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**DRIVING INSTRUCTIONS FOR
DIESEL MULTIPLE UNIT TRAINS
POWER CARS**

(Hydraulic Transmission)

"RED TRIANGLE" COUPLING SYMBOLS

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**DRIVING INSTRUCTIONS FOR DIESEL
MULTIPLE-UNIT TRAINS
"RED TRIANGLE" COUPLING SYMBOLS**

GENERAL DESCRIPTION

Each power car is powered by two engines. Driving controls are provided at one end only of each car. The train may be made up of twin car sets or as a four car train. When the trains are marshalled a driving compartment will be at each end.

TECHNICAL DATA

Type	.....	.....	.....	2 - 2 - 2 - 2 (1A - A1).
Weight in running order	.....	.....	.....	27 tons 5 cwt.
Tractive effort (single Power Car):				
Torque converter drive	.....	.....	.....	(Max.) 8,575 lbs..
Direct drive	.....	.....	.....	(Max.) 1,775 lbs.
Wheel base (car)	.....	.....	.....	48ft. 6ins.
Wheel base (bogie)	.....	.....	.....	8ft. 6ins.
Bogie centre distance	.....	.....	.....	40ft. 0ins.
Wheel diameter	.....	.....	.....	3ft. 0ins.
Width overall	.....	.....	.....	9ft. 2ins.
Length overall	.....	.....	.....	121ft. 4ins. (Twin car set).
Height overall	.....	.....	.....	12ft. 8½ins.
Minimum curve negotiable	.....	.....	.....	3½ chains.
Maximum speed:				
Torque converter drive	.....	.....	.....	36 m.p.h.
Direct drive	.....	.....	.....	60 m.p.h.
Fuel oil capacity	.....	.....	.....	112 gallons per power car.
Lubricating oil sump capacity	.....	.....	.....	10 gallons per power car.
Cooling water capacity	.....	.....	.....	45 gallons per power car.
Control system	.....	.....	.....	Electro-pneumatic.
Brake system	.....	.....	.....	Vacuum.
Warning device	.....	.....	.....	Compressed air operated.

Engines

Two 6-cylinder 9.8 litre horizontal oil engines	.....	.....	.....	Leyland Motors Ltd. Type 600/229 B.H.P. 138 (Gross). R.P.M. (Max.) 2,000.
Compression ratio	.....	.....	.....	15.75 to 1.
Bore	.....	.....	.....	4.8ins. (122m/m).
Stroke	.....	.....	.....	5.5ins. (139.7m/m).
Firing order	.....	.....	.....	1, 5, 3, 6, 2, 4.
Rotation	.....	.....	.....	Clockwise.

Fuel injector type	.....	.....	Leyland type N.31.
Fuel injector lifting pressure	.....	.....	145 atmospheres (2,130 lbs./sq.in.).
Fuel pump type	.....	.....	B.P.E.6B.75T. 32056189X.
Injector timing	.....	.....	26° B.T.D.C.
Weight with engine driven auxiliaries	.....	.....	1 ton 2 cwts. 1 qtr.

Transmission

Type	.....	.....	Lysholme - Smith hydraulic Torque Converter with direct drive and free wheel incorporated.
Makers	.....	.....	Leyland Motors Ltd.
Torque ratio (Converter drive)	.....	.....	4.5 : 1.
Torque ratio (Direct drive)	.....	.....	1 : 1.
Final drive gear ratio	.....	.....	3.58 : 1.
Reversing arrangement	.....	.....	Axially sliding pinion between bevel gears in constant mesh in final drive gearbox.

Auxiliaries

Battery	.....	.....	NIFE. Type LR.23. 18 cells. 235 amp./hr. capacity.
Generator	.....	.....	C.A.V. 8in. 24v. clockwise rotation belt driven.
Starter motor	.....	.....	C.A.V. US.24-13. 24v.
Compressor	.....	.....	Westinghouse type E.15 gear driven.
Exhauster	.....	.....	Clayton-Dewandre Type 725. Belt driven.
Car heating equipment	.....	.....	Smith's Combustion Air Heater.
Windscreen wipers	.....	.....	Pneumatic.
Speedometer	.....	.....	Smith's (Electrical drive).

DRIVER'S CONTROLS

1. Interlocking isolating switch (with removable key).
2. Main controller, incorporating the Deadman's Handle.
3. Reversing switch.
4. Torque converter control switch. } One removable key only provided for both controls.
5. Engine Start buttons.
6. Engine Stop buttons.
7. Engine indicator lights.
8. Reversing indicator lights.
9. Engine tachometers.
10. Car heater switches and main car switches.
11. Dual horn control.

12. Speedometer.
13. Main reservoir air pressure gauge.
14. Vacuum gauge.
15. Driver's brake valve handle.
16. Hand brake.
17. A.W.S. key.
18. A.W.S. isolating cock.
19. A.W.S. indicator.
20. A.W.S. reset button.

} When fitted.

GENERAL INFORMATION

All control devices, e.g. drive selector, throttle handle (engine speed), reverser, etc., are operated by electro-pneumatic (E.P.) valves, therefore, **DO NOT USE FORCE WHEN MOVING CONTROL LEVERS OR HANDLES.**

The electrical control system of each car is complete in itself, but may be linked to that of another car by electrical jumper connections.

The throttle handle is also the Deadman's handle and if it is allowed to spring up the engines will drop down to IDLING speed and after 5 to 7 seconds delay the vacuum brake will be applied. To re-set the Deadman's device and regain control, the throttle handle must be moved back to the IDLING position before the handle can be depressed.

DRIVER'S DAILY DUTIES WHEN IN SERVICE

1. Obtain the satchel containing the cab door key, interlocking isolating switch and reversing switch keys, and driver's brake valve handle, also the A.W.S. key (when fitted).
2. Check that detonator cases are intact in all driving compartments.
3. Check that fire extinguishers are intact.
4. The handbrake is ON in the leading driving compartment.
5. **THE HANDBRAKES ARE OFF IN ALL TRAILING COMPARTMENTS.**
6. **LOCK ALL DOORS OF TRAILING DRIVING COMPARTMENTS.**

At a convenient time during Turn

1. Make a short inspection of the train and check that the apparatus is generally in good working condition. Check fuel tank levels. **REPORT ALL KNOWN DEFECTS AT END OF TURN.**

STARTING THE ENGINES

1. Place the A.W.S. key into position and move to ON, then put the interlocking isolating switch key into position and turn into one of the two ON positions. (In the ON position it is not possible to remove key). Place the vacuum brake handle into position.

2. **If more than 40 lbs./sq.in air pressure is available** place torque converter control switch handle in position and then select neutral "N." Press each engine "Starter" button in turn and check that the engine indicator lights become illuminated. (When in NEUTRAL position depress and release the A.W.S. reset button, the Deadman's handle must be kept depressed).
3. **If less than 40 lbs./sq.in. air pressure is available**, or the engines are cold, **do not** place torque converter switch handle in position. The engines must be started individually from the side of the car by pressing the local "Starter" buttons. When 40lbs./sq.in. air pressure is obtained, proceed to the cab and place the torque converter switch handle in position.

NOTES : (a) If an engine does not start within approximately three seconds, release "Start" button for not less than 10 seconds to allow the engine to come to rest before pressing the button again.

(b) It is not necessary to run the engines above idling to build up air pressure or vacuum.

4. When 21ins. of vacuum has been obtained, apply vacuum brake and release Deadman's handle.
5. Check that the reverser is in the correct position for the direction of travel. If not, with the vacuum brake still applied, remove converter control switch key, place into reverser switch, select required position, then return key to converter control switch and check that the reversing indicator lights are extinguished. If one or more of the lights remain glowing, select converter drive "C" position on the converter control switch, keeping the engines running at Idling speed, when all reverser indicator lights should be extinguished. If, however, engagement of reverse gear is still not effected, release the vacuum brake and allow the train to move slightly forward. This should complete the gear engagement and the indicator lights should be extinguished. Return converter control switch to the "N" position.

NOTE : Should the above procedure fail to extinguish the reversing indicator light the appropriate action is detailed under "Faults in Final Drive" (Page 7).

STARTING THE TRAIN

1. Before attempting to move the train, check that the air pressure is over 60lbs./sq.in. and that the vacuum gauge is indicating more than 21 inches on the reservoir side, then:—
 - (a) Release the vacuum brake to about 15 ins. of vacuum then "lap" the brake valve.
 - (b) **WITH THE ENGINES IDLING**, move the drive selector handle to the "C" position.
 - (c) Release the vacuum brake fully by placing the brake handle into the OFF position. The train should not be moved with the brake dragging.
2. Select converter drive position—"C."
3. Release vacuum brake and move throttle handle to 1st engine speed. Progressively move throttle handle from 1st to 4th speed with a slight pause in each speed notch.

4. When the train speed reaches **30 m.p.h.** return throttle handle to **IDLING** position. As the engine r.p.m. falls below 800 r.p.m. move the converter control switch handle to direct "D" and then return the throttle handle to 4th speed position. The train speed can then be controlled by the throttle. The brakes **must not** be applied with the throttle handle in a power notch.

COASTING

A free wheel is fitted on the output shaft of the torque converter enabling the train to coast in either "C" position or direct drive "D"; the train can, therefore, overrun the maximum engine speed of 2,000 r.p.m. When this occurs the throttle must be returned to IDLING position.

CHANGING DOWN FROM DIRECT TO CONVERTER DRIVE

If the speed of the train is reduced for any reason to 30 m.p.h. or below, the torque converter drive should be engaged. There is no need to throttle back when moving from "D" to "C".

STOPPING THE TRAIN

1. Return throttle handle to IDLING (keeping Deadman's Handle depressed).
2. Place the torque converter switch handle into the converter drive —"C" position.
3. Apply vacuum brake as required.
4. The train **MUST NOT** be stopped with the torque converter switch handle in the direct drive "D" position. If this is done the engines will stop as the train is brought to rest and it will be necessary to select neutral "N" and restart the engines by depressing the appropriate push buttons.
5. Whenever the train is brought to a stand the torque converter switch handle must be moved to neutral "N" and converter "C" only selected whenever it is required to move the train or to engage the reversing gears.

CHANGING ENDS

It is NOT necessary to stop the engines to carry out this operation.

1. With the vacuum brake ON place the converter control switch to OFF, and remove key.
2. Place the interlock isolating switch to OFF and remove key.
3. Release the DEADMAN'S handle, and remove A.W.S. key.
4. Place the vacuum brake handle to the LAP position and remove handle. Lock driver's compartment doors and proceed to opposite end of the train. The brake handle, A.W.S. and the interlock isolating keys must then be placed in position.
5. Depress and release the A.W.S. reset button.
6. Release vacuum brake, then make a partial application and move the interlock isolating switch key to one of the ON positions.

7. Place converter switch key in reversing switch and select direction required.
8. Remove key from reverser and, placing it in the converter control switch, move it to "N" position. Hold the Deadman's Handle down.
9. Check that the final drives engage as indicated in item 5 under "STARTING THE ENGINES"; then proceed as shown under "RUNNING".

REVERSING THE TRAIN

If it is necessary to reverse the train without changing ends, when the train has been brought to a stand, see instructions contained in item 5 under heading "STARTING THE ENGINES".

STOPPING THE ENGINES

1. Check that the throttle handle is in the IDLING position and that the vacuum brake is ON.
2. Place the torque converter control switch key to NEUTRAL.
3. Press the engine "Stop" buttons in turn and check that the engine warning lights become extinguished after a few seconds, indicating that the engines have stopped.
4. Place the torque converter switch into the OFF position; remove the key.
5. Place interlock isolating switch to OFF and remove key. Release the Deadman's Handle.
6. Apply the hand brake.

STABLING THE TRAIN

Reversal of Final Drives

When diesel multiple unit trains are stabled and it is known (i.e. at terminal points) or anticipated that the next movement will be in the opposite direction, drivers before leaving the train should select the opposite direction on the reverser with a view to the final drives being engaged in the correct direction for the next movement, thus obviating any difficulty of correct engagement later when the equipment and lubricant may have become cold.

First operate reverser and check that the final drives engage, then proceed as for stopping the engines, but before leaving the train carry out the following:—

1. Check that the hand brake is applied.
2. Place vacuum brake valve to LAP position and remove the brake handle, also converter and interlock isolating switch keys.
3. Lock cab and partition doors.
4. Return the brake handle, reversing switch, interlock isolating switch, A.W.S. and door keys to the responsible person on duty at the depot.

TRAIN HEATING

Heating is by means of hot-air suitably directed into the passenger compartment of each vehicle. The operation of the heater is automatic apart from switching on and operating the heat control.

To operate the heater:—

1. Turn heater switch in a clockwise direction to FULL HEAT (not Reduced Heat) position.

This supplies current to the glow plug (an Element) and the glow

plug light on the Indicator Panel should be illuminated. If this fails, return switch to OFF position and do not attempt to restart. After a period of 30 seconds the air fan light will be illuminated on the indicator panel denoting that the heater fan and fuel pumps are working. In approximately 3½ minutes the Glow Plug indicator light will be automatically extinguished.

If the oil fails to ignite in the above period the fan and fuel pump is automatically switched off, and it is then necessary to return the control switch to OFF and restart. Not more than three attempts should be made to start the apparatus.

2. To reduce heat, the switch should be turned anti-clockwise to "Reduced Heat" position: care should be taken not to go beyond this position or the heater will be automatically shut down. To admit cold air to the train the switch should be turned in an anti-clockwise direction past the OFF position to Cold.
3. If the switch is in the Full or Reduced Heat position and the heater cuts out, the indicator light will be extinguished. Return switch to OFF, then attempt to restart the heater, as in 1 above.

FAULTS IN TRAFFIC

If an engine stops or is stopped with a gear in a drive position, it is not necessary for the driver to take any action until he reaches the terminus or other suitable point.

The engines are automatically stopped if the water level drops below a certain point.

There is **no** protection against loss of lubrication oil and a close watch must be kept for any oil leaks and these should be immediately reported.

If an engine stops and the cause is not apparent no attempt must be made to restart the engine until examined by Maintenance Staff.

If the engines are stopped by mishandling the controls it is necessary to select neutral "N" before they can be restarted.

Engine Failure

In the event of the oil pressure in an engine falling to zero the appropriate engine light will be extinguished. When this occurs the following procedure must be immediately carried out:—

1. Return throttle handle to IDLING, place converter switch handle to NEUTRAL, press "Stop" button and hold depressed for at least ten seconds.
2. Carry on without utilising this engine until it is convenient to visually inspect the engine for loss of lubricating oil.

NOTE: When a "Stop" button is depressed with no oil pressure, the appropriate engine light should illuminate. If it does not, the Guard should be asked to observe the light in the remote driving compartment as a check on the serviceability of the lamp. If difficulty is experienced the appropriate engine should not be run until the maintenance staff have carried out an inspection.

Faults in Final Drive

1. If any of the reverse indicator lights glow, when running, return

throttle handle to IDLING position IMMEDIATELY, and when the light is extinguished restore throttle to required position to maintain running time.

The train should not normally be driven with the indicator lights glowing.

2. Faulty operation of the reversing control will be indicated by the appropriate indicator lights glowing. If the fault is in either the two final drives of the leading car, the defective drive will be shown directly, i.e. either No. 1 or No. 2 reversing light will glow.

If the defective final drive is in a trailing vehicle then the indication will be "General" in the driving compartment, i.e. the appropriate train light will glow in the left hand group.

It will then be necessary for the driver to proceed in turn to the driving compartment of each car comprising the train.

The defective final drive will be located when it is observed that both the "General" and Local" panel lights are illuminated in the driving compartment of the car concerned.

Isolating Defective Final Drive

The only immediate action necessary by the driver, to enable the train to be worked to a convenient point with a defective final drive isolated, is to stop the engine concerned by operating the respective local "Stop" button and Isolating switch.

In the event of the defective final drive being either one of the two in the leading unit the operation of the Battery Isolating Switch may have the effect of removing control from the remainder of the train. If this is found to be the case the Interlock Isolating Switch on the driver's control panel should be moved to the opposite position.

ASSISTING DISABLED TRAIN

In an emergency, a disabled diesel train may be assisted by another diesel train or by a locomotive.

Engine or Transmission Failure

1. *Assistance by a train of same type.*

If the control equipment and vacuum brake train systems are in order, normal coupling to units of the same type may be made in accordance with the Appendix Instructions for the Working of Diesel Trains—Coupling & Uncoupling.

Before proceeding, the final drive gears of the defective power unit must be set and locked in the NEUTRAL position, if possible.

Where the final drive cannot be disengaged, a speed of 25 m.p.h. in either direction must not be exceeded to the point where the disabled train can be taken out of traffic.

2. *Assistance by a train of different type or by a locomotive.*

When assisted by a different type of train or a locomotive, the vacuum hose to the train pipe only must be connected.

The driver's brake valve must be set in the LAP position.

Stop all engines on the disabled train and isolate the Deadman's apparatus by the cock provided. Set and lock all final drives in NEUTRAL.

Where a final drive cannot be disengaged a speed of 25 m.p.h. in either direction must not be exceeded to the point where the disabled train can be taken out of traffic.

FAILURE OF CONTROL EQUIPMENT

Remove battery interlocking isolating switch, reverse key and brake handle and then proceed to the next driving cab and endeavour to gain control. Then act in accordance with the Appendix Instructions for Working of Diesel Mechanical Trains—Driving Apparatus disabled.

FIRE PRECAUTIONS

In the event of a fire which will be normally indicated by the fire warning bells ringing, bring the train to a stand as laid down in Rule No. 188. When the train has been brought to a stand take a hand operated fire extinguisher from the driving compartment and inspect the engine that has been affected, as shown by the indicator light in the driving compartment. An additional indication of the engine concerned will be given by the red warning light which will be illuminated on the appropriate fire alarm control box.

After ensuring that the fire has been extinguished, the small metal tab on the front of the fire alarm control box should be pulled off. This will uncover a switch which should be operated to stop the alarm bell, extinguish the warning light and render it impossible to restart the affected engine. After this has been done, and before proceeding, the final drive gears of the defective engine must be set and locked in the NEUTRAL position, if possible.

The alarm isolating switch referred to does not cut out the re-setting thermostat and should this operate through a recurrence of fire on the engine or fluid flywheel, the alarm bells will ring and the warning light will be lit. In this event the fire will not be extinguished automatically. It is essential, therefore, for the remaining hand operated fire fighting equipment to be used as a matter of the utmost urgency after the train has been stopped.

If the automatic extinguishing apparatus has operated, avoid inhaling a concentration of the gas which has a faint smell and avoid touching the liquid with the skin or clothes.

As the gas is heavier than air, the concentration will be at low levels near the ground.

See General Instructions and Notices in Appendix to the Operating Instructions regarding First Aid treatment to a person contaminated by the fire extinguishing medium used in the automatic appliance.

GENERAL NOTES

CONVERTER CONTROL SWITCH

DO NOT place the converter control switch into the converter ("C") or direct drive ("D") positions with the engines stopped.

INTERLOCKING ISOLATING SWITCH

This switch controls the supply of current for all the primary train controls from one or the other of the batteries in the car from which the train is being driven. When the switch key is moved to the right, one battery is selected, and when moved to the left, the other battery is selected.

The batteries should be selected alternately to avoid an excessive drain on any one battery.

DEADMAN'S DEVICE

The Deadman's Handle is incorporated in the throttle handle.

If the Deadman's Handle is released while the train is running and the throttle handle is in a power notch, all the engines will be brought down to Idling speed. The drives throughout the train will go into Neutral position and after a five second delay a full brake application will be made.

If the throttle is in the Idling position, the drives will go to Neutral and after five seconds delay a full brake application will be made.

After a Deadman's Handle application, if the throttle is still in a power notch, it should be returned to Idling position and the converter control switch placed in the Neutral position.

After this has been done the train can then be restarted in the normal manner.

If the Deadman's Handle is released inadvertently when running, the throttle should be immediately returned to Idling, the Handle depressed and quickly returned to the power notch which was being used.

NOTE : When the Deadman's Handle has been released, it cannot under any circumstances be again depressed until the throttle handle is returned to IDLING position.

COUPLING AND UNCOUPLING

1. See that the Driver's controls are in the OFF position before trains are coupled or uncoupled.
2. Place the Battery Interlocking Isolating switch to OFF before the jumper cables are coupled or uncoupled.
3. On re-starting the engines ensure that all indicator lights and controls respond before moving the train.

WARNING HORNS

When sounding the horn, to comply with Rule 127 and the Appendix instructions, operate the lever in such a manner as to give the 2-tone sound that these horns are designed to emit. This is of the utmost importance and if the horn is defective it must be reported immediately.

DRIVERS IN COURSE OF TRAINING

Drivers in course of training are only allowed to operate the controls and brake on passenger lines under the direct supervision of the Instructor.

MOVEMENT UNDER FLOOD WATER CONDITIONS

1. **Normal** movement of rail cars should cease when the water level reaches 1 in. below the underside of the head of the running rail.
2. **Emergency** running at 3 m.p.h. is permissible, whether conductor rails are present or not, with the water level not exceeding 4 in. above the top of the running rail.
3. Movement should not be permitted when the water level exceeds 4 in. above the top of the running rail.

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