

BR. 33003/45

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B.U.T.-CRAVEN POWER CARS

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GENERAL DESCRIPTION

Each power car is provided with two engines. Driving controls are provided at one end only 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).		
Weight in running order:				
Twin Car Set ... ..	...	52 tons (Power Car 29 tons; Driving Trailer 23 tons).		
Tractive effort, Total (single Power Car):—				
	1st Gear	2nd Gear	3rd Gear	4th Gear
	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 unit).		
Height overall ... ..	...	12ft. 6½ins.		
Minimum curve negotiable ...	...	3½ chains.		
Maximum speed at maximum engine revs.:—				
	1st Speed	2nd Speed	3rd Speed	4th Speed
	15.3 m.p.h.	27 m.p.h.	41 m.p.h.	65.5 m.p.h.
Gear Ratio:—				
	1st Gear	2nd Gear	3rd Gear	4th Gear
	4.28 : 1	2.42 : 1	1.59 : 1	1 : 1
Fuel capacity ... ..	...	95 gallons per engine, including fuel for one heater; total 190 gallons.		
Lubricating oil sump capacity		6½ gallons per engine.		
Cooling water capacity ... ..	...	12 gallons per engine.		
Control system ... ..	...	Electro-pneumatic.		
Brake system ... ..	...	Vacuum.		
Warning device ... ..	...	Compressed air operated.		

Engines (B.U.T.)

(a) Leyland Type

Two 6-cylinder 11.1 litre horizontal oil engines ...	Leyland 680/1 type, 150 h.p. at 2,000 r.p.m.
Compression ratio	15.75 to 1.
Bore	127mm. = 5.00ins.
Stroke	144.05mm. = 5.75ins.
Firing order	1, 5, 3, 6, 2, 4.
Rotation	Clockwise.
Fuel injector type	Leyland N 41.
Fuel injector lifting pressure	140-145 atmospheres = (2,057 - 2,130 lbs./sq.in.).
Fuel pump type	C.A.V. Monobloc type.

(b) A.E.C. Type

Two 6-cylinder 11.3 litre horizontal oil engines ...	A.E.C. type "A", 150 h.p. at 1,800 r.p.m.
Compression ratio	16 to 1.
Bore	130mm. = 5.12ins.
Strokes	142mm. = 5.5907ins.

Firing order	1, 5, 3, 6, 2, 4.
Rotation	Clockwise.
Fuel injector type	C.A.V. B.D.L.L. 150.S.
Fuel injector lifting pressure	175 atmospheres (2.570lbs./sq.in.).
Fuel pump type	C.A.V. 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	Lead Acid BRA.2 12 Cells: 24 volt. 440 amp.hr.
{ Driving Trailer	Lead Acid BRA.2 12 Cells: 24 volt. 440 amp.hr.
Generator—	
{ Power Car	Stones, Type XR 29L 24 volt. Belt-driven from the output end of one gearbox (non-reversible).
{ Driving Trailer	Stones, Type XR 22L. Belt-driven from axle (reversible).
Starter Motor	C.A.V. Axial Type.
Compressors	Westinghouse type E.11 — Leyland engine.
	Clayton-Dewandre CD series type PCGA. 189 — A.E.C. engine.
Exhausters	Clayton-Dewandre. Type C.725. Belt-driven.
Car heating equipment ...	Smith's Combustion Air Heater.
Fuel Tank — Driving Trailer	45 gallon fuel tank on each driving trailer for heaters.
Windscreen wipers	Compressed air operated.
Speedometer	Smith's (Electrical drive).

DRIVER'S CONTROLS

1. Electrical control switch (with Yale type 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/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. Head light switches.

17. Windscreen wiper valve.
18. Instrument panel light switches and dimmer.
19. Change-over switch, engine speed.
20. Destination Indicator light switch.
21. Buzzer and Button.
22. Handbrake.
23. Deadman's Isolating valve (in power cars only).
24. Car heater switches.
25. Deadman's hold-over button.
26. Car and train light control.
27. Fire alarm bell.
28. Demister control.
29. A.T.C. key (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 shut down the engines to Idling.

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 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 the throttle handle must be moved back past the Idling position before the handle can be depressed.

The gear selector handle and reversing lever are mechanically interlocked. 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

1. Obtain the satchel containing the control switch key, reversing lever, vacuum brake handle, A.T.C. key (where fitted) and carriage keys.
2. Check that:—
 - (a) the detonator cases are intact in all power cars,
 - (b) the Deadman's isolating valve covers are intact in all power cars,
 - (c) the handbrake is **ON** in the leading driving compartment,
 - (d) the handbrakes are **OFF** in all trailing compartments.**LOCK ALL DOORS.**
3. Report all known defects at the end of each turn of duty. (Make a short inspection of the train at a convenient time and check that the apparatus is generally in good working condition. Also check fuel tank levels.)

STARTING THE ENGINES

1. Turn the control switch key to the ON position. Place A.T.C. key (where fitted) in 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 75lbs./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) Depress the throttle handle to engage the Deadman's device, then move it to 1st or 2nd throttle position.
 - (c) Press left and right "Start" buttons in turn and release each immediately the indicator lights show that all engines on that bank have been started. **DO NOT PRESS BOTH "START" BUTTONS TOGETHER.** 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 "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 that the engine isolating switch is in the ON position. 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-c). 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 electrical control switch key is in the ON position.
 - (b) Check that the gear selector handle is locked in the NEUTRAL position and the reversing lever removed from the controller, and that the handbrake is ON.
 - (c) **At side of car** 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) **Leyland Type Engines**
Release the fuel injection pump hand throttle control gradually until the engine runs at Idling speed—**do not race the engine.**
 - A.E.C. Type Engines**
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 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.** When the air pressure in the system has built up to 75lbs./sq.in., STOP all engines, then place the reversing lever into position in the controller and proceed to restart the engines as shown in Item 3 (a-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 ENGINES RUNNING

- (a) Place the brake handle in position and move it to the Release position. Check that 21ins. of vacuum can be obtained in the train pipe and not less than 26ins. on the reservoir side.
- (b) Release the throttle handle. Check that it springs up 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 95lbs./sq.in.
- (d) Apply the vacuum brake and take off 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 and hold the throttle handle in the IDLING position.
- (c) Release the vacuum brake to about 15ins. of vacuum then "lap" the brake valve.
- (d) **WITH THE ENGINES 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. Then speed up the engines to increase the vacuum by opening the throttle handle, but not beyond notches 1 or 2.

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.
2. STOP the engines.
3. Remove the reversing lever. Place the vacuum brake handle to the LAP position and remove handle.
4. Place control switch in the OFF position and remove key.
5. Remove A.T.C. key (where fitted).
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 A.T.C. key (where fitted) in position.
9. Place reversing lever in FORWARD OR REVERSE as required. Place A.T.C. flag in the "In Use" position (Western Region).

10. Proceed to restart the engines as shown under "Starting the Engines" item 3 (b-d), when at least 75lbs./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 illuminated indicating that the final drives have 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 in "Starting the Train", items (c) to (f).

N.B. : 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.
3. Press engine "Stop" button and hold in that position until engines have stopped (engine lights are extinguished).
4. Place the reversing lever into the NEUTRAL position.
5. Apply the handbrake.

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.
3. Remove reversing lever. Place control switch in OFF position and remove key.
4. Remove A.T.C. key (where fitted).
5. Shut off compartment heaters if in use.
6. Lock the driving compartment and partition doors.
7. Return the satchel containing the brake handle, reversing lever, control switch key, A.T.C. key (where fitted) and carriage keys to the Running Foreman or other responsible person on duty.

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 turn heater switch in a clockwise direction to FULL 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 re-start.) After a period of 45 seconds the air fan light will be illuminated on the indicator panel denoting that the heater fan and fuel pumps are working. In approximately $3\frac{1}{2}$ 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 are automatically switched off; it is then necessary to return the control switch to

OFF and re-start. Not more than three attempts should be made to start the apparatus.

If the switch is in the Full Heat position and the heater cuts OUT, the indicator light will be extinguished. Return the switch to OFF, then attempt to re-start the heater as described above.

To shut down the heater, return the switch to the OFF position.

To admit cold air to the train, turn the switch in an anti-clockwise direction past the OFF position to COLD.

FAULTS IN TRAFFIC

If there is indication that an engine has stopped while the train is running, before attempting to re-start, confirm at the next convenient stopping point that the engine has in fact stopped. Attempt to re-start by depressing the appropriate local "Start" button, not more than three times. If this fails to re-start the engine, turn the engine isolating switch to OFF and, if possible, lock the final drive in NEUTRAL. 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 ENGINES, then, with the special tool which is available in the Guard's compartment, withdraw the "Neutral" lock, turn it a quarter turn and allow it to go right home. Proceed to the driving compartment and move the reversing lever slowly from Forward to Reverse and back several times, to ensure that the "Neutral" lock is entered fully into 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 be engaged 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 isolation switch of engines concerned to OFF: the gears must be in the NEUTRAL position and 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 in the LAP position.

- (b) Place the gear 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 on 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 and control switch key.

FAILURES OF CONTROL EQUIPMENT

Driving Controls

(a) Leading Driving Compartment

Remove control switch key, reversing lever, brake handle and A.T.C. key (where fitted) and 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 restart 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 on 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 the 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 if fire is adjacent to an engine, 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 re-start the affected engine. After this has been done, and before proceeding, turn the isolating switch to OFF and, if possible, set and lock the final drive gears of the defective engine in the NEUTRAL position. 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 two-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.