

DRIVING INSTRUCTIONS FOR
DIESEL MULTIPLE UNIT TRAINS
POWER CARS

(Mechanical Transmission)

"YELLOW DIAMOND" COUPLING SYMBOLS



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DRIVING INSTRUCTIONS FOR DIESEL MULTIPLE-UNIT TRAINS "YELLOW DIAMOND" COUPLING SYMBOLS

GENERAL DESCRIPTION

Each power car is provided with two engines. Driving controls are provided at one end of each power car and each driving trailer. When the trains are marshalled a driving compartment must be at each end.

TECHNICAL DATA

Type	2-2-2-2 (1A-A1).
Tractive effort:	1st gear 2nd gear 3rd gear 4th gear
Total (single Power Car)	6,570lbs. 3,710lbs. 2,420lbs. 1,610lbs.
Wheel base (Coach)	48ft. 6ins.
Wheel base (Bogie)	8ft. 6ins.
Bogie centre distance	40ft. 0ins.
Wheel diameter	3ft. 0ins.
Width overall	9ft. 3ins.
Length overall	121ft. 4ins. (Twin car set).
Height overall	12ft. 8½ins.
Minimum curve negotiable	3½ chains.
Maximum speed at maximum engine revs	1st speed 2nd speed 15.3 m.p.h. 27 m.p.h. 3rd speed 4th speed 41 m.p.h. 65.5 m.p.h.
Lubricating oil sump capacity	6½ gallons per engine.
Cooling water capacity	44 gallons per power car.
Control system	Electro-pneumatic.
Brake system	Vacuum.
Warning horns	Compressed air operated.
Gear ratio	1st gear 2nd gear 3rd gear 4th gear 4.28:1 2.42:1 1.59:1 1:1
Engines	
Two 6-cylinder 11.3 litre horizontal oil engines	A.E.C. type No. A.220, 150 h.p. at 1,800 r.p.m.
Compression ratio	16 to 1.
Bore	130mm. = 5.12ins.
Stroke	142mm. = 5.5907ins.
Firing order	1, 5, 3, 6, 2, 4.
Rotation	Clockwise.
Fuel injector type	CAV. B.D.L. L. 150.S.
Fuel injector lifting pressure	175 atmospheres (2,570lbs./sq.in.).
Fuel pump type	CAV. Monobloc Type.

Transmission

Type	Fluid Coupling. Wilson type gearbox. 4 speed epicyclic. (Electro-pneumatic operated).
Reversing arrangement	Axially sliding dog clutch between bevel gears incorporated in final drive gearbox.
Final drive: gear ratio	2.81:1.

Auxiliaries

Battery:

Power Car NIFE, Type LR40. 19 cells: 24 volt: 400 amp./hr.

Driving Trailer NIFE, Type BSN. 12H. 19 cells: 24 volt: 300 amp./hr.

Generator:

Power Car CAV. type G7A24/4 or Stones, Type XR 29L, 24 volt. Belt driven from the output end of one gear box.

Driving Trailer Stones, Type XR 22L. Belt driven.

Starter Motor CAV. or Simms Axial type.

Compressors Clayton-Dewandre, C.D. Series, 2 $\frac{3}{8}$ ins. \times 1 $\frac{3}{4}$ ins. Type P.C.G.A. 189, gear driven.

Exhausters Clayton-Dewandre, Type C.725. Belt driven.

Car heating equipment Smith's Combustion Heater.

Speedometer Smith's (Electrical drive).

Windscreen wipers Compressed air operated.

DRIVER'S CONTROLS

1. Control switch (with removable key).
2. Throttle handle (engine speed) incorporating the Deadman's device.
3. Change gear selector handle.
4. Reversing lever (detachable).
5. Engine "Start" buttons.
6. Engine "Stop" button.
7. Engine indicator lights.
8. Air pressure and final drive direction indicator lights.
9. Engine tachometer/Change speed indicator.
10. Dual horn control.
11. Speedometer.
12. Air pressure gauge.
13. Vacuum gauge (Duplex).
14. Driver's brake valve (handle detachable).
15. Emergency vacuum brake valve.

16. Handbrake.
17. Car heater switches.
18. Head light switches.
19. Windscreen wiper valve.
20. Instrument panel light switches.
21. Deadman's hold-over buttons.
22. Deadman's device indicator light.
23. Change-over switch—Engine speed.
24. Destination indicator light switch.
25. Buzzer and button.
26. Fire alarm bell.
27. A.W.S. key.
28. A.W.S. isolating cock.
29. A.W.S. reset button.
30. Loudaphone (when fitted).
31. Handbrake indicator light (where fitted).

GENERAL INFORMATION

All control devices, e.g. gears, throttle handle (engine speed), reversing lever, etc., are operated by electro-pneumatic (E.P.) valves, therefore, **DO NOT USE FORCE WHEN MOVING THE CONTROL LEVER 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.

Any failure of the air pressure system resulting in a severe drop in pressure will stop the engines and return the gears to Neutral.

Loss of engine oil pressure will extinguish the engine indicator light and stop the engine.

The throttle handle is also the Deadman's handle and if it is allowed to spring forward past the Idling position 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 the throttle handle must be pulled back to the Idling position.

The gear selector handle and reversing lever are mechanically inter-locked. The gear selector handle is locked in the NEUTRAL position and cannot be moved until the reversing lever is moved to the FORWARD or REVERSE position.

The reversing lever cannot be moved unless the gear selector handle is in NEUTRAL.

SPECIAL NOTE

DO NOT MOVE THE GEAR SELECTOR HANDLE FROM THE NEUTRAL POSITION UNTIL READY TO START THE TRAIN.

DRIVER'S DAILY DUTIES WHEN IN SERVICE

At Commencement of Turn

1. Obtain the satchel containing the control switch key, reversing lever, vacuum brake handle, A.W.S. key and carriage keys.
2. Check that—
 - (a) the detonator cases are intact in all Driving Compartments;
 - (b) the Deadman's isolating valve covers **are intact** in all Power Cars. If a cover is not intact it must be reported;
 - (c) the handbrake is ON in the leading driving compartment;
 - (d) **THE HANDBRAKES ARE OFF IN ALL TRAILING COMPARTMENTS.**
3. **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.
2. "Toggle up" the gearbox brake bands as follows:-
 - (a) Check that full air pressure is available.
 - (b) STOP the engines.
 - (c) Hold the Deadman's device in the RUNNING position.
 - (d) With the reversing lever in FORWARD position, move the gear-drive selector handle to engage 1st, 2nd and 3rd gear (not 4th) about six times, pausing in each gear position to allow the brake bands to engage fully.
 - (e) Return the gear-drive selector handle to NEUTRAL.
 - (f) Re-start the engines.

REPORT ALL KNOWN DEFECTS AT END OF TURN.

STARTING THE ENGINE

1. Place A.W.S. key into position and move to ON. Turn the control switch key to the ON position.
2. Check that the gear selector handle is locked in the NEUTRAL position, i.e. reversing lever removed from controller, and that the handbrake is ON.
3. If at least 75 lbs./sq. in. air pressure is available in the system, and the engines are warm, they may be started from the driving compartment. The procedure is as follows:-
 - (a) Place the reversing lever into position and move it to FORWARD or REVERSE to obtain control of the equipment in the driving compartment.
 - (b) Hold the throttle handle in the OPEN position.
 - (c) Press each "Start" button in turn and release it immediately the indicator light shows that the engine has started. **DO NOT PRESS MORE THAN ONE "START" BUTTON AT A TIME.** When all the engines have started, return throttle handle to Idling position.

- (d) Check that the air indicator lights have illuminated, indicating that the final drives have been engaged. If not, with the engines running at IDLING speed, place the reversing lever to the opposite direction of travel—pause—and then re-select required direction of travel.

NOTE:- If an engine does not start, i.e. its indicator light does not light within approximately three seconds, release its "Start" button for not less than 10 seconds to allow engine to come to rest before pressing the button again. If an engine refuses to start, check fuel tank contents gauge for fuel content and ensure that the fuel cock is open. Then start engine locally as shown in item 4 (c-e). STOP the engine, proceed to the driving compartment and start all engines in the normal manner.

4. If 75 lbs./sq. in. air pressure is not available in the system or the engines are cold, they must be started individually from the side of the car. The procedure is as follows:-

- (a) Check that the control switch key is in the ON position.
(b) Check that the gear-drive selector handle is locked in the NEUTRAL position AND THE REVERSING LEVER REMOVED FROM THE CONTROLLER, and that the handbrake is ON.

At Side of Car

- (c) Pull the fuel injection pump hand throttle control to Full Open position and hold it there.
(d) Press the "Start" button, which is located on a small panel beside the engine, and release it immediately the engine starts.
(e) Release the fuel injection pump hand throttle control gradually until the engine runs at a fast tick-over—**do not race the engine**. As soon as air pressure is available (this may take about 15 seconds) release the hand throttle control. It will then be held in the Idling position by air pressure.
(f) Start the other engines in a similar manner, then return to the driving cab.
(g) **When the air pressure in the system has built up to 75 lbs./sq. in. STOP** all engines, then place the reversing lever into position in the controller and move it to FORWARD, also place A.W.S. key into position and move it to ON to obtain control of the equipment in the driving compartment. Depress and release A.W.S. reset button, then proceed to re-start the engine as shown in Item 3(b-d).

NOTE:- 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.

WITH THE ENGINE RUNNING

- (a) Place the brake handle into position, hold the throttle handle in IDLING position to obtain control of the Deadman's device, then move the brake handle to the RELEASE position. The

A.W.S. apparatus must be reset by pressing and releasing the "reset button." Check that 21 ins. of vacuum can be obtained in the train pipe and remains steady at not less than 19 ins. by returning the brake valve handle to LAP position. There should be at least 26 ins. on the high vacuum reservoir side gauge.

This is to ensure that there is sufficient vacuum in the top side of the brake cylinders for the efficient operation of the brake.

NOTE:- The time required to obtain 21 ins. of vacuum in the top side of the brake cylinders after the strings have been pulled on a vehicle or vehicles should not be less than **1½ minutes.**

- (b) Return the vacuum brake handle to **RELEASE** position, then let go the throttle handle. Check that it returns to the Deadman's position and that after 5-7 seconds delay the brakes are applied.
- (c) Check that the air pressure has built up to approximately 95 lbs./sq. in.
- (d) Apply the vacuum brake and **RELEASE THE HANDBRAKE** in the driving compartment.

STARTING THE TRAIN

- (a) Ensure that there is adequate vacuum on the reservoir side.
- (b) Obtain control of the Deadman's device by holding the throttle handle in the **IDLING** position.
- (c) Release the vacuum brake to about 15 ins. of vacuum then "lap" the brake valve.
- (d) **WITH THE ENGINE IDLING** move the gear selector handle to first gear position. (Do not pause in any other gear position).
- (e) Release the vacuum brake **fully** by placing the brake handle into the **OFF** position. The train should not be moved with the brakes dragging.
- (f) After a pause of **NOT LESS THAN TWO SECONDS** from the moment of selecting first gear, open the throttle notch by notch; the train will commence to move. As the speed increases, change gear as indicated on the engine speed indicator (tachometer).

NOTE:- Never stand for more than a few seconds with first gear selected. If the brake fails to release, return the gear selector handle to **NEUTRAL**.

GEAR CHANGING

(a) Changing Up

When the Engine Speed Indicator shows "Change up":—

- 1. Return the throttle handle to **IDLING** position.
- 2. Allow the engine speed indicator needle to fall to a position midway between "Change up" and "Change down."
- 3. Select the next higher gear.
- 4. **PAUSE FOR TWO SECONDS**, then re-open the throttle notch by notch.
- 5. Change gear progressively in the same manner until top gear is engaged.

N.B. DO NOT MOVE THE GEAR SELECTOR HANDLE UNTIL THE ACTUAL GEAR CHANGE IS TO BE MADE.

(b) Changing Down

When the Engine Speed Indicator shows "Change down":—

1. Return the throttle handle to IDLING position.
2. Immediately select the next lower gear.
3. Pause for TWO SECONDS, then re-open the throttle notch by notch.

N.B. DO NOT MOVE THE GEAR SELECTOR HANDLE UNTIL THE ACTUAL GEAR CHANGE IS TO BE MADE.

COASTING

A free wheel is fitted on the propellor shaft between the fluid fly-wheel and the gearbox. When the maximum running speed required is obtained, to allow the train to coast: —

1. Return the throttle handle to IDLING position.
2. Place the gear selector handle into the **fourth** gear position.

Re-Opening the Throttle

If it is necessary to re-open the throttle, place the gear selector handle into the appropriate gear then pause for TWO SECONDS before re-opening the throttle handle notch by notch.

NOTE:- The correct speeds are as follows:—

- 1st gear 0—15 m.p.h.
- 2nd gear 15—27 m.p.h.
- 3rd gear 27—41 m.p.h.
- 4th gear over 41 m.p.h.

STOPPING THE TRAIN

1. Return the throttle handle to IDLING and hold in that position.
2. Apply the vacuum brakes as required.
3. When almost at a stand return the gear selector handle to NEUTRAL without pausing in any other gear. If in 4th gear the lever should be moved direct to Neutral.

NOTE:- If the train speed has been reduced, e.g., due to a signal check and the signal is placed into the clear position before the train is brought to a stand, release the vacuum brake and then follow the procedure described under "Coasting, Re-opening the throttle," above.

CHANGING ENDS

1. Put the vacuum brake ON, then place the vacuum brake handle to LAP position and remove handle.
2. STOP the engines.
3. Remove the reversing lever.
4. Place control switch in the OFF position and remove key.

5. Remove the A.W.S. key.
6. Lock driving compartment doors and remove keys.
7. Proceed to the other end of the train and place handles and lever into their appropriate positions. Place control switch in ON position.
8. Place the A.W.S. key into position, depress and release A.W.S. reset button.
9. Place reversing lever in FORWARD OR REVERSE as required.
10. Proceed to restart the engines as shown under "Starting the Engine" item 3 (b-d), when at least 75 lbs./sq. in. air pressure is available.

REVERSING THE TRAIN

If it is necessary to reverse the train without changing ends, **when the train has been brought to a stand** check that the gear selector handle has been placed into the NEUTRAL position, then:—

1. With the engines IDLING, move the reversing lever to REVERSE. Check that the air indicator lights are momentarily extinguished, indicating that the final drives are correctly engaged. If not, with the engines still IDLING, place the reversing lever to the opposite direction of travel—pause—and then re-select REVERSE.
2. Proceed as for "Starting the Train," items (c) to (f). **DO NOT ATTEMPT TO REVERSE WHEN THE TRAIN IS MOVING.**

STOPPING THE ENGINES

1. Return the throttle handle to IDLING position, then release to Deadman's position.
2. Check that the vacuum brake is ON, then return brake valve handle to LAP position.
3. Press engine "Stop" button and hold in that position until engines have stopped (engine lights are extinguished).
4. Apply the handbrake, then remove control switch key to stop the buzzer sounding and extinguish the handbrake indicator light.

STABLING THE TRAIN

After stopping the engines by the method shown above:—

1. Check that the handbrake is applied.
2. Place vacuum brake valve to LAP position and remove the handle.

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 direction for the next movement, thus obviating any difficulty of correct engagement later when the equipment and lubricant may have become cold.

If reversing the train without changing ends:—

1. When the reversing lever is moved to the REVERSED position, check that the indicator lights are momentarily extinguished—indicating that the final drives have correctly changed and re-engaged.
2. STOP THE ENGINES.
3. REMOVE THE CONTROL SWITCH KEY before moving the reversing lever through the “forward” position to the “remove lever” position. This is necessary to prevent the train being again reversed during the removal of the reversing lever.
4. Check that the handbrake is applied.
5. Place vacuum brake valve handle to LAP position and remove the handle.
6. Remove reversing lever.
7. Remove A.W.S. key.
8. Shut off compartment heaters if in use.
9. Lock the driving compartment and partition doors.
10. Return the satchel containing the brake handle reversing lever, control switch key, A.W.S. key and carriage keys to the responsible person on duty at the depot.
11. Report any known defects.

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 there is an indication that an engine has stopped while the train is running, before attempting to restart, confirm at the next train stopping point that the engine has in fact stopped. Attempt to restart by depressing the appropriate "Start" button, not more than three times. If this fails to restart the engine, if possible lock the final drive in NEUTRAL and proceed to the terminal point on the remaining engines. At the terminal point the final drive must be locked in NEUTRAL and the matter reported.

To Lock Final Drive in Neutral

STOP all the engines, then with the special tool which is available in the Guard's compartment, withdraw the "Neutral" lock and turn it a quarter turn and allow it to go right home. Proceed to the cab and move the reverser lever slowly from Forward to Reverse and back several times and ensure that the "Neutral" lock is entered fully in the slot. Check that the main propellor shaft to the final drive concerned can be rotated by hand.

NOTE:- If no air pressure is available the final drive cannot be operated to allow the lock to engage in NEUTRAL.

ASSISTING DISABLED TRAIN

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

Transmission Failure

1. Assistance by a train of same type

- (a) 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 and Uncoupling."
- (b) Before proceeding, (turn isolating switch of engines concerned to OFF if fitted) the final drive gears of the defective power unit must be set and locked in the NEUTRAL position, if possible.
- (c) 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 by a locomotive, the vacuum release pipe hose should remain on the stop, the vacuum hose to the train pipe only being connected.

- (a) Set the driver's brake valve handle in the LAP position.
- (b) Place the gear-drive selector handle in the NEUTRAL position and STOP ALL ENGINES on the disabled train. Set and lock ALL the final drive gears in the NEUTRAL position, if possible. If 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.

- (c) Tear off the cover in front of the Deadman's isolating valve and move the handle to the ISOLATE position. When in multiple, ALL Deadman's controls must be isolated.
- (d) Remove the reversing lever, control switch key and A.W.S. key.

FAILURES OF CONTROL EQUIPMENT

Driving Controls

- (a) **Leading Driving Compartment**

Remove control switch key, reversing lever, brake handle and A.W.S. key, then proceed to the next driving compartment and endeavour to gain control. Then act in accordance with the Appendix Instruction for the "Working of Diesel Mechanical Trains—Driving Apparatus Disabled."

- (b) **Train of more than two cars including two or more Power Cars**

In a train composed of more than two cars including two or more power cars, the failure of the battery on any one power car does not necessitate the failure of the train, as the control switch key can be transferred to any other power car and control obtained of the train. It is not possible, however, to re-start the engines of the power car on which the battery has failed. The final drives on this power car must be locked in NEUTRAL.

- (c) **Deadman's Device**

If there is a vacuum brake leakage caused by a defective Deadman's device, tear off the cover in front of the Deadman's isolating valve and move the handle to the ISOLATE position.

IF A DEADMAN'S CONTROL IS ISOLATED THE MATTER MUST BE REPORTED as soon as possible.

The tear-off cover must not be replaced by an unauthorised person.

COMPRESSED AIR SYSTEM—UNLOADER VALVE

In the event of an unloader valve defect remove the blank nut from dummy stud adjacent to the unloader valve and fit it on to the escape connection of the valve after unscrewing protection cap.

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 cab and inspect the engine that has been affected as shown by the indicator light in the cab. 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. Where the final drive cannot be disengaged, a speed of 25 m.p.h. must not be exceeded to the point where the train can be taken out of traffic.

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

COUPLING AND UNCOUPLING

1. See that the Driver's controls are in the "OFF" position before trains are coupled or uncoupled.
2. Place the Control 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.

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.

HAND BRAKES

All power cars and driving trailers will be fitted with an indicator lamp in the driving cab which when illuminated indicates that the handbrake in that driving cab is ON when the control switch key is turned to the ON position. In addition, if a handbrake is left on anywhere in the train the buzzer in all cabs sounds continuously.