GEC

1000 hp DIESEL ELECTRIC LOCOMOTIVES FOR BRITISH RAIL

GEC Traction Limited

ENGLISH ELECTRIC | AEI

Cover illustration shows two Class 20 locomotives with a pulpwood train in the Highlands of Scotland. (C. W. R. Bowman)

Diesel Locomotives for British Railways

First line-service units under the modernisation plan

AT the end of May was completed the first of the 174 line-service diesel locomotives ordered in November 1955-January 1956 for British Railways under the modernisation scheme, and detailed in our issue of January 1956. This was the first of 20 English Electric Bo-Bo locomotives of 1,000 b.h.p., built throughout in the works of the E.E. group, the engine and electrical equipment being of English Electric make and the mechanical portion built and the locomotive erected at the Vulcan Foundry.

No train-heating apparatus is installed; therefore apart from certain summer workings, operation will be in freight and freight-transfer traffic, though the top designed speed is 75 m.p.h. Multiple-unit coupling control is fitted, so that these units can be connected with many other types of diesel-electric locomotives being built for British Railways, and driven by one man.

Leading general particulars of these Bo-Bo single-cab locomotives are:

Wheel dia.	43 in.
Bogie wheelbase	8 ft. 6 in.
Bogie pivot pitch	24 ft.
Length over buffer beams	43 ft.
Weight in working order	72 tons
Starting tractive effort	42,000 lb.
Continuous tractive effort	19,500 lb.
Fuel tank capacity	400 gal.
Min. curve	230 ft.

The locomotive itself has a compressed air brake, but an exhauster is fitted so that vacuum-braked stock can be hauled. A vacuum/air proportional valve ensures that on normal application the locomotive and train brakes go on simultaneously.

Equipment Layout

The cab is positioned at one end. Adjacent to it is the engine compartment, which contains the control cubicle mounted transversely. One side of the cubicle faces directly into the cab, so that the driver or a fitter may have ready access to the control equipment. The engine compartment also contains one of the traction motor blowers. On the bulkhead behind the main power unit a motor-driven fuel transfer pump and a lubricating oil priming pump are mounted, alongside the fuel filters.

Beyond the engine compartment is the fan compartment which contains the radiators, the roof-mounted radiator fan, and the right-angle gearbox for the fan drive. A further end compartment contains the exhauster and Westinghouse DVC3 compressor, and the second traction motor blower.

Superstructure

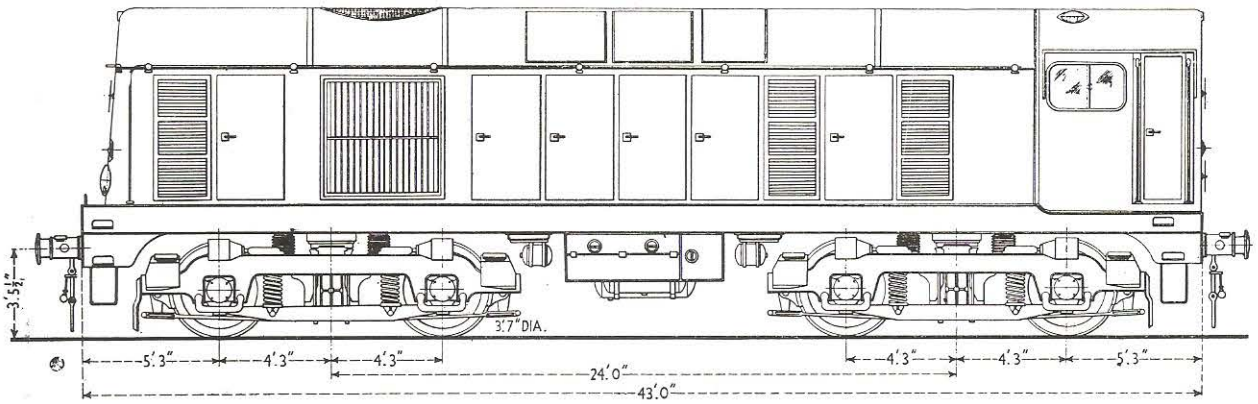
The locomotive superstructure is of the bonnet type with a full-width driving cab at one end. The cab has a 4 kW heater, a hot-air heater for foot level, a hot-plate, and two seats. Trico-Folberth window wipers, Beclawat windows and Stone's lighting details are also fitted in the cab, the last-named extending also to the headlights.

Doors are provided along the body sides to give ready access to the diesel electric equipment. The superstructure side framing is prefabricated and attached to the underframe by welding. Removable roof sections are provided over the control cubicle, the power unit, and the end compartment to facilitate maintenance of the equipment. In addition, hinged hatches are provided over the cylinder heads, and a small removable hatch is provided over the pressure-chargers. The cab is resiliently mounted on the underframe in order to reduce the noise level to a minimum.

Underframe construction is of four channel-section longitudinals divided into two pairs, each pair being joined at the top and bottom by plating thereby forming two box sections. The two box sections are strongly cross-connected at intervals by transoms of welded construction. The centre parts of the box sections are sealed off to form two fuel tanks, and are connected together by two of the transom members which act as balancer pipes. Drag boxes are welded at both ends of the underframe to carry the drawgear, which is of the standard British Railways screw coupling type, but provision is made for fitting Buckeye couplers. Two battery boxes are underslung from the centre of the underframe. They are well ventilated, and ready access to the batteries for topping up or removal is possible through dropdown hinged doors.

Bogies

Bogie frames are of fabricated construction. The solebars are welded to form a box section, and the fabricated transom and headstocks are riveted to the solebars. The load from the superstructure is trans-



Side elevation of Bo-Bo locomotive for 75 m.p.h. top speed

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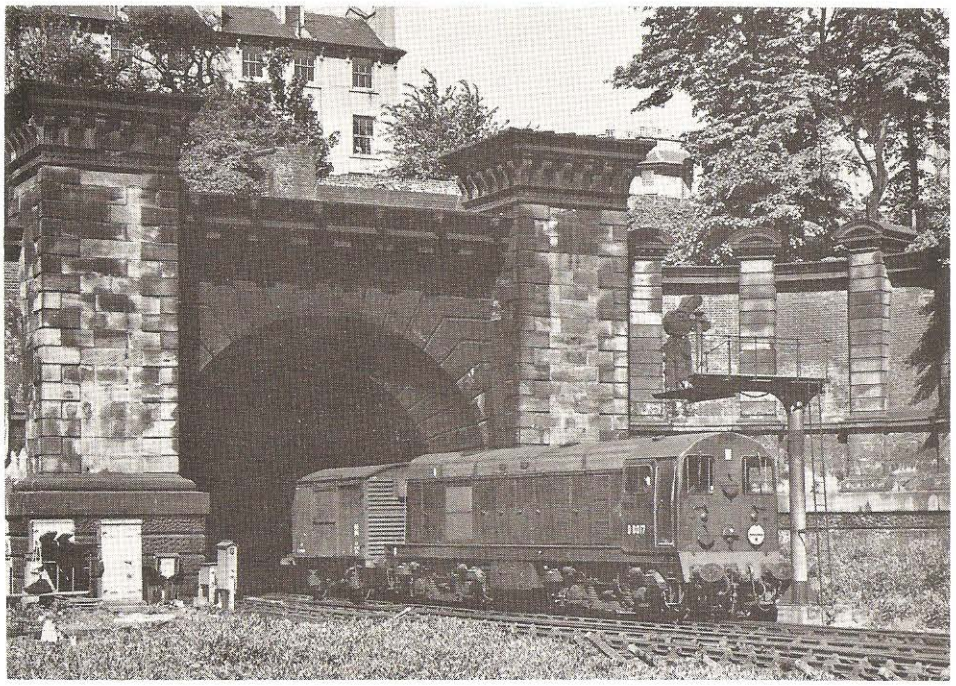


Primrose Hill Tunnel

mitted to the bogie frames through a single bolster in each bogie. This bolster is carried on semi-elliptic laminated springs, which in turn are carried on a swing plank, supported from the bogie frame by inclined swing links. Springing between the bogie frame and the wheels is provided by nests of coil springs which are located between the underside of the bogie frame and the top side of the equaliser beams. In turn, the forged steel equaliser beams are underslung from the roller-bearing axleboxes. Forged steel hornclips are fitted on each side of the axlebox guides.

Manganese steel liners are fitted on the axlebox guides and on the thrust faces of the Timken roller-bearing axleboxes. Similar liners are fitted on the thrust faces of the bolster and bogie transom; lateral swing of the bolster is limited by rubber blocks.

Brakes

Brake control equipment is of the Oerlikon type manufactured by Davies & Metcalfe. At each driving position there are two brake handles: one controls the straight air locomotive brake, the other controls the vacuum train brake. There is a vacuum/air proportional valve on the locomotive which ensures that when a vacuum brake application is made on the train, there is an automatic proportional application of the locomotive air brake. A deadman pedal is provided at each driving position, and when this is released it cuts off power and applies the locomotive

The South bound "Hillman Imp" car train starts from the Linwood Works of Rootes Ltd. hauled by two class 20 locomotives.

and train brakes. Clasp type brakes are fitted on all wheels. The air brake cylinders are mounted on the bogie solebars and operate the shoes through conventional rigging.

Engine Equipment

Power comes from an English Electric 8-SVT MkII engine, built at the Preston works and set to give a top output of 1,000 b.h.p. at 850 r.p.m. It is an eight-cylinder unit with the 10-in. by 12-in. cylinders arranged in vee formation, and with two Napier exhaust-gas turbo-chargers fitted at the driving end At the free end of the crankshaft is an extension to provide a mechanical drive to the radiator fan.

The main generator is bolted up solidly to the engine, and together with an overhung auxiliary generator these form a compact integral power unit. This power unit is supported on resilient bearers so that normal flexing of the locomotive underframe does not set up any stresses in the power unit. At the same time, removal of the unit from the locomotive is a comparatively simple operation.

Engine oil and water are cooled by a double bank spiral tube radiator, one radiator panel being mounted at each side of the locomotive. The radiator fan draws air across the radiators and expels it through the roof. The radiators are provided with shutters, which are controlled from the cab. The temperature of the cooling water is automatically controlled by a thermostatic radiator by-pass valve inserted within the water system.

The radiator fan is roof-mounted and is mechanically-driven from the free end of the main engine crankshaft. The drive to the fan is by a splined shaft with flexible couplings to a right-angle gearbox. The vertical drive from the gearbox to the radiator fan is made through a shaft with flexible couplings interposed; in addition, there is a centrifugal clutch in the final drive to reduce the torque imposed on the fan when starting up or shutting down the diesel engine.

Oil-wetted filters are provided in the sides of the locomotive, so that all air taken into the interior of the locomotive is fully filtered. The bulkhead between the fan compartment and the engine compartment is provided with openings through which the radiator fan is allowed to draw a large volume of air. This air enters the engine compartment through filters located towards the cab end, so that there is a flow of cooling air past the power unit. The diesel engine and generators, together with one of the traction motor blowers, draw their air from the filtered supply in the engine room. The end compartment is provided with filters in its sides, and air is drawn into this compartment by the traction motor blower and compressor.

Electrical Machines

The main generator is a d.c. self-ventilated single-bearing machine with a continuous rating of 1,070 amp. at 600 volts. In addition to a separately-excited winding which is used for normal running, it is provided with a series winding for engine starting. Power output to the traction motors is varied by simultaneous control of the diesel engine speed and main generator field excitation. The auxiliary generator is overhung from the free end of the main generator. It is also a d.c. self-ventilated machine, and its output tension is maintained constant at 110 volts by a carbon pile voltage regulator. The auxiliary generator provides the low-tension supply for charging the D.P. battery, for operating the control gear, and for driving the compressor motor, exhaustermotor and traction motor blowers.

The four nose-suspended traction motors drive the wheels through single-reduction spur gearing. They are series wound d.c. machines. In order to extend the range of locomotive speeds over which full engine power is available, provision is made for weakening the field strength of the traction motors by field divertor resistances. Each traction motor has continuous rating of 600 amp. at a nominal tension of 300 volts. Each pair of motors is force-ventilated from the adjacent blower in the locomotive superstructure,

The same train further South.

and the air is led from the blower by ducts and flexible bellows connections to the air inlet at the commutator end of the motor.

Control Gear

Most of the control gear is housed in the single cubicle which faces into the cab and is placed transversely across the locomotive. The remainder of the control gear, including the torque regulator and voltage regulator, is located behind the control cubicle on a bridge support which runs across the main casing from cantrail to cantrail.

The traction motors are connected in two parallel groups across the main generator, each group consisting of two traction motors in series. Wheel slip protection circuits are included which reduce the tendency for wheel slip to occur, but in the event of wheel slip commencing the driver is warned by an indicator light at the driving position and automatically the tractive effort is reduced.

Additional warning lights are placed at the driving position to indicate that the diesel engine has shutdown and to indicate the presence of a fault such as high water temperature or a failed traction motor blower. In the event of low lubricating oil pressure or low cooling water level, the diesel engine is automatically shut down.

There are two master controllers, one at each driving position. The control circuits are energised by electro-pneumatic and electro-magnetic contactors and relays. The speed of the diesel engine may be varied infinitely from 450 r.p.m. to 850 r.p.m. and the loading on the engine is automatically adjusted so as to cause the engine to deliver the maximum available power output corresponding to the selected engine speed. The advantage of this system is that for a given load demand, the diesel engine runs at the lowest possible speed at which the load demand can be met.

Driving Controls

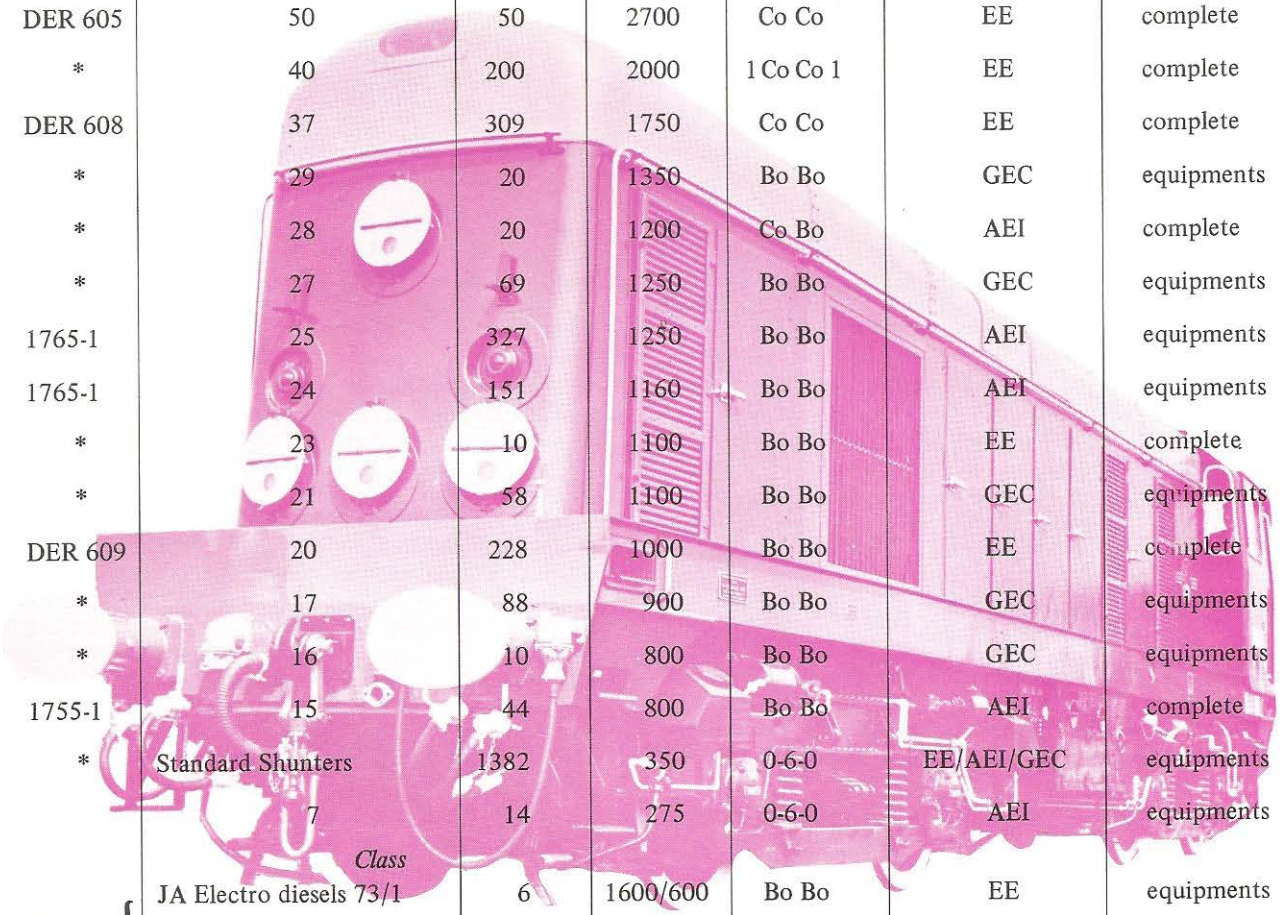
The driver's controls are built into a prefabricated desk. There is a desk at each driving position, and the one nearest the control cubicle is the master desk. The master controller is locked and made inoperative by a master key which prevents the locomotive from being driven by unauthorised persons. Once the controller has been unlocked, one of the two handles can be moved from the off position to either the forward, reverse or engine-only positions. The handle is first moved to the engine-only position, and the engine is started by pressing a push button which connects the battery to the main generator and motors the engine until it fires. Once the engine has fired, the handle can be moved to select the direction of travel. Thereafter, the locomotive power output is controlled by the second master controller handle. The controller handles and master key are interlocked to prevent any wrong operation of the controls. The driver may change from one driving position to another without stopping the engine, which has an independent engine-stop button control.

At each driving position instruments are provided, together with indicator lights, to show the condition of the equipment and to provide a warning of fault conditions. In addition to three air and vacuum gauges, there are a Smith's speedometer, and an ammeter to indicate the main generator current. One of the three indicator lights provides an indication that the diesel engine has stopped, the second indicates the existence of wheel slip, and the third indicates a fault condition such as high water temperature or that the traction motor blowers are not running.

(J. H. Cooper Smith)

BRITISH RAIL MODERNISATION PLAN

DIESEL ELECTRIC LOCOMOTIVES AND EQUIPMENTS BY GEC TRACTION



Leaflet Ref.	*BR Class*	*No. Built*	*Power*	*Wheel Arrangement*	*Supplied by*	
DER 608	55	22	3300	Co Co	EE	complete
DER 605	50	50	2700	Co Co	EE	complete
*	40	200	2000	1 Co Co 1	EE	complete
DER 608	37	309	1750	Co Co	EE	complete
*	29	20	1350	Bo Bo	GEC	equipments
*	28	20	1200	Co Bo	AEI	complete
*	27	69	1250	Bo Bo	GEC	equipments
1765-1	25	327	1250	Bo Bo	AEI	equipments
1765-1	24	151	1160	Bo Bo	AEI	equipments
*	23	10	1100	Bo Bo	EE	complete
*	21	58	1100	Bo Bo	GEC	equipments
DER 609	20	228	1000	Bo Bo	EE	complete
*	17	88	900	Bo Bo	GEC	equipments
*	16	10	800	Bo Bo	GEC	equipments
1755-1	15	44	800	Bo Bo	AEI	complete
*	Standard Shunters	1382	350	0-6-0	EE/AEI/GEC	equipments
	7	14	275	0-6-0	AEI	equipments
	Class					
ELR 1101	JA Electro diesels 73/1	6	1600/600	Bo Bo	EE	equipments
	JB Electro diesels 73/2	43	1600/600	Bo Bo	EE	complete
	HB Electro diesels 74	10	2500/650	Bo Bo	EE	equipments

*Out of print

A total installed power of 2817000 hp in 3051 locomotives for one customer.

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