clogged return line.	• Clear orifice. • Check valve stuck.
	Defective blow-down valve.	• Replace valve.
	Leak in lubrication system.	• Check all pipes, connections, and comments.
	Separator element damaged or not functioning properly.	• Change separator element.
	Fluid sump over-filled.	• Drain to proper level.
Compressor overheating.	Dirty fluid cooler.	• Clean core thoroughly.
	Plugged fluid cooler tube.	• Clean tube.
	Low sump fluid.	• Fill.
	Plugged compressor fluid filter.	• Change element.