Modern LOCOMOTIVES ILLUSTRATED

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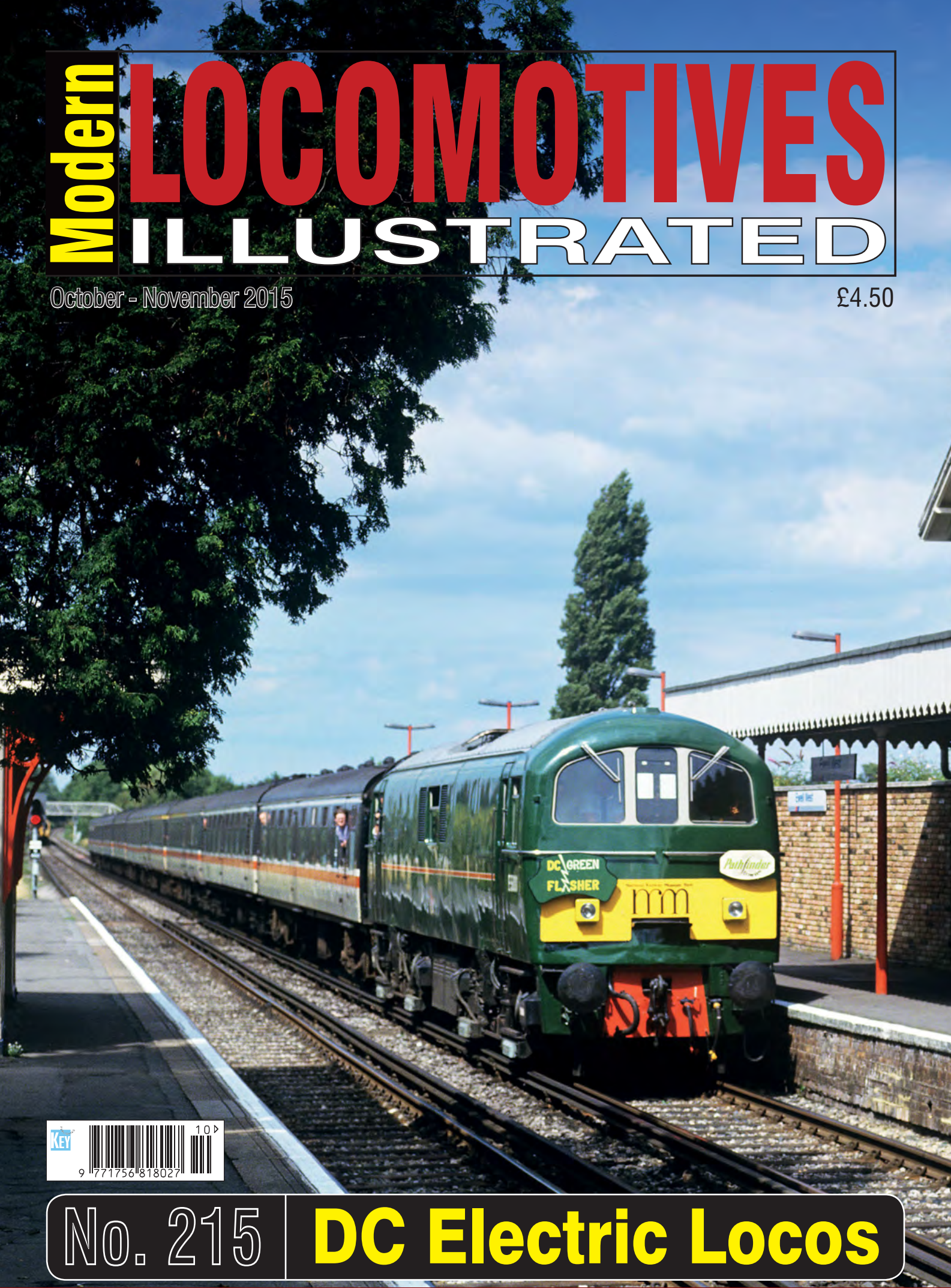

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No. 215 DC Electric Locos

The UK's Number One Modern Traction Partwork

Modern LOCOMOTIVES ILLUSTRATED

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Above: *In British Transport Commission (BTC) black livery and long before cast nameplates were applied, Class EM2 No. 27002 departs from Penistone with a Marylebone to Manchester London Road express on 26 February 1955.*
Kenneth Field/Rail Archive Stephenson

Front Cover: *After withdrawal from BR service in November 1977, No. 71001 was stored at Ashford and moved to BREL Doncaster for restoration as a static exhibit in June 1978, being placed on display at the NRM, York in March 1979. In May 1992 the loco was taken to Ashford Chart Leacon for restoration to the main line and operated for a couple of years on charter services. On 17 July 1993, as No. E5001 the loco passes Ewell West with the Pathfinder Railtours 'DC Green Flasher' tour, which was powered by the Class 71 from Eastleigh to Waterloo and from Waterloo to Southampton via Horsham.*
Peter Fitz-Gerald

DC Electric Locos

In the UK we have had relatively few direct current (DC) electric locomotives, compared with other European countries. This edition of *Modern Locomotives Illustrated* covers these interesting machines; (It does not include the dual-power electro-diesels, which were covered in *MLI* issue No. 198).

The first main line direct current electric locomotives emerged in 1904 when a pair of Bo-Bo machines were built by Brush/BTH for the North Tyneside Quayside branch from Manors Trafalgar Yard. Numbered NER1 & 2, they became LNER Nos. 6480/1 and later BR Nos. 26500/1 collecting power from either a bow/pantograph or the third rail.

In 1915 the North Eastern Railway expanded its electric fleet by 10 locomotives when freight Bo-Bos Nos. NER3-12 were introduced for use in the Shildon area, these were later renumbered as LNER6490-99 and later BR 26502-11.

Looking to the future and main line electrification, in 1922 a prototype loco No. 13 was built by the North Eastern, this was tested but as no main line electrification existed, the loco had no place to demonstrate its abilities, it was later renumbered as 6999 and 26600.

The first long distance main line direct current electrification was planned in the early 1940s by the LNER to modernise its Woodhead route over the Pennines, but the outbreak of war delayed this until the 1950s. This highly successful project led to the construction of two batches of electric loco, the Bo-Bo 26000 series, later Class 76 and the more powerful passenger Co-Co fleet, later classified as 77.

In the south, the Southern Railway with its mass of suburban electrification using the DC system built three main line locomotives between 1941-48 which proved the concept of short locomotives having the ability to collect power through gaps in the live rail.

The BR Southern 'Kent Coast Electrification' of the late 1950s saw a fleet of 'booster' electric locos built by Doncaster for use on both passenger and freight traffic.

I hope you enjoy looking at these fascinating locomotive classes at work and rest in this edition of *MLI*.

Colin J. Marsden
Editor

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NER Bo-Bo – Class ES1

Electrification of the North Tyneside lines in 1904, included the one mile freight only branch from Manors, Trafalgar Yard, to the Quayside Yard, located 130ft (40m) lower on the banks of the River Tyne.

The line dropped at a gradient of 1:27 through a deep cutting with a single track tunnel on a sharp curve, previously conditions under steam operation were appalling with little or no ventilation for footplate crews in the restricted environment.

Electrification demanded the use of the third rail system in the narrow tunnel, but in the shunting yards the presence of such ground level metalwork would be extremely hazadous to staff and contractors, therefore overhead wiring was deemed as necessary in this area.

For powering trains on this difficult line, the North Eastern Railway (NER) ordered and constructed two Bo-Bo centre-cab electric locomotives, allocated the numbers NER 1 and 2, these later became London & North Eastern Railway (LNER) Nos. 6480 and 6481 and eventually after 1948 and Nationalisation BTC/BR Nos. 26500 and 26501.

The locos, built by Brush, were equipped with four 160hp (119kW) British Thomson-Houston traction motors fitted to Brush-designed bogies, at first they collected power by means of a bow collector mounted on the bonnet, but this was soon replaced by a more traditional pantograph mounted on the roof of the steeple cab. Third rail collector shoes were originally mounted on all four side corners of the loco attached to the bogie frame, later this was altered to a more conventional shoe beam on the bogie side

For the best operations, trains were pushed or propelled downhill to the Quayside Yard, and hauled upgrade to Trafalgar Yard, with a maximum permitted load of just 160 tons. At the start of the ascent, it was the responsibility of the fireman, (second man), to 'cut-in' the power collector shoes and switch off and lower the pantograph, all this had to be achieved within a few yards where dual power supply was provided at the entrance to the tunnel.

Among the loads transported over the line were the steam 0-6-0 tank engines being transferred between Heaton Shed and the riverside yards.

The introduction of wholesale dieselisation for shunting operations, saw electric traction unnecessary over this short line, and the branch was de-electrified with effect from 29 February 1964.

The two electric locomotives were withdrawn in September 1964. Fortunately, No. 26500 has been preserved, and is now part of the National Collection, painted as NER No. 1.

The quayside branch was finally closed from 16 June 1969, and its route is now crossed by a tunnel on the Tyne & Wear Metro system. ■

Below: *Displaying original North Eastern Railway lined-green livery, NER No. 1, later classified as Class ES1 and renumbered in London North Eastern Railway ownership as LNER No. 6480 and later BR No. 26500, shows its as built arrangement. The main power collector was a bow, mounted on a tall hinged bracket on the number one hood, while the third rail 600V dc power pick up was by a simple slipper mounted on the outer corners of the bogies. No side fuse protection existed for the live shoes, this was provided by a brass fusible link mounted on the front end below the buffer beam.* **CJM-Collection**

NER Number	LNER 1946 Number	Date Renumber	BR 1948 Number	Renumber Date	Built By	Works Number	Date Introduced	First Depot	Date Withdrawn	Final Depot	Status Code	Disposal Detail
1	6480	Jun-46	26500	May-48	Brush/BTH		Dec-1903	52B	Sep-64	52J	P	National Railway Museum, York
2	6481	Jun-46	26501	May-48	Brush/BTH		Dec-1903	52B	Sep-64	52J	C	W Willoughby, Choppington

Class ES1

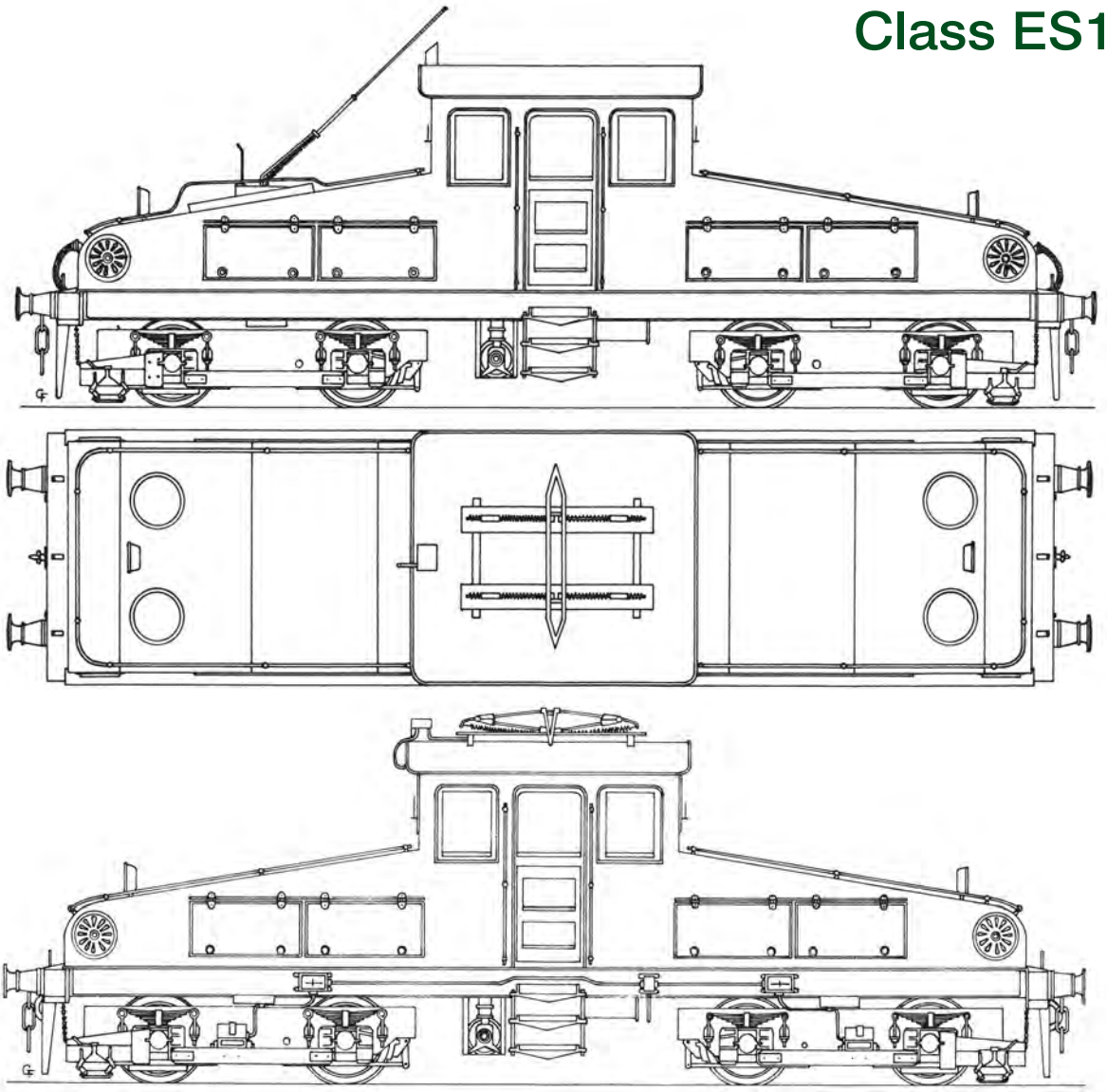
Right Top: *Original layout, showing bonnet or hood-mounted bow power collector.*

Right Middle: *Roof detail, showing revised roof mounted pantograph power collector.*

Right Below: *Revised side elevation, showing roof mounted pantograph, but with third rail collector shoes (slippers) mounted on bogie frame corners.*

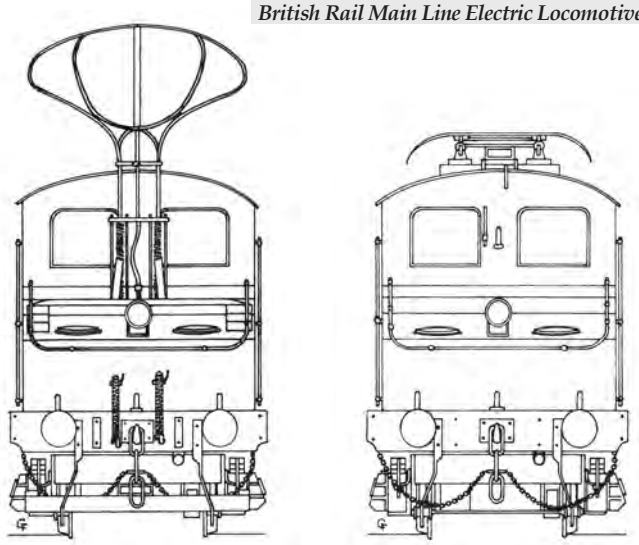
Bottom Left: *Front end elevation showing bonnet or hood mounted bow power collector.*

Bottom Right: *Front end elevation showing revised equipment with roof mounted pantograph in lowered position.*



The drawings are reproduced in exact OO gauge 1:76 - 4mm to the foot scale

British Rail Main Line Electric Locomotives - ISBN 0-86093-559-2



Technical Description

Class:	ES1
Original NER numbers:	1-2
Former LNER numbers:	6480-6481
1948 BR numbers:	26500-26501
Built by:	Brush
Introduced:	1903
Wheel arrangement:	Bo-Bo or 0-4+4-0
Weight (operational):	56 tons
Height - pan down:	12ft 11in (3.94m)
Width:	8ft 9in (2.67m)
Length:	37ft 11in (11.56m)
Maximum speed:	25mph (37km/h)
Wheelbase:	27ft 8in (8.69m)
Bogie wheelbase:	6ft 6in (1.98m)
Bogie pivot centres:	20ft 6in (9.30m)
Wheel diameter:	3ft (914mm)
Brake type:	Air (loco only)
Sanding equipment:	Pneumatic
Heating type:	Non fitted
Coupling restriction:	Not multiple fitted
Horsepower:	640hp (477kW)
Tractive effort - maximum:	25,000lb (111kN)
Number of traction motors:	4
Traction motor type:	BTH
Control system:	DC direct
Gear ratio:	3.28:1
Nominal supply voltage:	600V dc overhead and third rail

Disposal Date

Notes

Table Key
C - Cut up
P - Preserved
52B - HJeaton
52J - South Gosforth

-	No. 4075 carried 09/44-10/44, Stored: (U) 03/64
Jul-66	

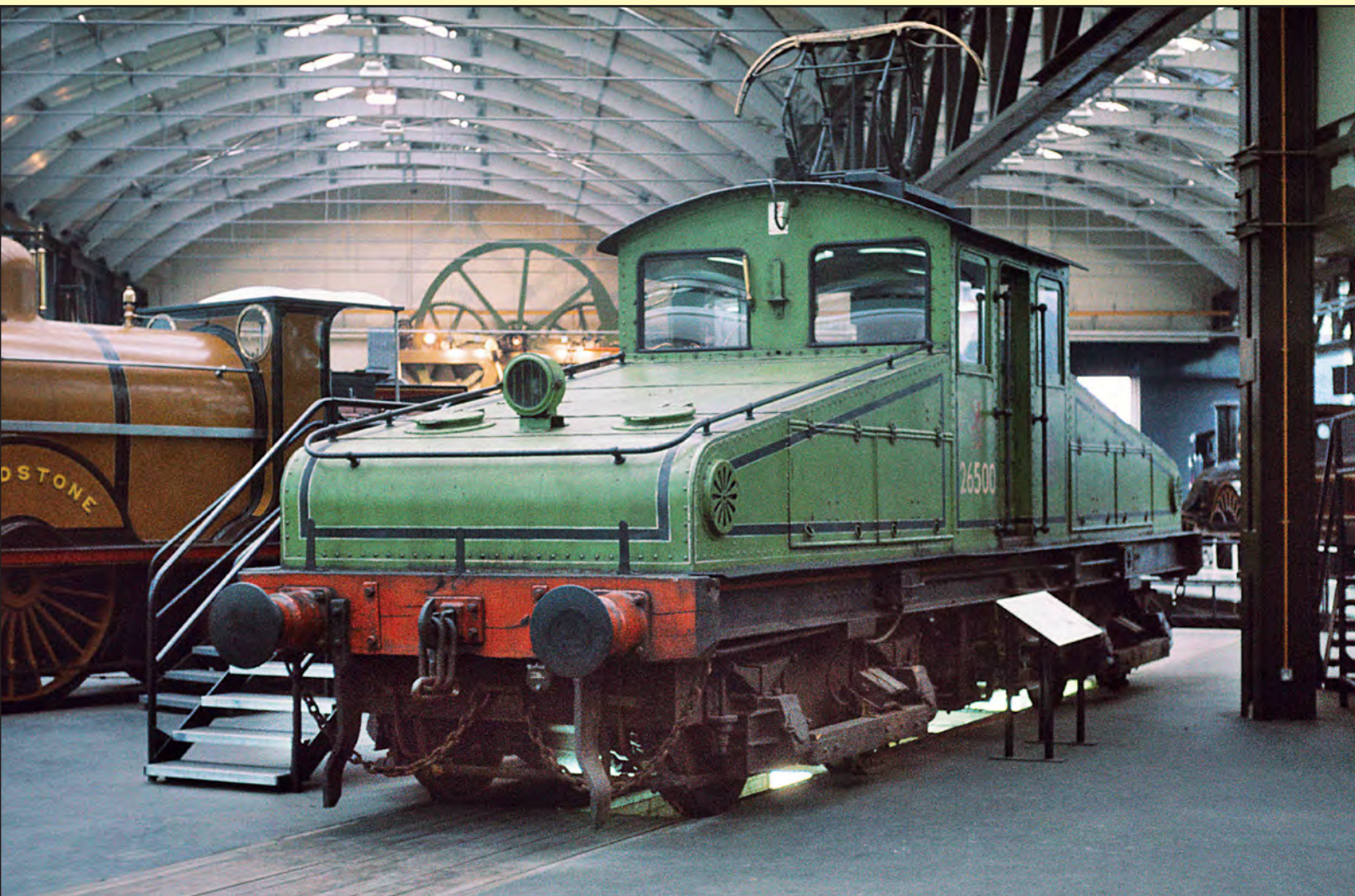
Above: *Recorded around 1919, North Eastern No. 2 is seen in Trafalgar Yard, Newcastle after traversing the tunnel section from Manors with a load bound for the Quayside yard.* **CJM-Collection**

Left: *Restored to North Eastern green livery, but carrying a BR motif on the cab side, No. 26500, the original NER No. 1, is seen at Trafalgar Yard after making its last trip from Newcastle Quayside on 29 February 1964, after this date all trains were diesel-shunter powered.* **Ian S. Carr**

Below: *The second of the original North Eastern Railway pair, No. 26501, originally No. 2 and later LNER No. 6481, shunts in Newcastle Quayside Yard in the late 1950s. By this time more conventional shoe gear, mounted on a shoe beam had been fitted. As well as working the trains 'up' and 'down' the branch from Manors, the electric pair performed shunting operations.* **CJM-Collection**

Above: *In the early 1960s the two North Eastern Bo-Bo electrics were based at Heaton depot and repainted into North Eastern green livery, with both BR and North Eastern cab-side branding. The pair saw reduced use until both were finally withdrawn in 1964 after electric workings were taken over by diesel shunting locos. On 16 June 1962 the pair are seen sharing depot space at Heaton depot with DMMU and North Eastern EMUs.* **www.colour-rail.com**

Below: *After withdrawal the first of the North Eastern pair No. 26500 was saved as part of the National Collection and placed on display at the National Railway Museum, York for future generations to see one of the earliest forms of 'modern traction' in the UK. This view was taken in the original Great Hall at the NRM York on 20 November 1976.* **CJM**



NER Bo-Bo – Class EB1/EF1

With the North Eastern Railway (NER) handling a considerable amount of coal traffic from mines in the Shildon and Bishop Auckland area to docks and ironworks around Middlesbrough, the railway considered, in the prosperous years before the first World War, that the route justified electrification. The NER board sanctioned the project and engineers embarked on one of the first examples of 1,500 volt dc overhead power supply railways.

The first section of line from Middridge Sidings in Shildon, to Bowesfield Junction was completed and commenced electric operation from 1 July 1915, with the full 18½ mile (30km) route from Shildon Yard to Newport East completed and authorised for use from 1 January 1916.

Locomotives for the project were built by the North Eastern Railway at their Darlington Works, under the design and control of Sir Vincent Raven. Electrical equipment was purchased from Siemens. The order consisted of 10 1,100hp (820kW) Bo-Bo locomotives, they were of the centre cab design with two power collection pantographs mounted on the roof. The cab, which gave an excellent all round visibility had driving controls for either direction.

Under the NER numbering scheme the locos became NER3 to NER12, after railway Grouping in 1923 the fleet became LNER Nos. 6490-6499, but were not renumbered until 1946. Under BTC/BR ownership the fleet were nominally allocated the numbers 26502 to 26511 from January 1948.

The locos maximum hauling capacity was 1,400 tons, and the 18½ mile (30km) route, mostly downhill, from Middridge Junction to Erimus Yard, Newport, was rostered to take 57 minutes.

The inter-war decline of the UK coal industry rendered electric working of the route uneconomic, and electric operation was discontinued from 8 July 1935.

The 10 electric locomotives were placed into store, firstly at Darlington Works and later at Gosforth depot on Tyneside. It was then envisaged that they *might* be modified and used for banking duties on the then proposed Manchester - Sheffield - Wath electrification scheme, but this was not to be.

In order to get further use out of these expensive assets, in 1949, No. 26510 was totally rebuilt at Darlington and emerged with a single pantograph and fully modified cab which now sported end side doors. Electrical equipment was also significantly upgraded, increasing the available power to 1,256hp (937kW). The plan was to use this loco as a banker on the Manchester-Sheffield-Wath system and it was thus classified as EB (Electric Banker). The remaining locos which were not converted became Class EF (Electric Freight).

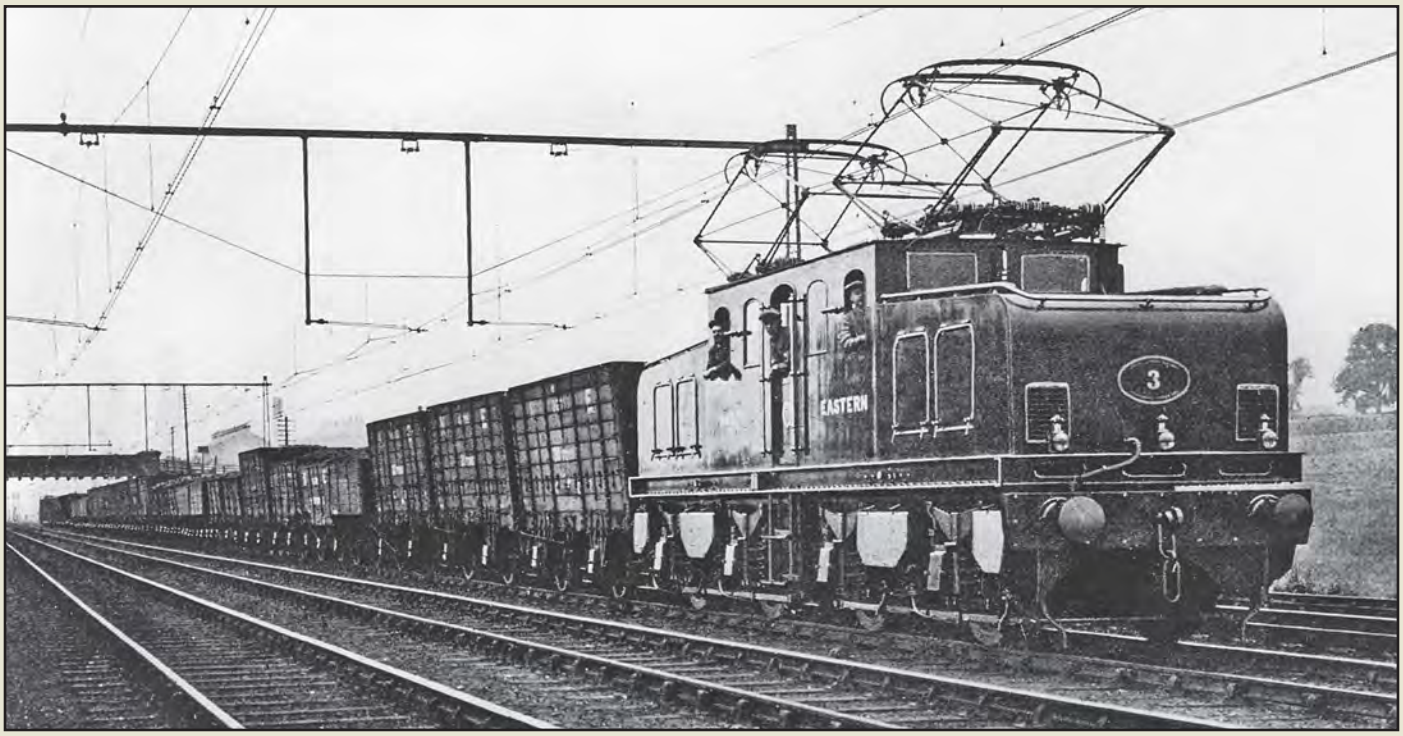
After static testing, No. 26510 was transferred to Ilford Depot in London on the Great Eastern route from Liverpool Street. Here it was used as a depot shunter and also took part in some main line performing and braking trials between Ilford and Shenfield in 1950, this was mainly in connection with the Manchester - Sheffield - Wath electrification project. When final plans for this route emerged it did not require additional banking locomotives, and the unrebuilt members of the NER Bo-Bo fleet were withdrawn in August 1950.

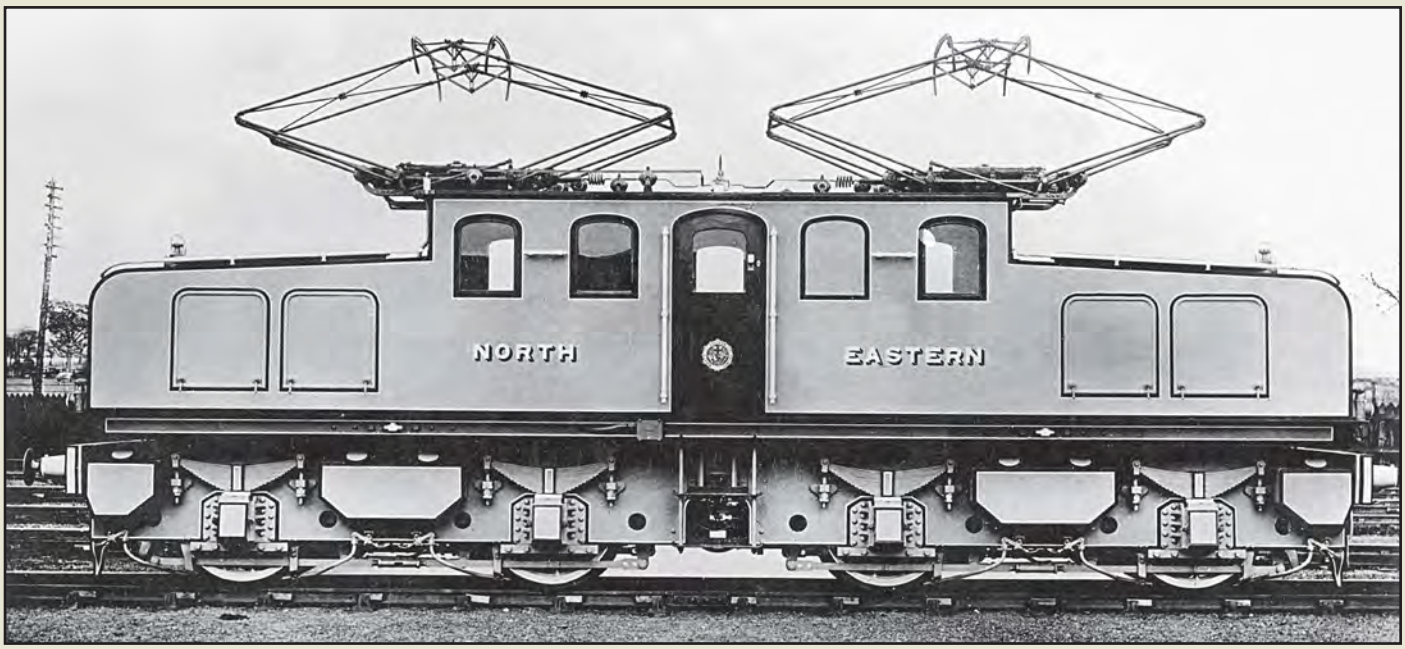
No. 26510 remained on the Great Eastern section based at Ilford. In 1959 it was transferred into departmental stock as No. 100, finally being withdrawn 1964.

It is interesting to note, that the design of this fleet formed the basis for the first batch of 1,500V dc locomotives for the Midi Railway of France, for which Dick Kerr & Co. of Preston supplied the traction equipment in 1923. ■

Left: *North Eastern Railway electric freight loco No. 4, is seen leading a westbound empty mineral train near Aycliffe on 24 August 1923. 1,500V dc electric operation only lasted on this route from January 1916 until July 1935. NER No. 4, later became LNER No. 6491 and BR No. 26503.* **William Rogerson / Rail Archive Stephenson**

Below: *The pioneer of the ten strong Bo-Bo freight fleet No. NER3 is seen soon after introduction in 1916 carrying out performance and riding tests with a long rake of wooden bodied coal and mineral wagons. Information on the reverse of the original photograph, indicates the train was bound for Newport with driver Jefferson at the controls. It also quotes that each train operated with a footplate crew of three.* **CJM-Collection**





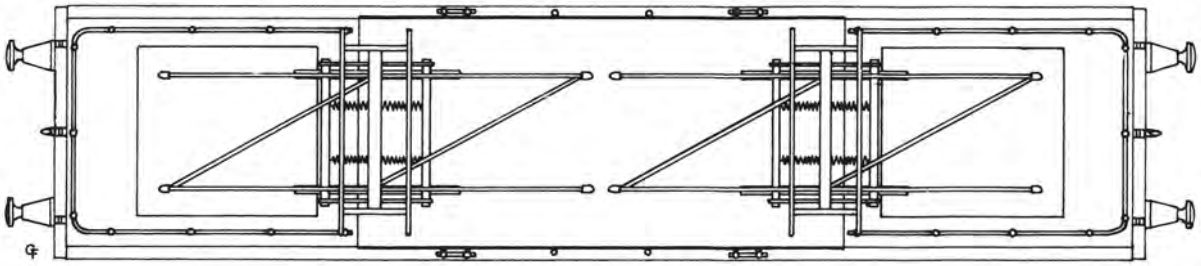
Above: *The first of the Newport-Shildon 1,500V dc electric locomotives No. NER3 is seen posed in the yard at Darlington Works on 11 May 1914, painted in workshop grey, but lined and branded. The two pantographs have been raised for the photograph, but of course no overhead power equipment was to be found at the works.* **CJM-C**

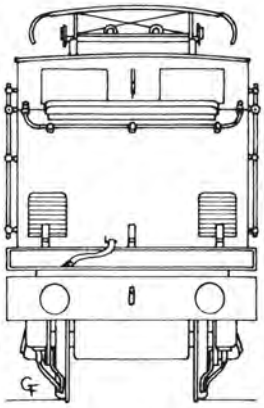
Right: *North Eastern Railway No. 11, later BR No. 26510 and the loco rebuilt as a Class EB and later went into departmental use, is seen passing Simpasture in May 1923 at the head of a loaded coal train formed of four-wheel wooden bodied wagons.* **CJM-Collection**

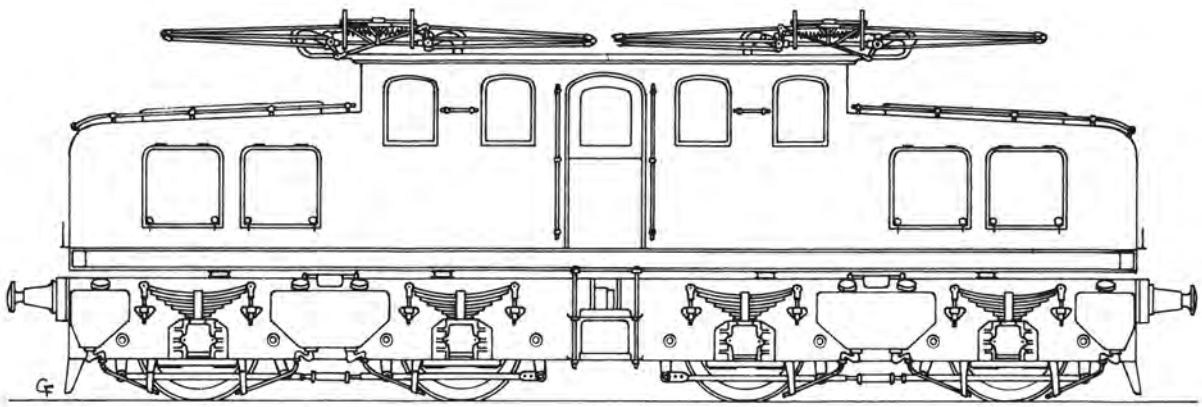
Below: *The number three roundhouse at Shildon was adapted to house and maintain the 10 North Eastern Electric locos. In this picture recorded on 21 May 1932, when the electrified system was still in full use, shows Nos. 6, 11, 12 and 4 stabled between duties in the stalls, with a fifth loco on the far left side.*
W. H. Whitworth / Rail Archive Stephenson

Class EB1
Class EF1

Right Top: *Original roof layout, showing two power collectors.*



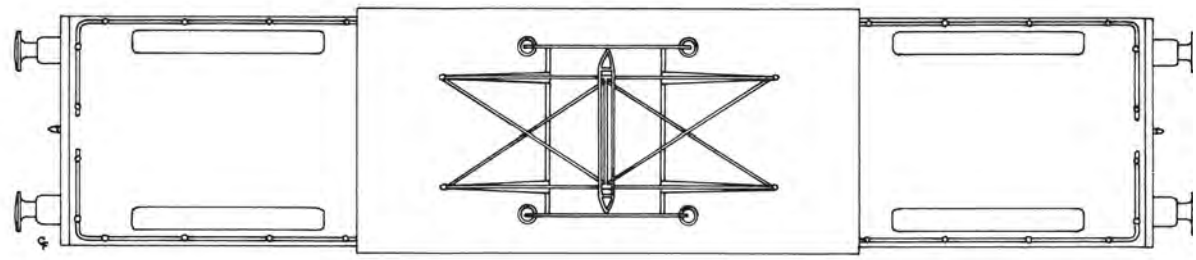


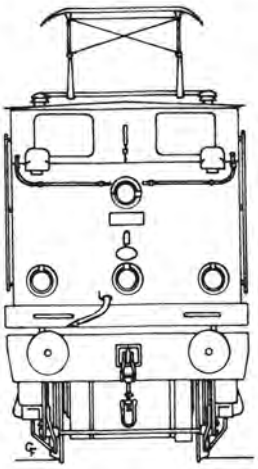


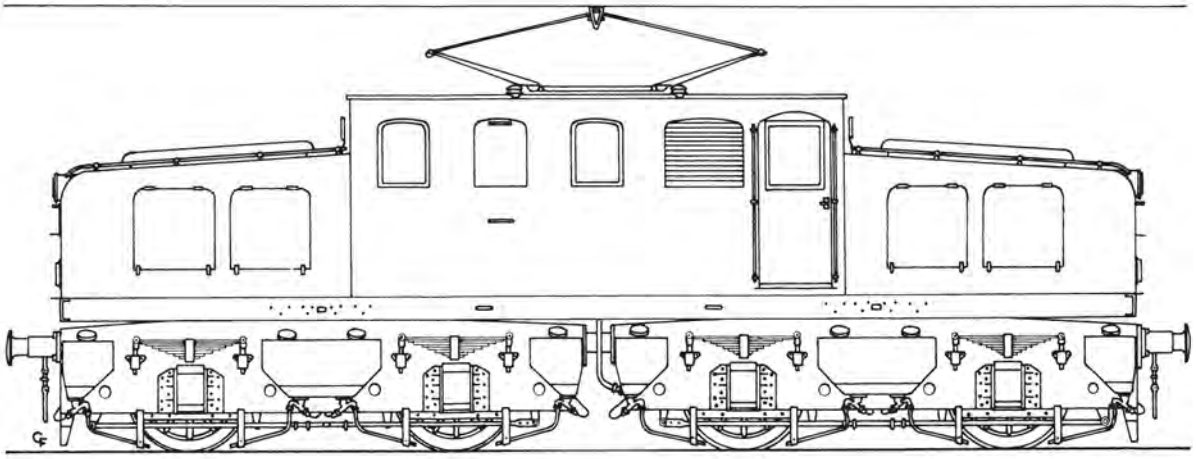
Above: *Electric Freight (EF) front end layout.*

Right Middle: *Electric Freight (EF) side elevation.*

Right: *Electric Banker (EB) roof layout showing single pantograph.*







Above: *Electric Banker (EB) front end layout, also applicable to Departmental No. 100.*

Above: *Electric Banker (EB) side elevation, showing revised cab with single door and single roof pantograph. This design was also applicable to Departmental No. 100.*

The drawings are reproduced in exact OO gauge 1:76 - 4mm to the foot scale

NER Number	LNER 1946 Number	Date Renumber	BR 1948 Number	Date Renumber	Built By	Works Number	Date Introduced	First Depot	Date Withdrawn	Final Depot	Status Code
3	6490	May-46	26502	Jul-49	NER Darlington	999	Jun-1915	Shildon	Aug-50	51A	C
4	6491	May-46	26503	Jul-49	NER Darlington	1000	Jun-1915	Shildon	Aug-50	51A	C
5	6492*	-	26504*	-	NER Darlington	1001	Jun-1915	Shildon	Aug-50	51A	C
6	6493	May-46	26505	Aug-49	NER Darlington	1002	Jun-1915	Shildon	Aug-50	51A	C
7	6494	May-46	26506	Jul-49	NER Darlington	1003	Jun-1915	Shildon	Aug-50	51A	C
8	6495	Jun-46	26507	Sep-49	NER Darlington	1004	Jun-1915	Shildon	Aug-50	51A	C
9	6496	Jun-46	26508	Jul-49	NER Darlington	1005	Jun-1915	Shildon	Aug-50	51A	C
10	6497	May-46	26509	Aug-49	NER Darlington	1006	Jun-1915	Shildon	Aug-50	51A	C
11	6498	May-46	26510	Aug-49	NER Darlington	1007	Dec-1915	Shildon	Jan-59	51A	C
12	6499	May-46	26511	Jul-49	NER Darlington	1008	May-1920	Shildon	Aug-50	51A	C

Above: *As a part of the Manchester-Sheffield-Wath electrification, it was proposed to convert the Shildon locos, which were now out of use, into banking engines. In 1941 No. 11 was moved to Doncaster Works for modification as a banking loco. Alterations included more powerful traction motors giving a one hour rating of 1,256hp with a total tractive effort of 37,600lb. Sandboxes and electric lights were fitted, and one central pantograph replaced the original two. Carrying its LNER No. 6498 the loco is seen at Doncaster Works.* **CJM-Collection**

Below: *In 1949, after the decision was taken not to use the fleet as bankers, No. 6498 now renumbered 26510 was transferred to Ilford for depot shunting duties following the Shenfield electrification. In January 1959, No. 26510 was transferred to departmental depot only operations and renumbered as Departmental No. 100. The loco had by then acquired the nickname of 'Denis' after Mr Denis Dodridge, a technician at Ilford depot who looked after the unique machine. No. 100 operated until November 1960 when the Shenfield line and Ilford depot were converted to AC power operation. After being dumped at the depot for a long time, No. 100 was withdrawn in April 1964 and broken up the following month at Doncaster Works.*
CJM-Collection

Disposal Detail	Disposal Date	Notes
Wanty & Co, Catcliffe	Jun-51	Stored: (S) 01/35
Wanty & Co, Catcliffe	Apr-51	Stored: (S) 01/35
BR Darlington Works	Dec-50	Stored: (S) 01/35
Wanty & Co, Catcliffe	Aug-51	Stored: (S) 01/35
Wanty & Co, Catcliffe	May-51	Stored: (S) 01/35
Wanty & Co, Catcliffe	Jul-51	Stored: (S) 01/35
Wanty & Co, Catcliffe	Apr-51	Stored: (S) 01/35
Wanty & Co, Catcliffe	Aug-51	Stored: (S) 01/35
BR Works, Doncaster	May-64	Stored: (S) 01/35. To Departmental Stock - 100
Wanty & Co, Catcliffe	Apr-51	Stored: (S) 01/35

Table Key
C - Cut up
51A - Darlington
* Not carried

Technical Description

Class:	EF1 EB1*
Original NER numbers:	3-12 11*
Former LNER numbers:	6490-6499 6498*
BR numbers:	26502-26511
Built by:	NER Darlington
Introduced:	1915
Wheel arrangement:	Bo-Bo or 0-4+4-0
Weight (operational):	75 tonnes
Height - pan down:	13ft 1¼in (3.99m)
Width:	8ft 4in (2.54m)
Length:	39ft 4in (11.99m)
Maximum speed:	45mph (66km/h)
Wheelbase:	27ft (8.23m)
Bogie wheelbase:	8ft 9in (2.68m)
Bogie pivot centres:	18ft 3in (5.56m)
Wheel diameter:	4ft (1.22m)
Brake type:	Air
Sanding equipment:	Pneumatic
Heating type:	Not fitted
Route availability:	Not issued
Coupling restriction:	Not multiple fitted
Horsepower:	1,100hp (820kW) 1,256hp (937kW)*
Tractive effort - maximum:	28,000lb (124.5kN) 37,000lb (164.6kN)*
Number of traction motors:	4
Traction motor type:	Siemens
Gear ratio:	4.5:1
Pantograph type:	Siemens
Nominal supply voltage:	1,500V dc overhead

Above, Left and Below Left: *The rebuilding work for NER No. 11 was authorised in 1936 and soon after it was transferred from Darlington to Doncaster for a major strip and rebuild. Revised traction equipment was installed as was a totally revised driving cab with new controls. From the outside the most noticeable difference was the moving of the cab door from the central position to the right end on both sides, as well as the obvious changes to the power collection, now using a single pantograph. Output horsepower was increased to 1,256hp with a corresponding increase in tractive effort to 37,000lb. The official release date in its new guise was 13 October 1944. Due to World War 2 and the stopping of the Woodhead electrification, 6498 was stored and eventually moved to South Gosforth. The loco, renumbered as 26510 was then transferred south to Ilford on 24 August 1949, where it became the depot pilot, becoming Departmental 100 in 1959. In the above view No. LNER26510 is seen at Shenfield while undertaking testing, In the middle view the loco is seen marshalled with a Shenfield electric at Ilford depot, while in the lower image, it carried the identity of Departmental 100 outside the servicing shed at Ilford. All:* **CJM-Collection**

NER 2-Co-2 – Class EE1

In the latter years of the North Eastern Railway (NER) the company considered a project for the overhead electrification of the York to Newcastle route, mainly with the remit of saving operating costs and increasing speeds.

In 1922, Sir Vincent Raven oversaw the design and assembly of a massive prototype express electric locomotive, operating from 1,500V dc overhead, weighing 102 tons and mounted on a 2-Co-2 chassis.

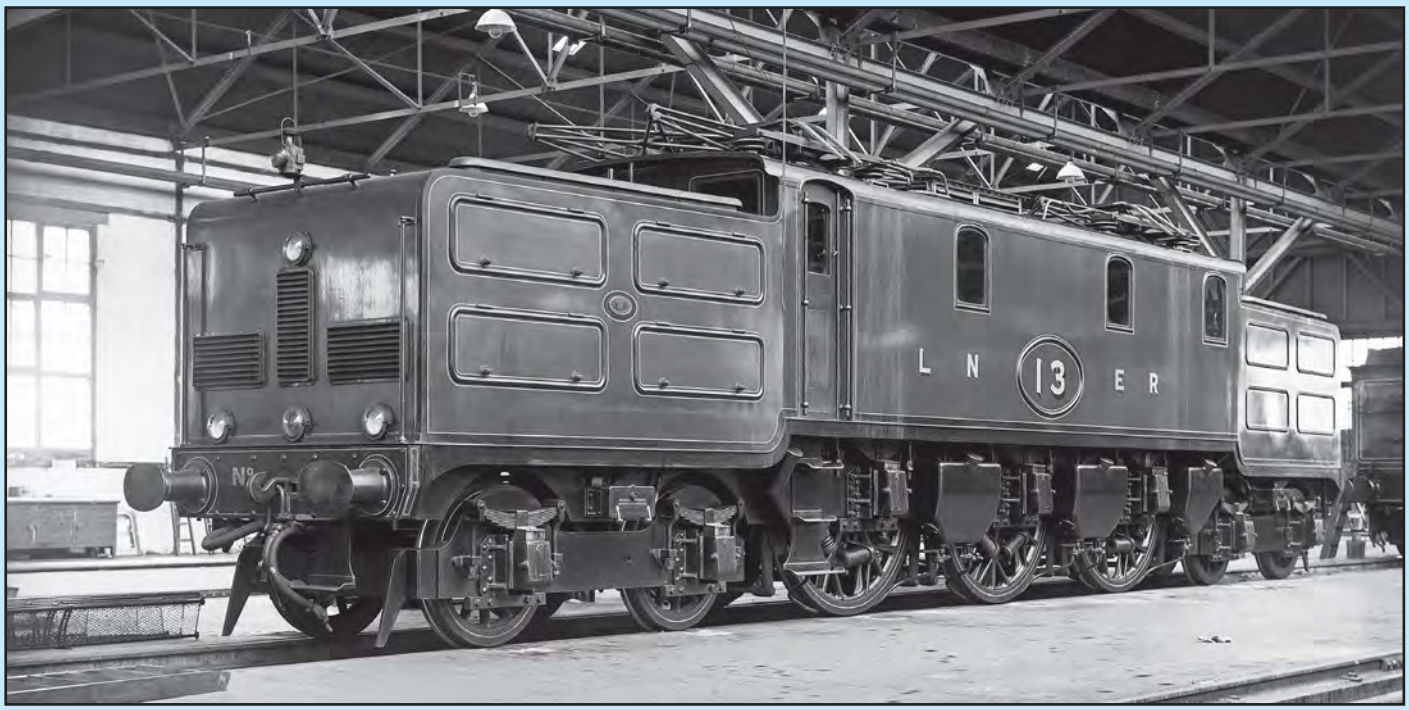
The loco developed a stunning 1,800hp (1,342kW), and had a maximum speed of 90mph (145km/h). Electrical equipment was provided by Metropolitan-Vickers. The locomotive was fitted both air and vacuum brake equipment and train heating was provided by a steam heat boiler.

The machine was allocated the number 13. As NER 13 it carried out some dynamometer car trials hauling a 460 ton train over the Shildon to Newport line, this at the time was the only source of 1,500V dc railway power in the country.

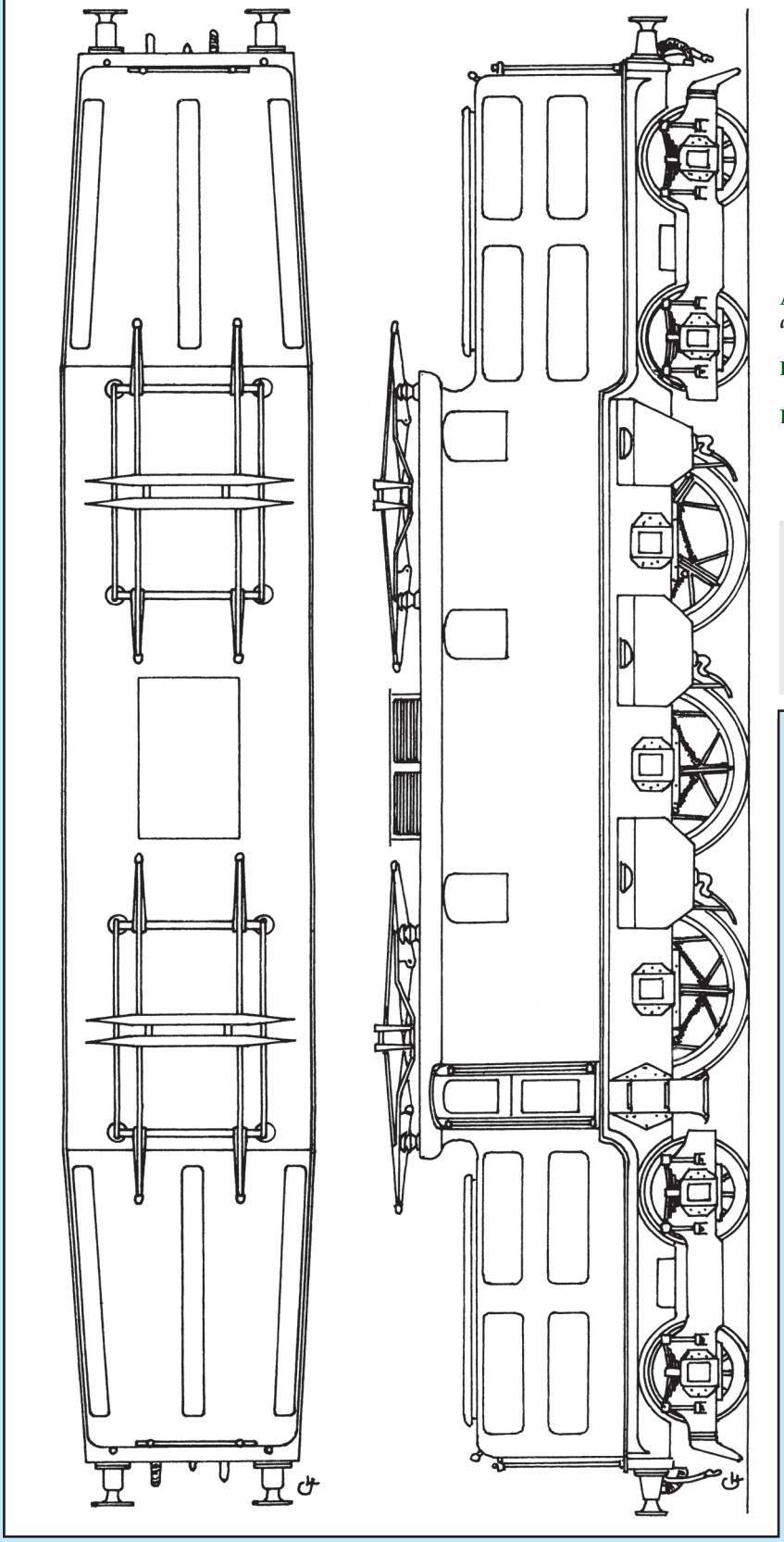
The loco also made a 'hauled' appearance at the 1925 Stockton & Darlington Centenary celebrations, but otherwise spent most of its time parked up at Darlington Works.

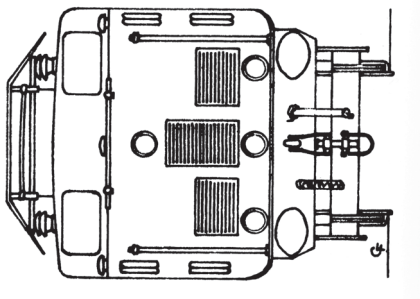
After Grouping in 1923, the loco became the property of the LNER who had little money and no desire for electrification schemes, therefore the loco remained out of use and soon fell into disrepair.

It was renumbered by the LNER to 6999 in 1946, and upon Nationalisation in 1948 became BR No. 26600. It was withdrawn, along with the other Newport to Shildon locomotives in August 1950 and broken up. ■



NER Number	LNER 1946 Number	Date Renumber	BR 1948 Number	Date Renumber	2nd BR 1948 Number	Renumber date	Built By	Works Number	Date Introduced	First Depot	Date Withdrawn
13	6999	May-46	26999*	-	26600	Sep-48	NER Darlington	1169	May-1922	Shildon	Aug-50





Above: *Electric Express (EE) locomotive No. 13 front end detail.*

Far Left: *Electric Express (EE) locomotive No. 13 roof detail.*

Left: *Electric Express (EE) locomotive No. 13 side elevation.*

Class EE1

The drawings are reproduced in exact OO gauge 1:76 - 4mm to the foot scale

Technical Description

Class:	EE1
Original NER number:	13
Former LNER number:	6999
BR 1948 number - original:	26999
BR 1948 number - revised:	26600
Built by:	NER Darlington
Introduced:	1922
Wheel arrangement:	2-Co-2
Weight - operational:	110 tons
Height - pan down:	13ft 0¼in (3.97m)
Width:	8ft 10in (2.69m)
Length:	53ft 6in (16.31m)
Maximum speed:	90mph (132km/h)
Wheelbase:	43ft 8in (13.31m)
Fixed wheelbase:	16ft (4.88m)
Pivot centres:	37ft 2in (11.33m)
Wheel diameter - driving:	6ft 8in (2.03m)
Wheel diameter - pony:	3ft 7¼in (2.93m)
Brake type:	Dual
Sanding equipment:	Pneumatic
Heating type:	Steam
Coupling restriction:	Not multiple fitted
Horsepower:	1,800hp (1.342kW)
Tractive effort:	28,000lb (124.5kN)
Number of traction motors:	6
Traction motor type:	MV
Gear ratio:	24:85
Pantograph type:	Siemens
Nominal supply voltage:	1,500V dc overhead
Boiler water capacity:	570gal (2,593.5lit)

Left Top: *Sometimes described as a big 'white elephant' North Eastern Railway No. 13 was built for the proposed York to Newcastle electrification, which never went ahead. Here the loco is seen outside Darlington Works in May 1922, painted in workshops grey.* **CJM-Collection**

Left Lower: *NER express electric loco No 13, carrying LNER green livery, but still its NER identity of No. 13, is shown stored inside the paint shop at Darlington Works on 25 June 1932.* **Rail Archive Stephenson**

Final Depot	Status Code	Disposal Detail	Disposal Date	Notes
51A	C	Wanty & Co, Catcliffe	Jul-51	Stored for many years prior to withdrawal

Table Key
C - Cut up
51A - Darlington
* Not carried

SR Co-Co – Class CC (70)

In the period immediately prior to the outbreak of Word War II in 1939, the then Chief Electrical Engineer of the Southern Railway, Mr A. Raworth could see huge benefits of using electric power to operate either main line passenger or freight services, considering so much of the system was electrified for passenger multiple unit services.

He sought authority to build three 'straight' electric locomotives, primarily for freight use.

After the initial plans were drawn up and submitted to the Southern Railway Board, objections were raised, principally by O. V. S. Bulleid, who insisted that all future main line locomotives should be of a 'mixed traffic' (passenger/freight) type. After further meetings, Bulleid's case was accepted and the Southern's drawing office finalised plans for a Co-Co wheel configuration locomotive using a box-like external structure, having a full width driving cab at each end, which resembled the suburban electric multiple units of the day.

A major technical challenge with the electric locomotive principle soon became apparent, as 'gaps' of larger than a locomotive length existed in numerous places in the electrified network, in these areas power would be lost, which would jolt a train, which could cause buffer locking, or even stall a train if speed was low. This problem did not effect multiple unit trains as power collector shoes existed throughout the train which 'bridged' even the largest of third rail gaps.

To overcome this problem, a 'booster' was provided; this was basically a flywheel-driven generator, enabling a proportion of power to be supplied by the ongoing momentum of the flywheel while passing through third rail gaps. The 'booster' system would be sufficient to coast through gaps of around 100 feet (30m)at a minimum speed of 12mph (20km/h).

In addition to having live rail pick-up shoes on each bogie, a diamond shape collapsible roof-mounted pantograph was installed, this was raised in suitable equipped yards, where the presence of a ground level live rail would have been dangerous to railway staff and contractors.

Plans were eventually agreed by the Southern Railway Board, and construction commenced of the first of three locomotive, allocated the number CC1 and built at the Southern's Ashford Works in Kent. It emerged in the autumn of 1941, carrying Southern green livery.

The first of the 'booster' electrics was rated at 1,470hp (1,096kW), with a maximum rail output of 2,200hp (1,641kW) at 35.5mph (57.1km/h). The second of the electric trio, numbered CC2, emerged in 1945. This was of the same basic style as No. CCl, but incorporated several minor detail differences. The two Southern Railway pioneer electric locomotives operated mainly on what was then the Central Section, usually from Brighton on freight traffic to and from Redhill or Norwood.

Problems were few, and by late 1945 reliability levels rose to around 80 per cent. The third of the electric build originally sanctioned was not built until 1948, by this time construction had moved to Brighton Workshops. This loco broadly resembled the previous two, but, if anything, was even more box-like in structural appearance, having a slab-fronted cab, very similar to the SUB electric stock of the period. As this locomotive did not make an appearance until after UK rail nationalisation, it carried the BTC electric series number of 20003 and was painted in BR Southern green livery with a large British Railways legend on the body side. It was one of the first locos to sport the new British Railways modern traction black livery being repainted in 1950 and lined in silver.

Although the three locomotives were constructed to mixed traffic specifications, their main work was on freight diagrams. However, following a gradual decline in freight during the post-war years, other work was sought, and this was found on the Victoria to Newhaven boat trains, where the locos gave good service. After this traffic declined, the machines saw less and less daily work.

For a number of years, they were used to haul the Royal Train when it operated on the Southern Region electrified routes. This was typically the annual run from Victoria to Tattenham Corner for the Queens visit to Derby race meeting held at Epsom; and the operation of Royal specials between Gatwick Airport to Victoria for arriving Heads of State and operating Royal duties between Waterloo and Portsmouth.

By the late 1960s, when the 'in' word with the British Railway Board was standardisation, the small fleet was deemed as surplus to requirements. After spending a short period out of use stored at Brighton depot, all three were withdrawn in 1969 and sold for scrap.

Although these locos were not the most handsome, they gave the railway good service and provided a good test bed for the subsequent BR/SR designed 'HA' fleet of E5000 'booster' electrics. ■

Below: ***Introduced in July 1941 amid the hectic years of World War II, little publicity surrounded the entry into traffic of the first of the three Southern design booster electric locos. Carrying the number CC1, the loco would be the sole electric locomotive on the Southern for four years. On 5 December 1941, No. CC1 is seen with a southbound freight near Merstham. At this time a multiple unit style headcode stencil frame was mounted between the two front cab windows, these were reduced in size by black-out blinds on the inside due to war time restrictions.*** **CJM-Collection**

Above: *The second of the Southern booster electric locomotives emerged from Ashford workshops in 1945, painted in Southern green livery and numbered CC2. Again the loco emerged with little publicity due to the ongoing war restrictions and issues. The loco was slightly different from the original example in not having a stencil headcode box on the front end, but sporting an additional marker light towards the upper bodywork. The loco is seen when very new with its pantograph in a raised position, viewed from its equipment or grilled body side.* **CJM-Collection**

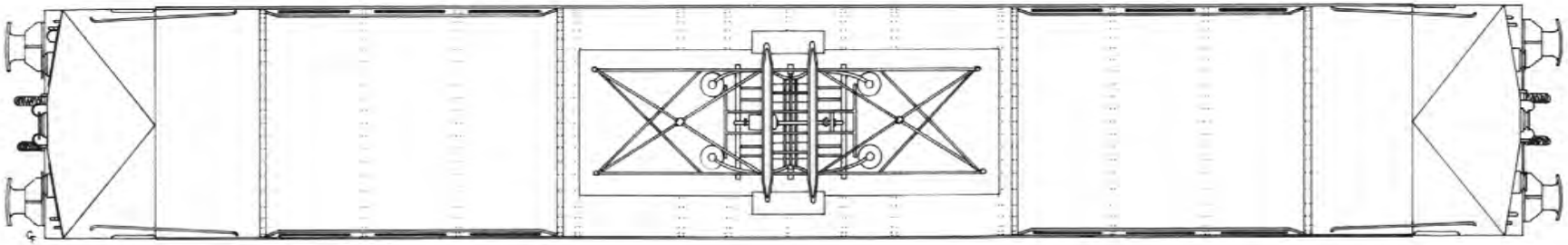
Technical Description

Southern Railway numbers:	CC1	CC2	-
BR 1948 numbers:	20001	20002	20003
Former SR classification:	CC	CC	-
Built by:	SR Ashford	SR Ashford	BR Brighton
Introduced:	1941	1945	1948
Wheel arrangement:	Co-Co	Co-Co	Co-Co
Weight - operational:	100 tons	100 tons	105 tons
Height - pan down:	12ft 6in (3.81m)	12ft 6in (3.81m)	12ft 8in (3.86m)
Width:	8ft 7¼in (2.62m)	8ft 7¼in (2.62m)	8ft 7¼in (2.62m)
Length:	56ft 9in (17.30m)	56ft 9in (17.30m)	58ft 6in (17.83m)
Min curve negotiable:	5½ chains (110.6m)	5½ chains (110.6m)	5½ chains (110.6m)
Maximum speed:	75mph (110km/h)	75mph (110km/h)	75mph (110km/h)
Wheelbase:	43ft 6in (13.26m)	43ft 6in (13.26m)	44ft 6in (13.56m)
Bogie wheelbase:	16ft 0in (4.88m)	16ft 0in (4.88m)	16ft 0in (4.88m)
Bogie pivot centres:	27ft 6in (8.38m)	27ft 6in (8.38m)	28ft 6in (8.69m)
Wheel diameter:	3ft 7in (1.09m)	3ft 7in (1.09m)	3ft 7in (1.09m)
Brake type:	Vacuum	Vacuum	Vacuum
Sanding equipment:	Pneumatic	Pneumatic	Pneumatic
Heating type:	Steam - Bastian & Allen	Steam - Bastian & Allen	Steam - Bastian & Allen
Boiler water capacity:	320gal (1,456lit)	320gal (1,456lit)	320gal (1,456lit)
Multi coupling restriction:	Within type only	Within type only	Within type only
Brake force:	85 tons	85 tons	89 tons
Horsepower:	1,470hp (1,096kW)	1,470hp (1,096kW)	1,470hp (1.096kW)
Tractive Effort - maximum:	49,0001b (217.9kN)	49,0001b (217.9kN)	45,0001b (200.1kN)
Number of traction motors:	6	6	6
Traction motor type:	EE 519A	EE 519A	EE 519-4D
Control system:	DC Booster	DC Booster	DC Booster
Pantograph type:	EE cross-arm	EE cross-arm	EE cross-arm
Nominal supply voltage:	600-750V dc	600-750V dc	600-750V dc

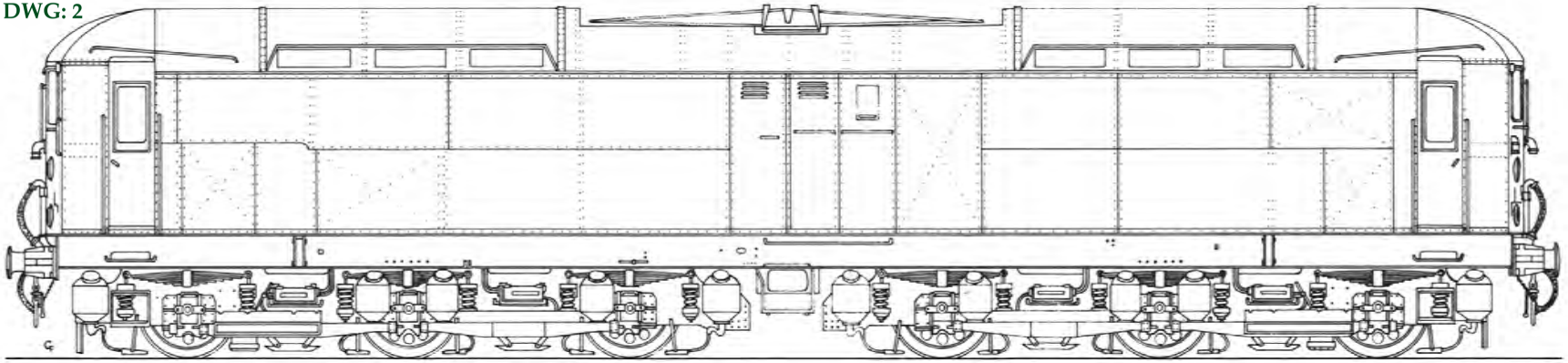
Right: *When originally released into traffic in 1941, No. CC1 did not sport Southern branding, its body was finished in 'workshop paint' reported to be a dark grey with yellow 'whisker' bands on the side and front end. This view shows the non-grille side of the bodywork with the No. 1 end nearest the camera. Train identification was by a two-section stencil headcode of multiple unit design, which was clipped into the stencil frame from the outside, by the driver hanging out of the non driving window. Train classification was by the steam era Southern disk system.* **CJM-Collection**

Class 70

DWG: 1



DWG: 2



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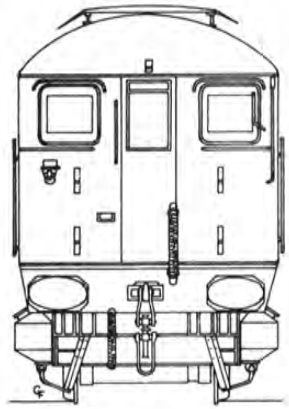

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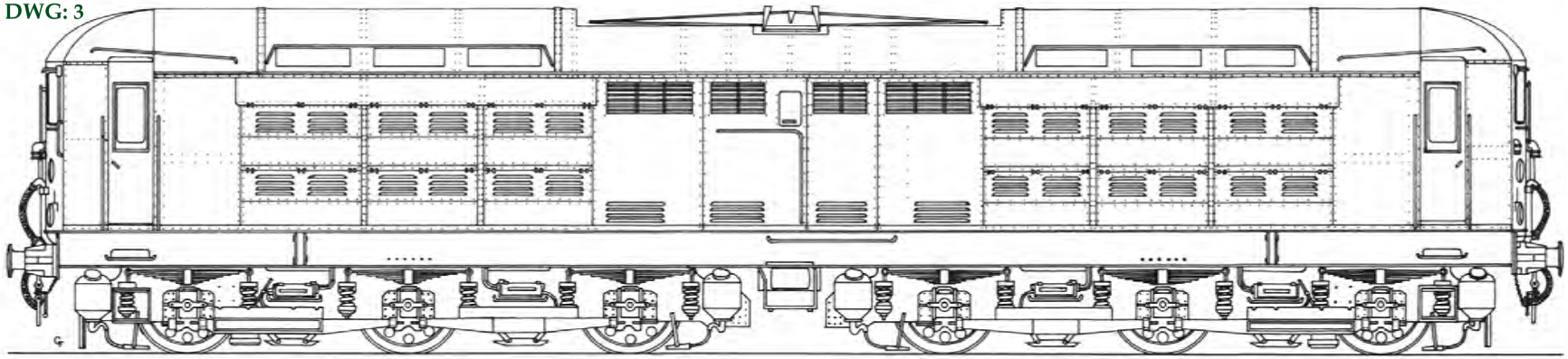

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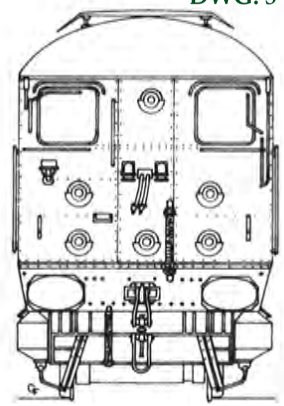


Drawing 1
SR prototype electric locomotive roof detail, applicable to locomotives Nos. CC1 and CC2, (20001 and 20002) in original condition.

Drawing 2
SR prototype electric locomotive side 'A' elevation, as applicable to locomotives Nos. CC1 and CC2 (20001 and 20002), showing original bogie style with five sand boxes per bogie.

Drawing 3
SR prototype electric locomotive side 'B' elevation, as applicable to locomotives Nos. CC1 and CC2 (20001 and 20002), showing modified bogie style with two sand boxes per bogie.

Drawing 4
Front end detail of SR prototype electric locomotives Nos. CC1 and CC2 (20001 and 20002) showing original condition with stencil type headcode box.

Drawing 5
Front end detail of SR prototype electric locomotives Nos. CC1 and CC2 (20001 and 20002) showing the addition of multiple operation jumper equipment, waist height air connections and marker lights.

Drawing 6
Front end detail of SR prototype electric locomotives Nos. CC1 and CC2 (20001 and 20002) showing revised condition with two character roller-blind headcode box.

Drawing 7
SR/BR electric locomotive roof detail, applicable to locomotive No. 20003.

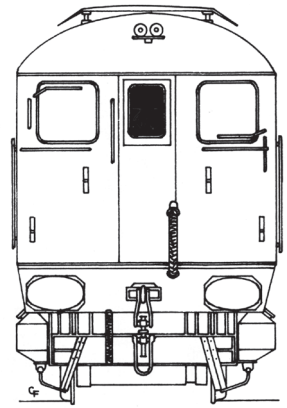
Drawing 8
Side 'A' elevation of SR/BR electric loco No. 20003, showing as built condition.

Drawing 9
Side 'B' elevation of SR/BR electric loco No. 20003, showing as built condition.

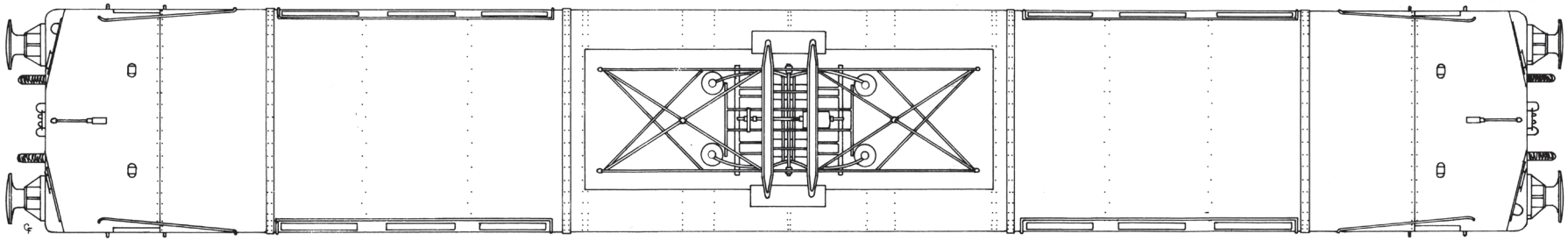
Drawing 10
Front end elevation of SR/BR electric loco No. 20003, showing as built condition.

Drawing 11
Front end elevation of SR/BR electric loco No. 20003, showing revised design incorporating two character roller blind headcode box and four lamp irons.

DWG: 6



DWG: 7



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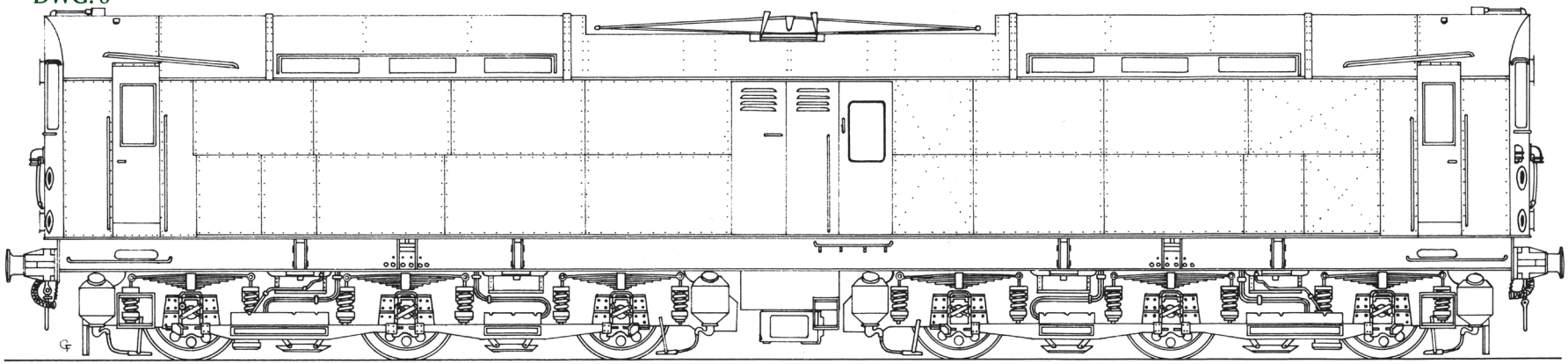

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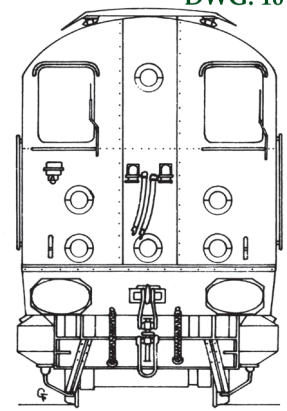
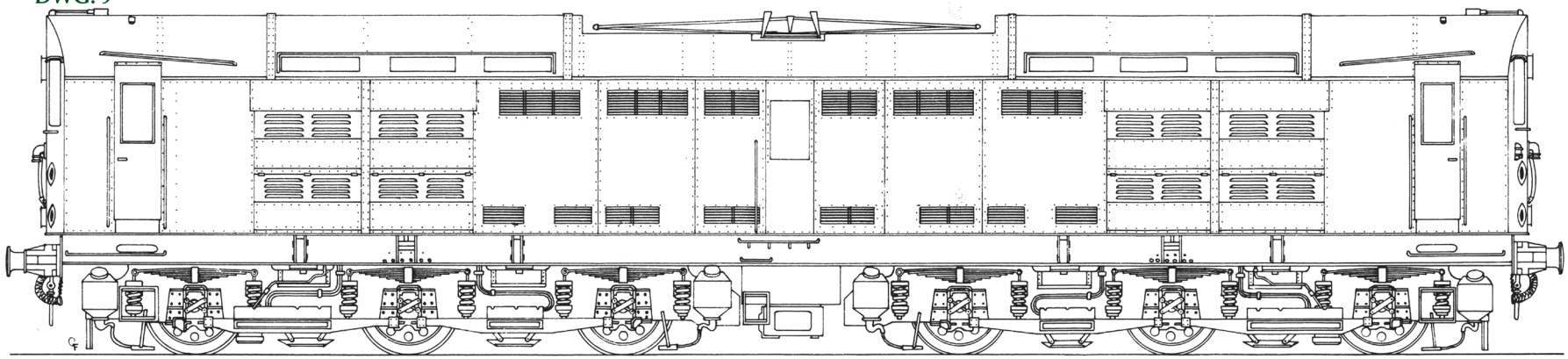
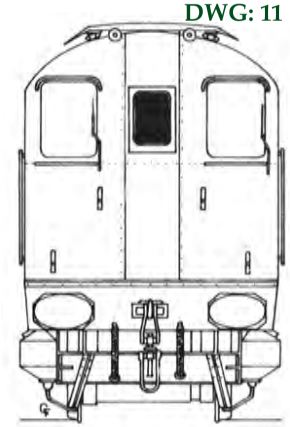


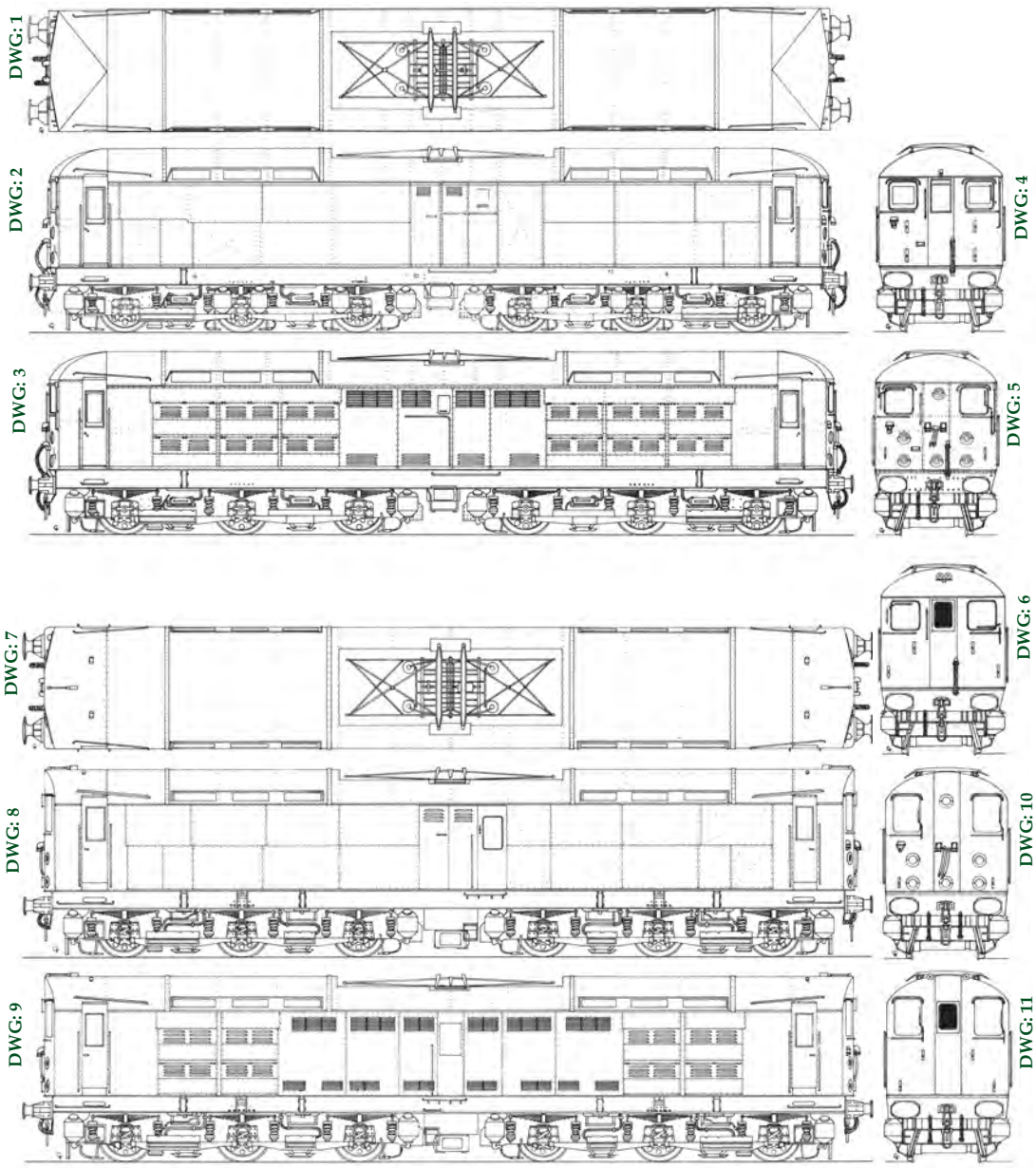
DWG: 9



DWG: 11



The drawings are reproduced in exact OO gauge 1:76 - 4mm to the foot scale



Class 70

The drawings are reproduced in exact N gauge 1:148 - 2.02mm to the foot scale

Drawing 1
SR prototype electric locomotive roof detail, applicable to locomotives Nos. CC1 and CC2, (20001 and 20002) in original condition.

Drawing 2
SR prototype electric locomotive side 'A' elevation, as applicable to locomotives Nos. CC1 and CC2 (20001 and 20002), showing original bogie style with five sand boxes.

Drawing 3
SR prototype electric locomotive side 'B' elevation, as applicable to locomotives Nos. CC1 and CC2 (20001 and 20002), showing modified bogie style with two sand boxes.

Drawing 4
Front end detail of SR prototype electric locomotives Nos. CC1 and CC2 (20001 and 20002) showing original condition with stencil type headcode box.

Drawing 5
Front end detail of SR prototype electric locomotives Nos. CC1 and CC2 (20001 and 20002) showing the addition of multiple operation jumper equipment, waist height air connections and marker lights.

Drawing 6
Front end detail of SR prototype electric locomotives Nos. CC1 and CC2 (20001 and 20002) showing revised condition with two character roller-blind headcode box.

Drawing 7
SR/BR electric locomotive roof detail, applicable to Loco No. 20003.

Drawing 8
Side 'A' elevation of SR/BR electric loco No. 20003, showing as built condition.

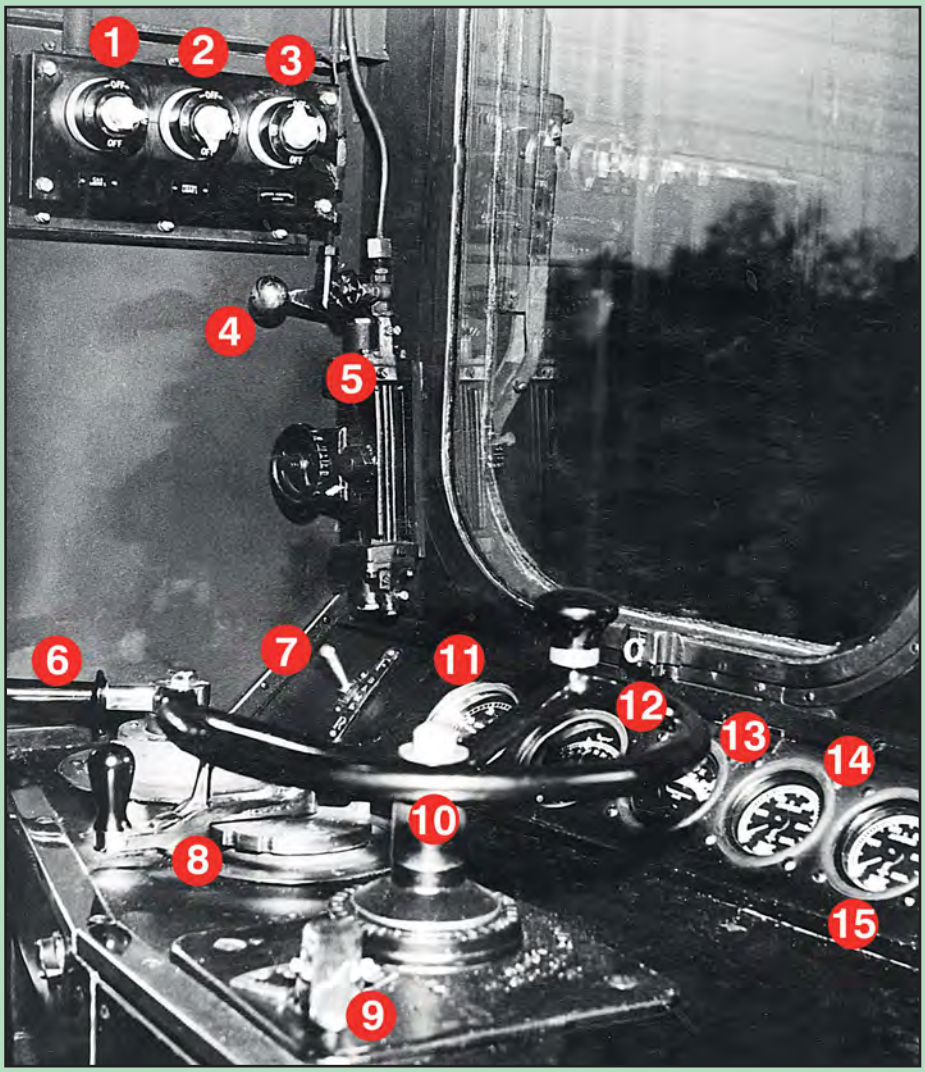
Drawing 9
Side 'B' elevation of SR/BR electric loco No. 20003, showing as built condition.

Drawing 10
Front end elevation of SR/BR electric loco No. 20003, showing as built condition.

Drawing 11
Front end elevation of SR/BR electric loco No. 20003, showing revised design incorporating two character roller blind headcode box and four lamp irons.

Left: *The third of the Southern design electric 'booster' locomotives was not built until 1948, emerging some nine months after the formulation of the British Transport Commission and British Railways, and thus emerged in British Railways Southern green livery off-set by a large British Railways on the bodyside and the No. 20003. Soon after delivery, the loco is seen from its grille side at Brighton with its pantograph raised to its maximum extent.* **CJM-Collection**

Right: *Southern CC class driving cab, from locomotive No. 20002 and taken in mid 1948. 1: Cab light on/off rotary switch, 2: Meter light on/off rotary switch, 3: Route indicator on/off rotary switch, 4: Whistle valve, 5: Windscreen wiper air motor and valve, 6: Locomotive direct air brake valve, 7: Sand valve, 8: Train brake valve, with proportional application on the locomotive, 9: Master switch (direction controller), 10: Power controller (rotary), 11: Bogie brake pressure gauge, 12: Main reservoir air pressure gauge, 13: Booster RPM gauge, 14: Traction ammeter, 15; Traction ammeter.* **CJM-Collection**



Right Middle: *In March 1950, the British Transport Commission rolled out a new standard British Railways black livery for 'modern traction' locomotives. This saw an overall black body, off-set by a silver underframe, wide central banding and roof. The buffer beam and buffer shanks were finished in red. A large Lion on Wheel motif was placed mid-way along the body just below the bodyside band. On 22 March 1950 No. 20003 was displayed to the BTC at London Waterloo station, where the loco was placed in the sun just outside the canopy of the then platform 15.* **CJM-Collection**

Below: *Painted in British Transport Commission BTC/BR silver lined black livery, No. 20003 was used to power a VIP Pullman special on 20 May 1954 when a special operated from London Victoria to Brighton in conjunction with the International Rail Congress held at Willesden in June 1954. A trip to Brighton was made to inspect Brighton Works which had just produced the third of the Bulleid main line diesel-electric locos No. 10203. The special is seen approaching Brighton passing Preston Park.* **CJM-C**

Left: *The pioneer of the SR booster fleet No. 20001, by now carrying a modified front end with six marker/tail lights and a sealed up headcode box, passes west through Lancing in August 1962 with a freight. The loco is now painted in BR Southern lined green livery, off-set by a red buffer beam. The loco is seen from its non-grille side.* **www.colour-rail.com / R Tibbits**

Right: *In immaculate condition at Eastleigh Works in May 1959 following a classified overhaul, No. 20002 shows BR Southern green, with a red buffer beam and buffer shanks and a white sole bar. It is worth noting the varnished hardwood show beams, which did not stay in this condition for long once the loco was in daily service. Buffer beam connections on these locos was only basic with a coupling hook and shackle, a vacuum pipe mounted upward from the buffer beam and a steam heat pipe mounted downwards from the buffer beam.* **www.colour-rail.com / T Owen**

Left: *The BR-built Southern booster loco No. 20003 shows its green livery from its grille side stabled at Barnham on the south coast on 17 June 1961. If this view is compared with the image above, it clearly shows the front end design differences between this and the earlier built pair.* **www.rail-online.co.uk**

Below: *Looking in rather poor external condition and devoid of any BR motif on the bodyside, No. 20003 stands at Eastleigh in May 1959. By the looks of the loco, the white sole bar had recently been applied. This loco was obviously awaiting attention at the nearby workshops as part of the power pickup equipment is missing from the near bogie and some of the high tension cables have been tied up.* **www.colour-rail.com**

Above: *The three Southern-designed electric locos were mainly used on freight, but for a period the trio could be found operating on the London Victoria to Newhaven loco-hauled services forming the UK section of the London-Paris via Dieppe boat train service. On 15 May 1949 No. 20003 is seen departing from Victoria with an afternoon service bound for Newhaven.* **CJM-Collection**

Right: *In the early 1960s, a regular freight turn for the class, which under TOPS became Class 70 was the daily Horsham to Three Bridges duty. On 7 April 1963 No. 20003 is seen passing Goffs Park, Crawley with this duty.* **CJM-Collection**

Below: *On 27 May 1949 Southern-designed booster electric No. 20002 powers a London Victoria to Newhaven boat train through Balham. Today's traveller heading from central London to Paris would find it quite strange to go via the port of Newhaven and a ferry to Dieppe and then a SNCF train to Paris, a journey shown to take some 10 hours. Today they would board a 186mph (300km/h) Eurostar service from St Pancras and be in central Paris is just two hours 20 minutes.* **CJM-Collection**

Above: *With the line from Ardingley on the right, green-liveried No. 20003 hurries south at Copyhold Junction near Haywards Heath in early 1967 with a London Victoria to Newhaven Harbour boat train, formed of BR(SR) green-liveried stock.* **www.colour-rail.com / N Sprinks**

Below: *The three Southern-design booster electric locos spent most of their time on the Southern Central section, around Stewarts Lane, Norwood Junction and Brighton. In April 1963, No. 20001 in BR Southern green with a red between cab body band sits with HA Class booster electric No. E5004 at Stewarts Lane depot.* **www.colour-rail.com / C Hurricks**

SR Number	BR 1957 Renumber	Date Renumber	Built By	Works Number	Introduced	Original Depot	Date Withdrawn	Final Depot	Disposal Code	Disposal Detail	Disposal Date	Notes
CC1	20001	Dec-48	SR Ashford		Jul-41	75A	Jan-69	75A	C	J Cashmore, Newport	Aug-69	Withdrawn: 12/68, R/I: 01/69
CC2	20002	Feb-49	SR Ashford		Sep-45	75A	Dec-68	75A	C	J Cashmore, Newport	Aug-69	
CC3*	20003	-	SR Brighton		Sep-48	75A	Oct-68	75A	C	G Cohen, Kettering	Nov-69	Stored: (U) 09/68

Table Key
C - Cut up
75A - Brighton
* Not carried

Above: *The 'booster' electrics were given the TOPS numeric classification of 70, but none survived long enough to be given the five digit TOPS identity. Repaints after mid 1966 emerged from Eastleigh in standard corporate rail blue with full yellow warning ends and some revisions to front end equipment. For several years one of the class was used to power Royal Trains when used exclusively in third rail electrified areas, this frequently involved the annual Derby race special from Victoria to Tattenham Corner and Royal specials from Waterloo to Portsmouth and Southampton. No. 20001 powers the down Royal special from Victoria to Tattenham Corner for the Derby race meeting in May 1968, seen passing East Croydon.* **www.colour-rail.com / Chris Gammell**

Right Middle: *On 8 June 1968 The Bullied Commemorative Rail Tour was operated over various lines on the South Western and Central divisions. The train started off from Waterloo powered by booster electric No. 20002 and later in the day blue-liveried No. 20001 took over on the Brighton-Hove-Worthing-Chichester to Havant leg, before picking up the train again later and powering it from Guildford to Waterloo via Cobham. Here, No. 20001 departs from Brighton on an inter-platform shunt move before heading to Havant.* **D Idle**

Right Below: *For the Derby race meeting in June 1969 at Epsom Downs, the Royal Train was operated from Victoria to Tattenham Corner powered by rail-blue No. 20001, which can be seen to have its steam heating boiler working by the puff of steam from the middle of the loco above the Bastian and Allen boiler.* **www.colour-rail.com / B Patton**

BR/SR 'Booster' Bo-Bo – Class 71

The 1955 British Transport Commission (BTC) Modernisation Plan called for Kent Coast main lines of the Southern Region to be electrified. The majority of rolling stock proposed was of electric multiple-unit (EMU) types, but for some express passenger and freight services, mainly to and from the Kent sea terminals, a fleet of 24 2,552hp (1,903kW) 'booster' electric locomotives were ordered; these were classified by the BTC/BR Southern Region as E5000 class or 'HA' series using the alpha code system of the SR. Under later BR TOPS numeric classification, the fleet became Class 71.

These 'new-generation' electric locomotives, mounted on a Bo-Bo wheel arrangement, collected power at between 660-750V DC from either-third rail collector shoes or a centrally-mounted roof pantograph; the latter was used in yards where a live rail would not be acceptable on safety grounds.

Although, at first glance, these locomotives were similar to the Bulleid / Raworth 'CC' class of the 1940s, a number of major differences were incorporated. The 'booster' or flywheel for use over live rail gaps was retained, but fully spring-borne traction motors, with SLM flexible drives were fitted. The 24 locomotives were ordered by the BTC with construction awarded to Doncaster Workshops, where all components, including the bogies, which were of Swiss design, were assembled.

The design weight of the locos was 77 tonnes, giving an axle load of 19¼ tonnes, the maximum tractive effort was 43,000lb at 25 per cent adhesion. The first locomotive, carrying running number E5000, emerged from Doncaster Works in late 1958, and was hauled to Ashford for extensive test, trial and staff training operations. In many cases men who were to handle these locos in terms of fitting and driving staff were direct 'converts' from steam, with a protracted period of introduction.

The final member of the fleet was delivered at the end of 1960.

All locos were painted in BR green livery with some locos sporting a red band midway up the body side between the cab doors. Originally no yellow ends were carried, progressively small yellow ends were added which eventually gave way to full yellow ends.

Unlike the three prototype electric locos for the Southern which used steam for train heating, the 'HAs' used the electric train heat, then under development as the SR intended to replace this archaic heating system at an early opportunity. When introduced, locomotives had their electric train-heating jumper mounted on the nose-end bodywork, this was later repositioned onto the buffer beam, following difficulties when coupling/uncoupling trains.

After the entire fleet had been in traffic for just two years, the first member of the fleet, No E5000, was renumbered as E5024 thus fitting in with regional policy of fleets starting with the number 001.

After the fleet was placed into regular service, the performance was excellent, often returning an availability figure of between 85-90 per cent.

The 'HAs', later Class 71s were normally only used on duties in the South Eastern Section of the Southern Region and staff in other areas were not trained in their operation. However, when first delivered some did operate on London Victoria to Newhaven boat trains. Their principal duties included passenger services on such trains as the 'Golden Arrow' and 'Night Ferry'. However, freight activities were their main activity, operating Continental freights to and from the docks at Dover, and the London distribution terminal near Hither Green, as well as domestic freight services, mainly in Kent.

The installation of overhead power equipment in yards was restricted to a few locations and most operations were undertaken using the third rail supply.

By the mid-1960s, a number of the locomotives were deemed surplus to requirements following a general decline in freight traffic. At around the same time, the Southern Region was involved in the electrification of the Bournemouth line and this called for the introduction of a high-output electro-diesel locomotive, able to haul passenger and freight trains over non-electrified routes and yards.

After lengthy negotiations between BR and contractor English Electric, it was decided that 10 of the Class 71 electrics would be rebuilt into dual-powered electro-diesels and reclassified as Class 74. The remaining 14 Class 71 locomotives would continue operating over the South Eastern area, especially on the 'Golden Arrow' and 'Night Ferry' service between Dover and Victoria, together with a number of freight duties.

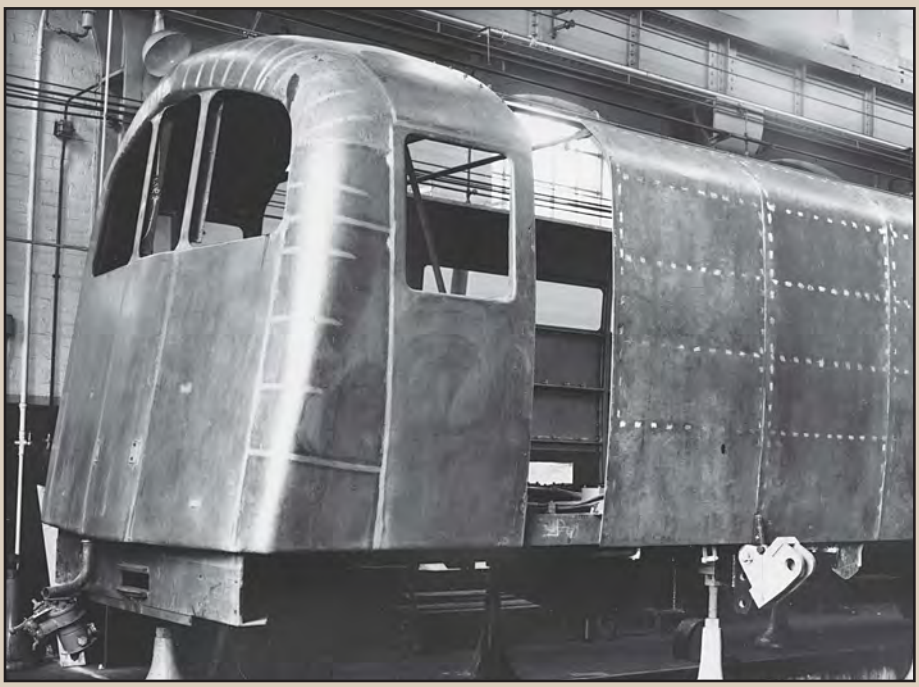
The rebuilt from 'booster' electric to electro-diesel was undertaken at Crewe Works and saw a complete strip down and rebuild.

'Booster' electric locos receiving classified attention from the mid 1960s emerged painted in rail blue with full yellow warning ends.

In 1977, BR decreed that duties performed by the Class 71 fleet could be taken over by spare capacity in the Class 33 and 73 fleets, and from December 1977, all Class 71s were withdrawn. For a period, the fleet lay dumped at Ashford, Hither Green and Stewarts Lane depots, all eventually being sold for scrap, except for No. 71001 which was rebuilt by BREL Doncaster and emerged as No E5001 and became part of the National Collection at the NRM York.

After restoration the No. E5001 returned to main line operation and saw limited use on enthusiast specials. Sadly it is now domiciled at the National Railway Museum, it is restored to green livery with yellow warning panels. ■

Above: *Cast builders plate as fitted to the BR Southern Region HA class electric locos. These followed the standard design with the extra casting showing the power equipment supplier English Electric below. The plate shown is from loco No. 71011, the original E5011.* **CJM**

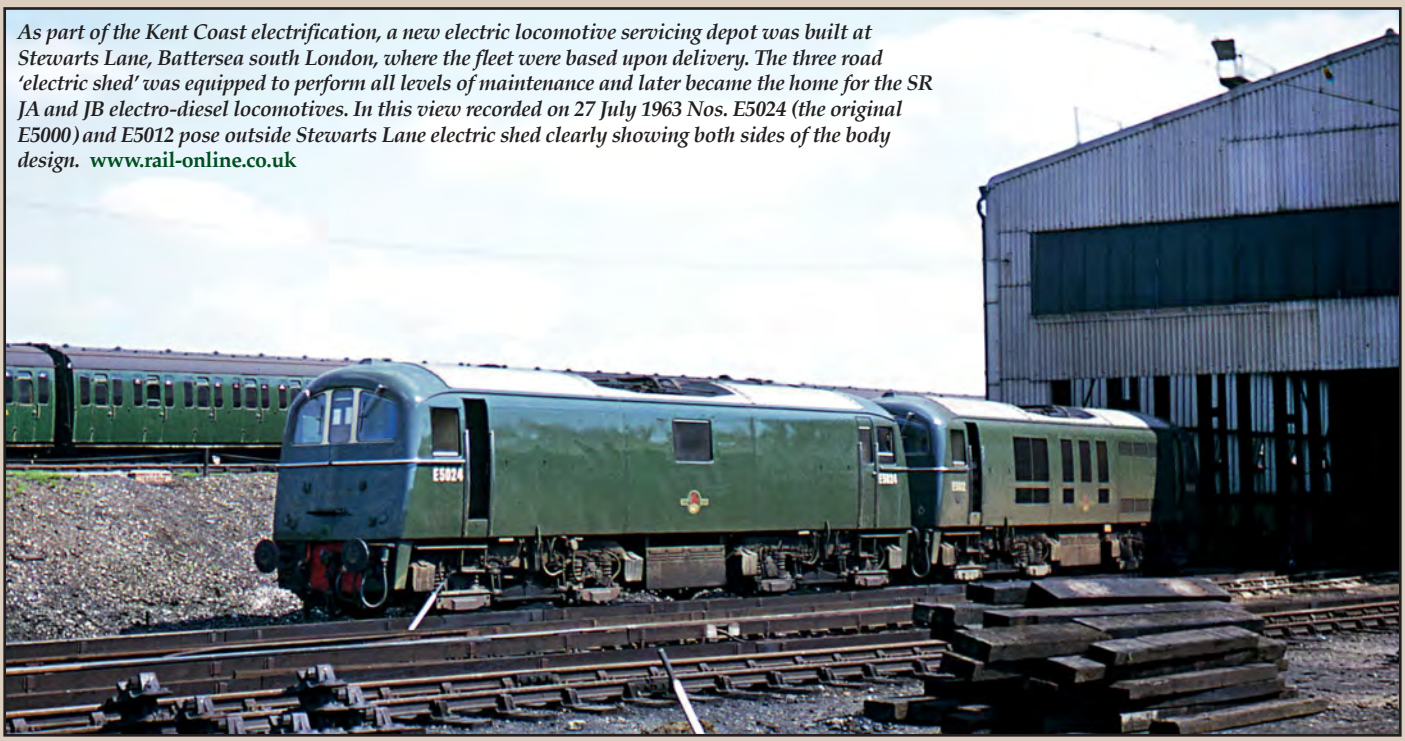


Left: *Fabrication and assembly of the first Southern Region HA class electric locomotives was carried out throughout 1958. Paperwork shows that metal fabrication commenced on 28 December 1957 with the body near completion in late February 1958. Here the first bodyshell is seen in the fabrication shop while the medium gauge steel panels were attached to the skeleton frame.* **CJM-Collection**

Above: *Delivery of the first 'HA' was to Durnsford Road electric depot just after New Year 1959, before taking up testing on the Brighton line. The loco is seen after completion and prior to delivery at Doncaster. In December 1962 this loco was renumbered as E5024, thus keeping all fleets starting with the '01' number.* **CJM- Collection**

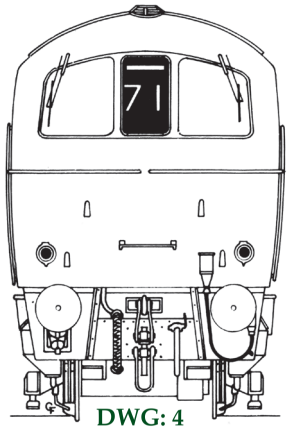
Right: *To enable operation in yards where the presence of a third live rail would have been dangerous, overhead power collection (at 750V dc) was included, with a handful of main yards on the South Eastern division of the Southern so equipped. In the early 1960s, No. E5010 is seen shunting at the south end of Hither Green Continental Depot, using its overhead power collection.* **www.colour-rail.com**

As part of the Kent Coast electrification, a new electric locomotive servicing depot was built at Stewarts Lane, Battersea south London, where the fleet were based upon delivery. The three road 'electric shed' was equipped to perform all levels of maintenance and later became the home for the SR JA and JB electro-diesel locomotives. In this view recorded on 27 July 1963 Nos. E5024 (the original E5000) and E5012 pose outside Stewarts Lane electric shed clearly showing both sides of the body design. **www.rail-online.co.uk**



Class 71 (HA)

The drawings are reproduced in exact OO gauge 1:76 - 4mm to the foot scale



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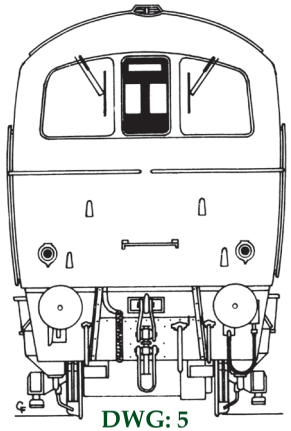
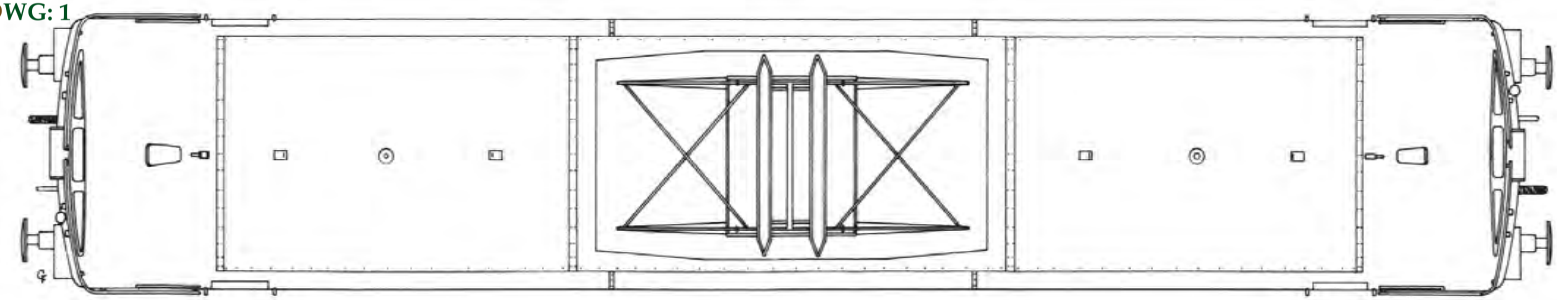


DWG: 5

DWG: 1



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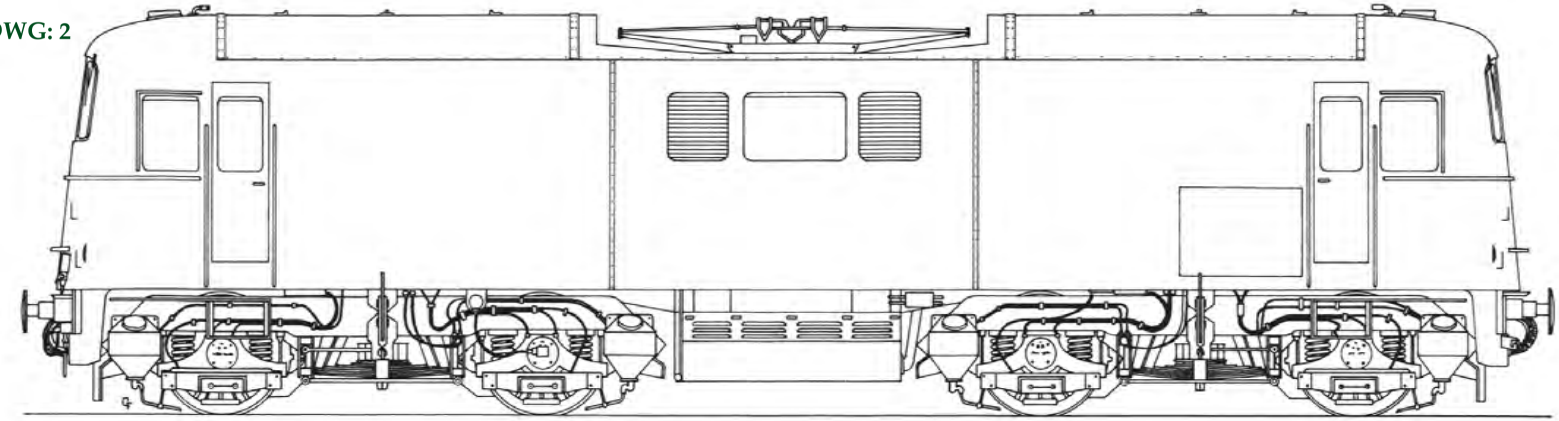

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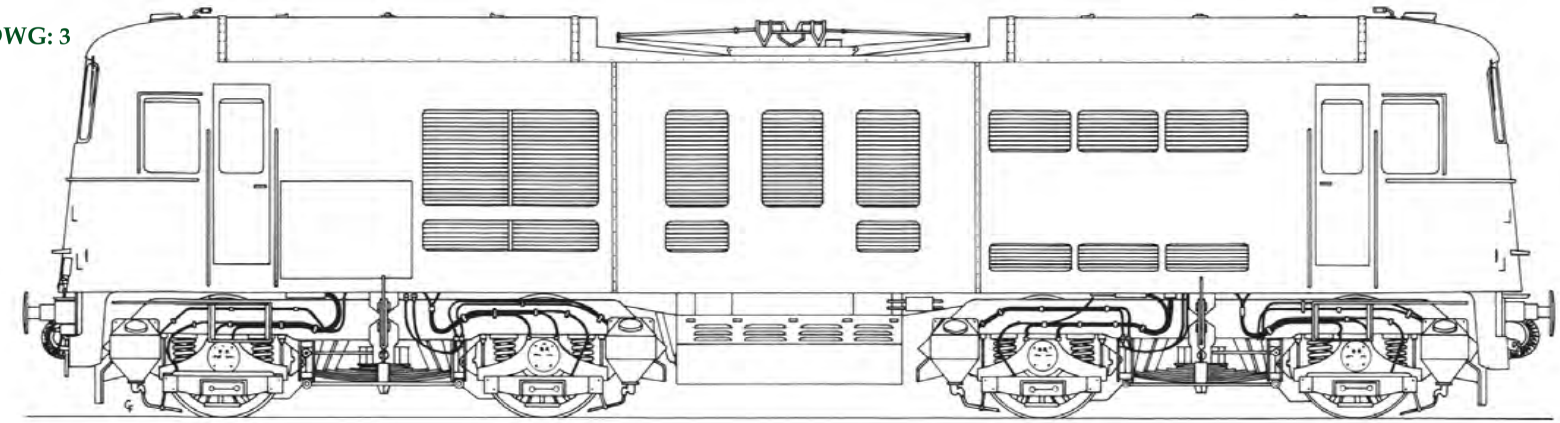


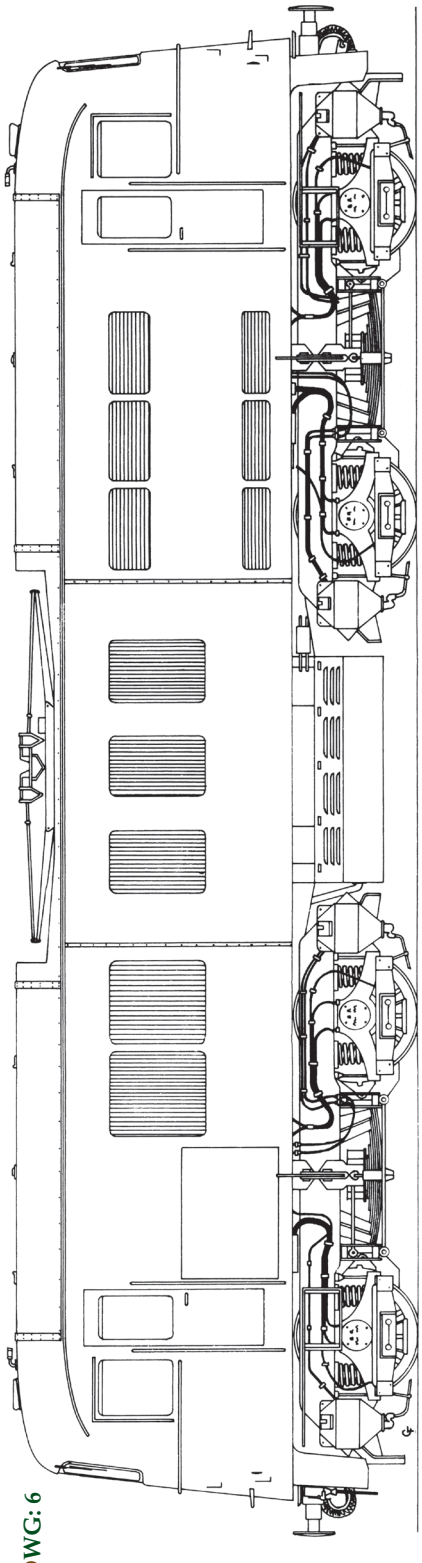
Drawing 1
BR dc Bo-Bo electric, later Class 71 roof detail.

Drawing 2
BR dc Bo-Bo electric, later Class 71 side 'A', showing original layout with body mounted ETH jumper, no rain water strip and round sand box filler caps.

Drawing 3
BR dc Bo-Bo electric, later Class 71 side 'B', showing original layout with body mounted ETH jumper, no rain water strip and round sand box filler caps.

Drawing 4
BR dc Bo-Bo, Class 71, front end layout, original design.

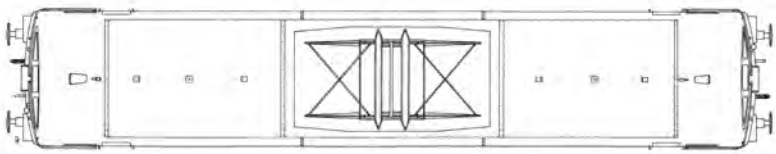
Drawing 5
BR Class 71 front end, revised style.



DWG: 6

Drawing 6
BR dc Bo-Bo, side 'B' showing modified side louvre arrangement applied to locomotives Nos. E5004 and E5011 (71004/011), revised rain water strip, ETH jumper position and later square sand box filler ports.

DWG: 1



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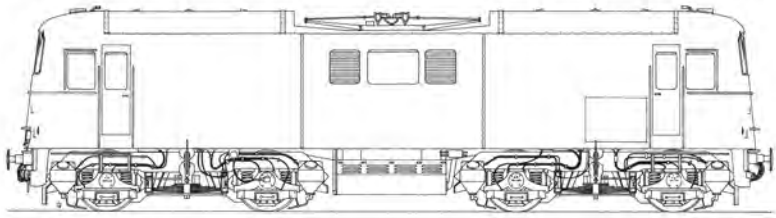

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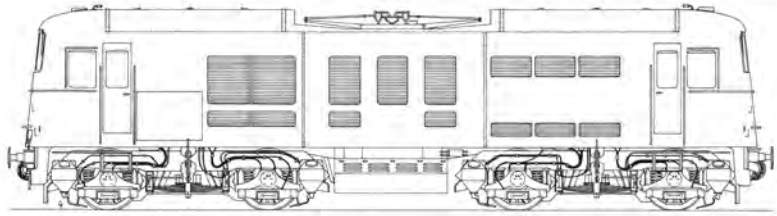

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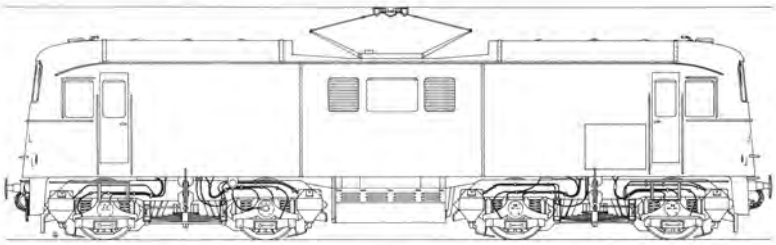

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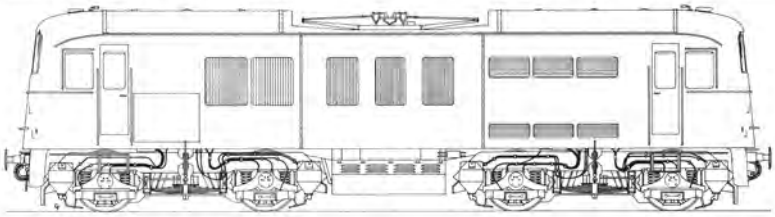

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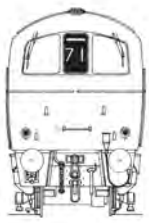
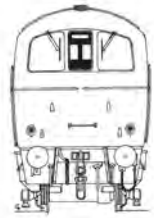


Class 71 (HA)



DWG: 5

Drawing 1
BR dc Bo-Bo electric, later Class 71 roof detail.

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BR dc Bo-Bo electric, later Class 71 side 'A', showing original layout with body mounted ETH jumper, no rain water strip and round sand box filler caps.

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BR Class 71 front end, revised style.

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BR dc Bo-Bo, side 'B' showing modified side louvre arrangement applied to locomotives Nos. E5004 and E5011 (71004/011), revised rain water strip, ETH jumper position and later square sand box filler ports.

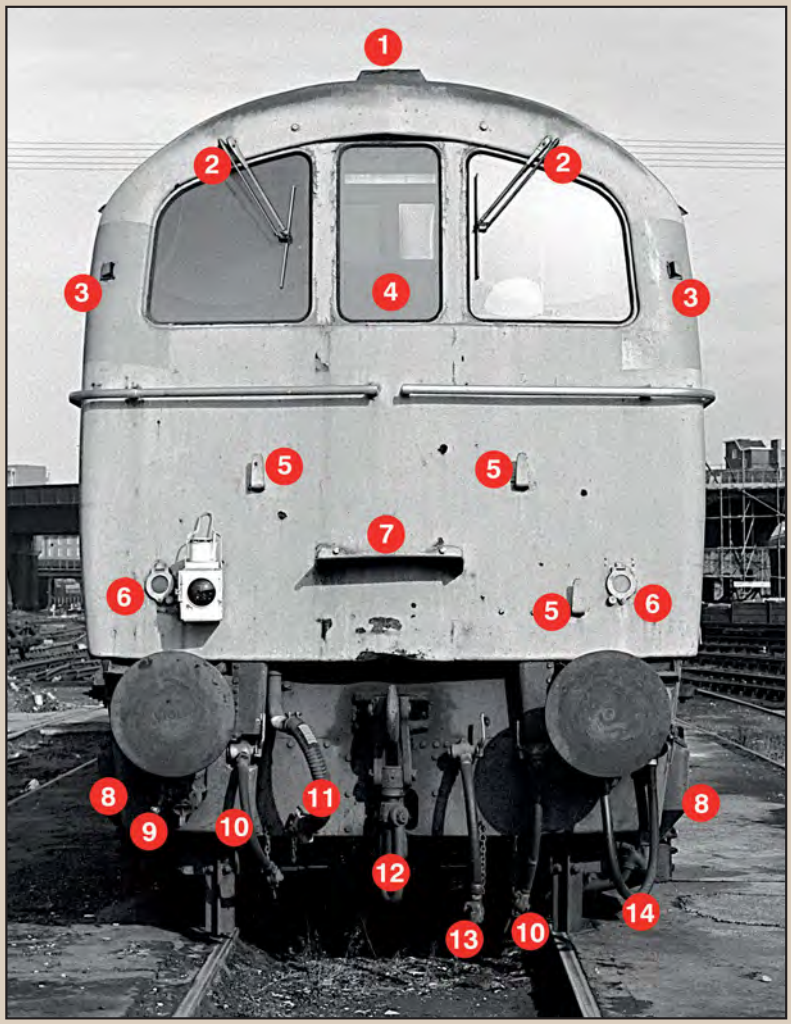
Drawing 7
BR Class 71 side elevation of side 'A' showing pantograph in raised position, with revised rain water strips, ETH jumper and square sand box filler ports.

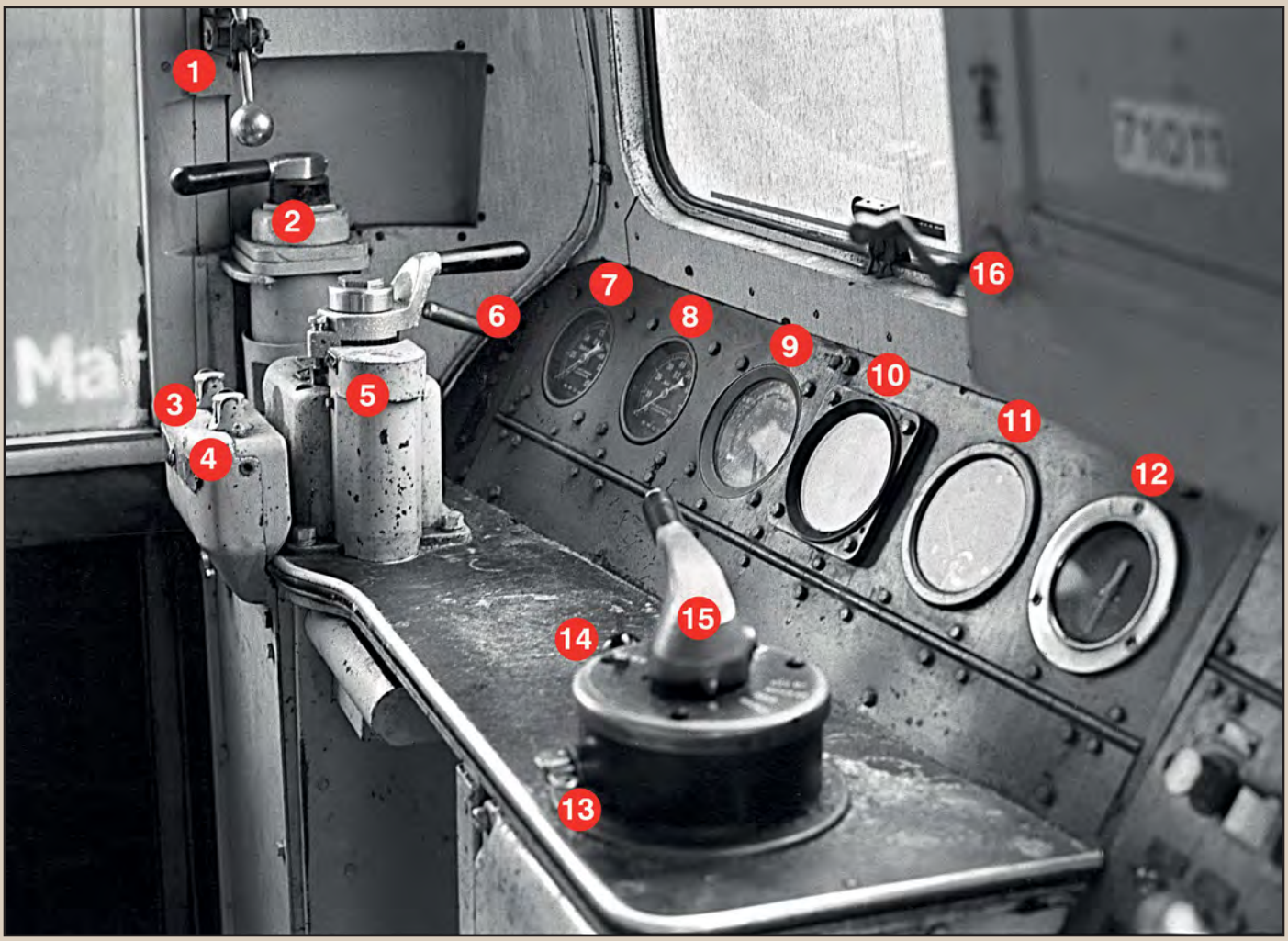
The drawings are reproduced in exact N gauge 1:148 - 2.02mm to the foot scale

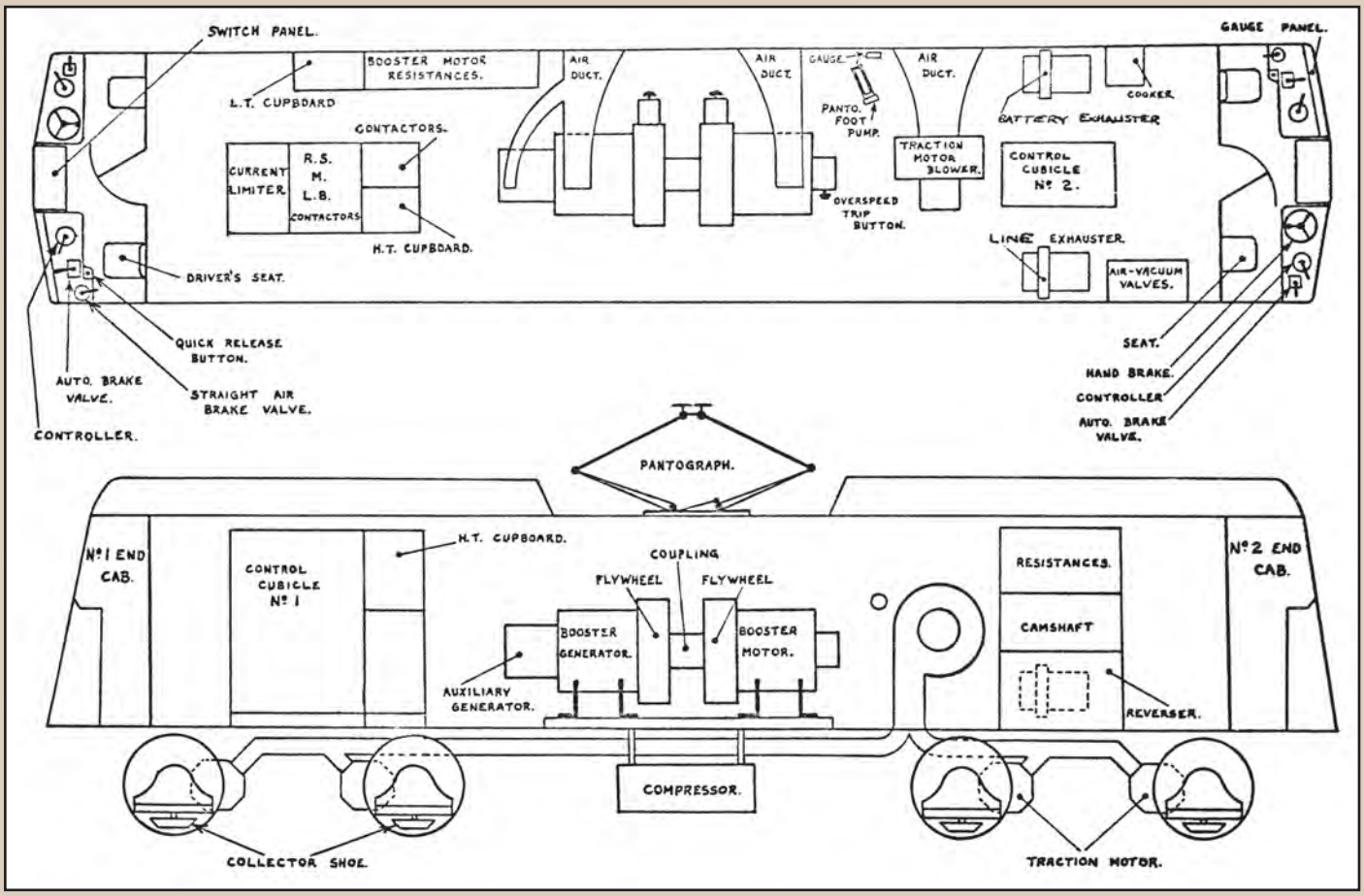
Technical Description

TOPS number range:	71001-71014
Former number range:	E5000-E5024 (Note 1)
SR classiication:	HA
Built by:	BR Doncaster
Introduced:	1959-1960
Wheel arrangement:	Bo-Bo
Weight - operational:	77 tonnes
Height - pan down:	13ft 1in (3.99m)
Width:	8ft 11in (2.72m)
Length:	50ft 7in (15.42m)
Min curve negotiable:	4 chains (80.4m)
Maximum speed:	90mph (145km/h)
Wheelbase:	37ft 6in (11.13m)
Bogie wheelbase:	10ft 6in (3.20m)
Bogie pivot centres:	27ft (8.23m)
Wheel diameter:	4ft (1.22m)
Brake type:	Dual
Sanding equipment:	Pneumatic
Heating type:	Electric
Route availability:	6
Multiple coupling restriction:	Not multiple fitted
Brake force:	41 tonnes
Horsepower - continuous:	2,552hp (1,903kW)
Horsepower - maximum:	3,000hp (2,237kW)
Tractive Effort - maximum:	43,000lb (191.2kN)
Number of traction motors:	4
Traction motor type:	EE 532A
Control system:	DC Booster EE836
Auxiliary generator:	EE 910B
Gear ratio:	76:22
Pantograph type:	Cross-Arm
Nominal Supply Voltage:	660-750V dc

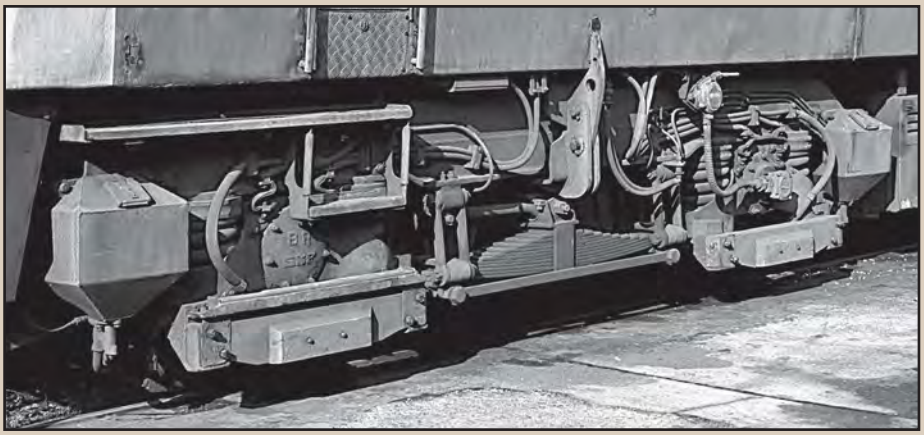
Note 1: A total of 24 locomotives were constructed, 10 being converted to Class 74 electro-diesel locomotives in 1966-67. When built, the first locomotive was numbered E5000, but this was renumbered as E5024.



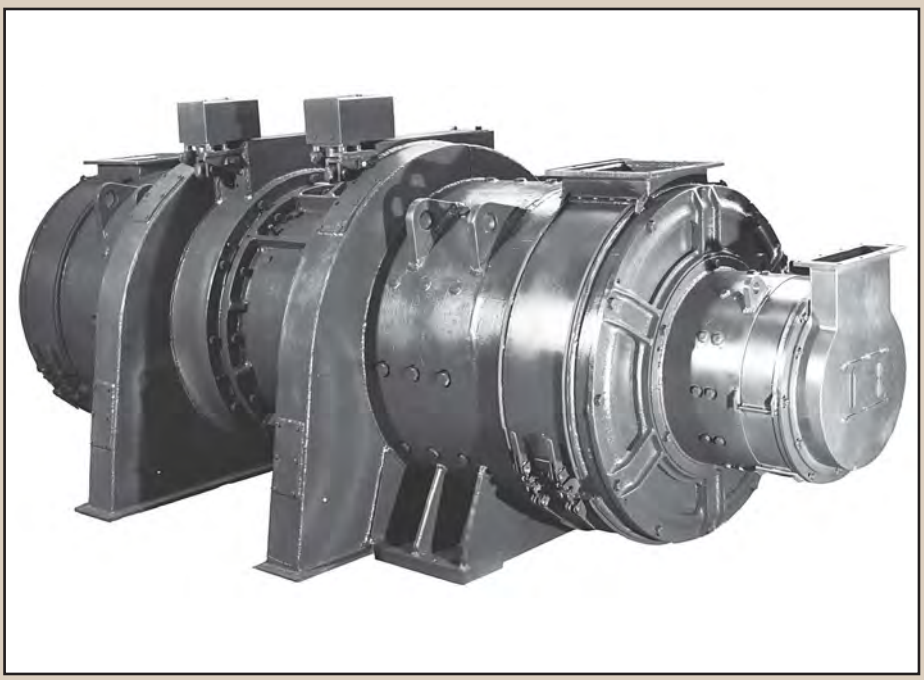




Above: *Class 71 equipment positions.*



Left Top: *Class 71 front end equipment. 1: Cab ventilation grille with whistle to the rear, 2: Windscreen wipers, 3: Cab ventilation grilles (added in later years), 4: Two character route display, 5: Lamp brackets (also used to mount headboards, 6: White marker light with red 'swing over' filter to act as tail light, 7: Foot step, 8: Sandbox, 9: Electric train heat jumper socket (UIC style), 10: Main reservoir pipe (yellow), 11: Vacuum pipe, 12: Coupling shackle and hook, 13: Air brake pipe (red), 14; Electric train heating cable (UIC style).* **CJM**



Right Middle: *Class 71 bogie detail, showing the two sand boxes one at either end and third rail pick up shoe beam, with one shoe mounted close to the axle centre.* **CJM**

Right Below: *English Electric EE836 booster set, with the auxiliary generator at the near end, followed by the booster/generator, a flywheel, coupling plate, a further flywheel and the booster motor at the far end.* **CJM**

Left Below: *Class 71 driving cab layout. 1: Warning whistle valve, 2: Straight air brake valve (loco only), 3: Exhaustr high speed button, 4: Anti-slip brake button, 5: Train brake valve, also proportional on loco, 6: Sanding valve, 7: Duplex gauge showing Brake pipe and main reservoir pipe pressures, 8: Bogie brake cylinder pressure gauge, 9: Vacuum brake gauge, 10: Speedometer, 11: Traction ammeter, 12; Booster gauge, 13: Master key socket, 14: Master switch, 15: Power controller. 16: Headcode control handle. Loco illustrated is No. 71011.* **CJM**

Above: *While allocated to the Southern Eastern section, the HA class booster electrics received classified attention at Eastleigh Works and often travelled to and from under their own power. In immaculate condition, No. E5011 is seen stabled at Eastleigh awaiting return to Stewarts Lane in September 1965.* **www.colour-rail.com**

Left: *Throughout 1959 a number of test and driver training runs were undertaken on the Eastern section. Here No. E5001, delivered in February 1959, is seen passing Dunton Green in June 1959 with a test/training special.* **Roy Small**

Below: *On 27 April 1960, No. E5013 powered an 'express freight' test hauling 16 loaded wagons carrying 1,010 tons of ballast from Dover to London, to gauge performance of the fleet. The train is seen near Swanley.* **Derek Cross**

Above: *With the equipment room drop-light window open to reduce heat, No. E5007 passes Shortlands Junction in spring 1960 with a short 4-wheel van train from Dover to Bricklayers Arms. Although often only associated with passenger services, the HA class booster electrics were frequently seen on Southern Eastern section freight and van services.* **CJM-Collection**

Below: *The 'Golden Arrow' and 'Night Ferry' services linking London Victoria and Dover were the main trains which the HA class booster electrics will be remembered. The daytime Golden Arrow services formed of pristine Pullman stock always had a clean loco, adorned with the Golden Arrow headboard, UK Union and French Tricolore flags and bodyside mounted gold arrows, making a stunning image wherever seen. No. E5015 in malachite green with red stripe departs from London Victoria bound for Dover in March 1963. This loco was later rebuilt as the first of the dual power electro-diesel Class 74s No. E6101, being withdrawn from all electric service in March 1966.* **www.colour-rail.com / J Inglis**

Above: *In full dress for the Golden Arrow, 'HA' No. E5015 passes Shortlands with the premier service in the summer of 1960, soon after electric locos took over the duty from 'Britannia' class steam traction. The train is formed of Pullman vehicles, plus two Bulleid green-liveried coaches and a four wheel van at the front end. The train is carrying the Eastern section Boat Train route indicator '46' covering the route from London Victoria to Dover Marine via Herne Hill and Orpington.* **www.colour-rail.com**

Right Middle: *Carrying the headcode '12' for the route from London Victoria to Dover Marine via Herne Hill and Maidstone East. No. E5007 in all-over green livery but carrying all the Golden Arrow trimmings, is seen at Chislehurst in April 1965. This time the train is formed of all Pullman stock, but with a maroon BG coupled between loco and passenger stock. No. E5007 was later renumbered to 71007 and remained in traffic until block withdrawal in November 1977.*
www.colour-rail.com / C Hogg

Right Below: *Displaying the short lived front end yellow 'band' livery, with the yellow carried just in the middle of the front end but running from side to side, No. E5012 powers a 'modern' Golden Arrow past the car sheds at Orpington in May 1968. By this time the Pullmans had gone to be replaced by a blue/grey-liveried Mk1 set with a blue GUV on the front. The gold body side arrows had gone from the loco, as has the flags - all part of change! In the background a rake of 2-EPB sets can be seen.*
www.colour-rail.com / C Hogg

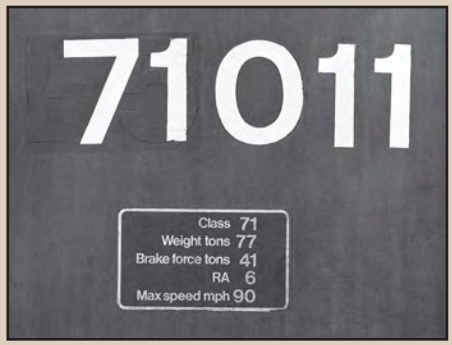
Above: *With a long train of Transfesa continental ferry wagons behind, No. 71012 approaches Headcorn on 2 August 1975 with a Dover Western Docks to Paddock Wood fruit service.* **www.colour-rail.com**

Left: *After withdrawal in June 1966 'HA' No. E5006 operated some test trains prior to transfer to Crewe to be rebuilt as Class 74 No. E6103. Here, it leads an all-blue liveried 4VEP out of Waterloo with a traction power test train bound for Bournemouth. It was very rare to find the HA or Class 71s working on the Western section, and traction conductors were required as Western section drivers were not trained on their operation.* **CJM-Collection**

Above: *For several years a train often associated with the Class 71 fleet was the South Eastern Travelling Post Office (TPO) train which operated between Dover and London Bridge until 1968 and then to/from Victoria until the service was withdrawn in February 1977. On 3 August 1971, No. E5009 is seen between Dover and Folkestone powering the train formed of two TPO carriages, one tender, and one sorting van with four bogie and four-wheel vans.* **John Cooper-Smith**

Left Below: *The Southern for many years operated mixed loco-hauled van and passenger train formations during the night hours. On 17 September 1974, rail blue-liveried Class 71 No. 71005 waits departure from London Victoria with the 03.00 mixed parcels and passenger service bound for Dover.* **Brian Morrison**

Below: *After restoration to full electrical working order by Chart Leacon depot, under the overall control of the National Railway Museum, preserved No. E5001 made its first public run, as the first preserved main line electric loco to operate on BR tracks, on 12 September 1992. It powered the 09.00 Waterloo to Bournemouth Hertfordshire Rail Tours 'E5001 Returns to the Mainline charter' from Waterloo to Bournemouth. The train was operated in conjunction with the National Railway Museum. The charter is seen near Totton. Class 73/1 No. 73132 was marshalled behind the '71' is case of failure.* **CJM**



Above: *TOPS number and data panel as applied to No. 71011.* **CJM**

Left Top: *After total withdrawal in November 1977, when the Southern decided they could operate the remaining Class 71 duties with Class 33 or 73 traction, the '71s' were stored at Ashford, Hither Green and Stewarts Lane depot awaiting sale for disposal. Stripped of its shoe gear and some internal equipment, No. 71010 is seen parked up adjacent to the Stewarts Lane diesel servicing depot on 4 December 1977.* **CJM**

Left Below: *In February 1978, Stewarts Lane depot undertook derailment training and the use of hydraulic jacks to rerail locomotives and rolling stock. To provide a dummy for this training, withdrawn Class 71 No. 71011 was used and is seen with its body supported on jacks in the old steam shed yard. This picture demonstrates how the lifting brackets on the body side were used.* **CJM**

Number	1957 Renumber	Date Renumber	TOPS Renumber	Date Renumber	Built By	Works Number	Introduced	Original Depot	Date Withdrawn	Final Depot
E5000	E5024	Dec-62			BR Doncaster		Dec-58	73A	Oct-66	73F
E5001			71001	Jan-74	BR Doncaster		Feb-59	73A	Nov-77	AF
E5002			71002	Dec-75	BR Doncaster		Feb-59	73A	Nov-77	AF
E5003					BR Doncaster		Mar-59	73A	Feb-67	73F
E5004			71004	Jan-74	BR Doncaster		Apr-59	73A	Nov-77	AF
E5005					BR Doncaster		May-59	73A	Mar-67	73F
E5006					BR Doncaster		May-59	73A	Jun-66	73A
E5007			71007	Jan-74	BR Doncaster		Jun-59	73A	Nov-77	AF
E5008			71008	Dec-73	BR Doncaster		Jul-59	73A	Nov-77	AF
E5009			71009	Jan-74	BR Doncaster		Aug-59	73A	Nov-77	AF
E5010			71010	Dec-73	BR Doncaster		Sep-59	73A	Nov-77	AF
E5011			71011	Dec-73	BR Doncaster		Sep-59	73A	Nov-77	AF
E5012			71012	Jan-74	BR Doncaster		Oct-59	73A	Nov-77	AF
E5013			71013	Jan-74	BR Doncaster		Dec-59	73A	Nov-77	AF
E5014			71014	Dec-73	BR Doncaster		Feb-60	73A	Nov-77	AF
E5015					BR Doncaster		Feb-60	73A	Mar-66	75D
E5016					BR Doncaster		Apr-60	73A	Oct-66	73F
E5017					BR Doncaster		Mar-60	73A	Apr-67	73F
E5018	E5003	Dec-68	71003	Dec-73	BR Doncaster		Apr-60	73A	Nov-77	AF
E5019					BR Doncaster		Jun-60	73A	Oct-66	73A
E5020	E5005	Oct-68	71005	Dec-73	BR Doncaster		Jun-60	73A	Nov-77	AF
E5021					BR Doncaster		Aug-60	73A	Mar-67	73F
E5022	E5006	Oct-68	71006	Dec-73	BR Doncaster		Sep-60	73A	Nov-77	AF
E5023					BR Doncaster		Nov-60	73A	Jan-67	73F
E5024	See E5000									

Above: *Awaiting its final drag to the breakers yard, No. 71011 poses at Stewarts Lane in March 1978, where it remained until June 1979 when it was hauled to Temple Mills for onward transfer to BREL Doncaster Works. It was finally broken up in November 1979.* **CJM**

Right: *On 31 August 1979 Class 71s Nos. 71002, 71007 and 71008 were hauled to J Cashmore at Newport for disposal, however the train was terminated at Swindon and the three spent a month in Swindon Works before completing their journey. The only time Class 71s visited Swindon Works. The trio were broken up by the end of the year.* **Garry Stroud**

Table Key

AF - Ashford	R - Rebuilt
C - Cut up	73A - Stewarts Lane
P - Preserved	73F - Ashford
	75D - Stewarts Lane

Disposal Code	Disposal Detail	Disposal Date	Notes
R	Rebuilt as Class 74 No. E6104	-	
P	National Railway Museum, Shildon	-	TOPS No. 89403 allocated
C	J Cashmore, Newport	Aug-78	Stored: (U) 10/76
R	Rebuilt as Class 74 No. E6107	-	
C	BREL Doncaster	Dec-79	Stored: (U) 10/76
R	Rebuilt as Class 74 No. E6108	-	
R	Rebuilt as Class 74 No. E6103	-	
C	J Cashmore, Newport	Aug-78	Stored: (U) 10/76
C	J Cashmore, Newport	Aug-78	Stored: (U) 10/76
C	BREL Doncaster	Sep-79	Stored: (U) 10/76
C	BREL Doncaster	Aug-79	Stored: (U) 10/76
C	BREL Doncaster	Nov-79	Stored: (U) 10/76
C	J Cashmore, Newport	Aug-78	Stored: (U) 10/76
C	BREL Doncaster	Nov-79	Stored: (U) 10/76
C	BREL Doncaster	Sep-79	Stored: (U) 10/76
R	Rebuilt as Class 74 No. E6101	-	
R	Rebuilt as Class 74 No. E6102	-	
R	Rebuilt as Class 74 No. E6109	-	
C	BREL Doncaster	Mar-80	Stored: (U) 10/76
R	Rebuilt as Class 74 No. E6105	-	
C	J Cashmore, Newport	Aug-78	Stored: (U) 10/76
R	Rebuilt as Class 74 No. E6110	-	
C	J Cashmore, Newport	Aug-78	Stored: (U) 10/76
R	Rebuilt as Class 74 No. E6106	-	

BR/LNER Bo-Bo – EM1 Class 76

The original Great Central Railway route between Sheffield and Manchester, via Woodhead, was considered for electrification in the early 1920s but, for various reasons, this was not achieved. Proposals were drawn up again in 1926, three years after the route had been taken over by the LNER, regrettably these financially sound proposals were again rejected.

Some 10 years later, the LNER who had by then obtained some operating experience of electric traction, drew up detailed proposals for a revised scheme, taking electric traction from Manchester (London Road) to Sheffield (Victoria), as well as the branch from Penistone to Wath, and onwards from Sheffield to Rotherwood.

The Railway Board and the Government of the day approved the scheme and by 1939 work commenced on substations and track equipment working from east to west of the route. Sadly, the outbreak of world hostilities in 1939 meant suspension of the scheme. However, assembly of a prototype loco for the route was underway at the LNER works in Doncaster, this was a Bo-Bo twin-cab loco, designed by Gresley, using electrical equipment supplied by Metropolitan Vickers. It was completed as LNER No. 6701.

It was the railways original intention to make use of the redundant Newport to Shildon Bo-Bo locomotives then in store, (for banking) and supplement these by a new purpose-built mixed traffic design. However, as time proved, this was not to be.

After No. 6701 was finished, there was no suitable electrified track on which to test it, and in 1941 it was hauled over the Pennines to Manchester and tested for a brief period on the Manchester South Junction & Altrincham (MSJ&A) line.

After the end of hostilities in 1945, the LNER was not in any position to recommence work on the cross-Pennine project, and to complicate matters, a decision was then made to make a second bore for the Woodhead Tunnel.

In the meantime, the prototype locomotive, No. 6701, which had been renumbered as No. 6000, was laying idle. The LNER keen to test and prove its design in operational conditions, struck a deal with the Netherlands Railway (NS) to operate the loco on its 1,500V dc system. Although the loco operated well, the ride was disappointing, particularly at speeds between 45-60mph (72-96km/h). Such were the problems that the LNER needed a major rethink on its Manchester to Sheffield line motive power policy.

After much deliberation, it was agreed to build 57 Bo-Bo locos of similar design to No. 6000 for lower speed or mixed traffic work. In addition, a fleet of Co-Co express passenger locos (later Class 77) were to be built.

The LNER prototype was returned to the UK in the late 1940s, modified for UK use and renumbered into BR stock as 26000, later being given the name *Tommy*, a nickname applied to the loco by Dutch Railway staff.

Assembly of the production locos was awarded to the ex-LNER works in Gorton, Manchester, with power/control equipment supplied by Metropolitan Vickers. A number of detail modifications existed between the prototype and production locos, including cab window and door layout, grille design and position and bogie fittings.

Under the post-1948 classification system, these locos were classified as EM1. When the initial machines had been completed, the trans-Pennine route was still not ready for use and several new locomotives were immediately placed into store, others went to the Great Eastern line from London Liverpool Street to Shenfield for testing and training, until the Pennine route was complete.

The Trans-Pennine electric service commenced operation on 4 February 1952, between Wath and Dunford Bridge, with the sections between Manchester (London Road) and Dunford Bridge opening in June 1954, and the remainder of the line from Penistone to Sheffield Victoria the following September.

When introduced, the Bo-Bo (EM1) locos were finished in BTC black livery, this was later changed to green and from the late 1960s, to corporate BR rail blue.

After introduction, the EM1 fleet operated jointly with the large Co-Co EM2 design on passenger duties, as well as being in charge of freight traffic. When introduced, the locos were fitted with air and electric regenerative brakes with vacuum braking for trains, however with the introduction of different stock and the need for a change in braking equipment in the late 1960s and 1970s, a number of machines received dual (air/vacuum) brake equipment, and some eventually acquired air brake only equipment.

Another significant change within the fleet came in the late 1960s, when a facility was sought to operate more than one loco on the leading cab, but under the control of one driver. Multiple control equipment was then fitted to a number of locos, enabling up to three to be controlled by one driver, this system was especially useful with the introduction of heavy air-braked freight services.

An interesting twist to this class, was that when the final 12 were built, these were fitted with steam heat boilers for passenger services and were given cast names, associated with Greek mythology.

Under the BR numeric classification system, the fleet became Class 76. They proved to be good and reliable performers, they remained in operation hauling lengthy freight trains, until BR decided that it was uneconomic to retain the trans-pennine route, which after considerable protest from public and staff, was closed from 20 July 1981, with all lineside equipment removed. The section at the Manchester end was retained for the Glossop to Hadfield services until 1994 when the route was converted to ac operation.

One locomotive, No. 26020, has been preserved and is now on display at the National Railway Museum, after withdrawal it was overhauled at BREL Doncaster and restored to its original 1950s lined black livery. All other class members were broken up. ■

Below: *The brand new apple-green liveried LNER No. 6701 stands in the works yard at Doncaster on 10 February 1941, being the pioneer 1,500V dc overhead electric locomotive built for the planned Manchester-Sheffield-Wath route. After this image was recorded No. 6701 was hauled to York for display on 19 February before returning to Doncaster Works and placed into store, only emerging to operate limited test trains.* **CJM-Collection**

Right Bottom: *LNER No. 6701 was renumbered to LNER 6000 in June 1946 and on 3 September 1947 it was exported to Holland to operate on the Dutch railways, covering a shortage of power in that country and allowing testing of the loco. No. 6000 remained working in Holland until returning to the UK on 23 March 1952, after which it was overhauled and renumbered to 26000. On 30 September 1947 the loco is seen at Utrecht with a train bound for Eindhoven.* **CJM-Collection**

Above: *To enable testing of LNER 6701 the loco was hauled over the Pennines to Manchester and operated limited test runs over the electrified Manchester-Altrincham line in mid 1941, this rare illustration shows the loco at Altrincham.* **CJM-Collection**

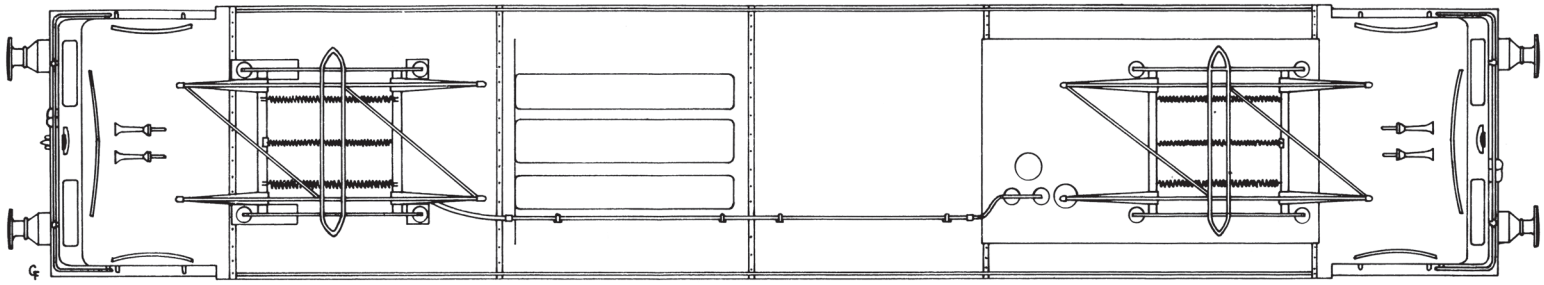
Below: *On 12 November 1950, the second of the production EM1 locomotives No. 26002 is seen at Shenfield, while undertaking a test run with a freight formation, as at the time the Manchester-Sheffield route was still to be commissioned. Several of the early deliveries operated in the London area, out-based at Ilford.* **CJM-Collection**

Technical Description

TOPS number range :	76001-76057
Former number range:	E26000-E26057 (Note 1)
Former class code:	EM1
Built by:	BR Doncaster and Gorton
Introduced:	1941-1953
Wheel arrangement:	Bo-Bo
Weight operational:	88 tonnes
Height - pan down:	13ft (3.96m)
Width:	9ft (2.74m)
Length:	50ft 4in (15.34m)
Min curve negotiable:	6 chains (120.66m)
Maximum speed:	65mph (105km/h)
Wheelbase:	35ft (10.67m)
Bogie wheelbase:	11ft 6in (3.51m)
Bogie pivot centres:	23ft 6in (7.16m)
Wheel diameter:	4ft 2in (1.27m)
Brake type:	Vacuum, Dual or Air (Note 2)
Sanding equipment:	Pneumatic
Heating type:	Steam - Bastian & Allen (Note 3)
Route availability:	8
Coupling restriction:	Within class (Note 4)
Brake force:	43 tonnes
Horsepower:	1,868hp (1,393kW)
Tractive effort:	45,000lb (200.1kN)
Number of traction motors:	4
Traction motor type:	MV 186
Control system:	Electro-pneumatic
Gear ratio:	17:70
Pantograph type:	MV cross arm
Nominal supply voltage:	1,500V dc overhead
Boiler water capacity:	210gal (955lit) [if fitted]

Note 1: Original loco 6701 in 1941, altered to 6000 then 26000.
Note 2: Fitted with regenerative braking. Dual brakes fitted to Nos. 76006-030. Air brake only equipment fitted to Nos. 76031-039.
Note 3: Steam heating fitted to Nos. 26000, 26046-26057 (76046-76057), removed after passenger services ceased.
Note 4: Multiple control fitted to locos Nos. 76006-10/21-39.

Class EM1 – 76



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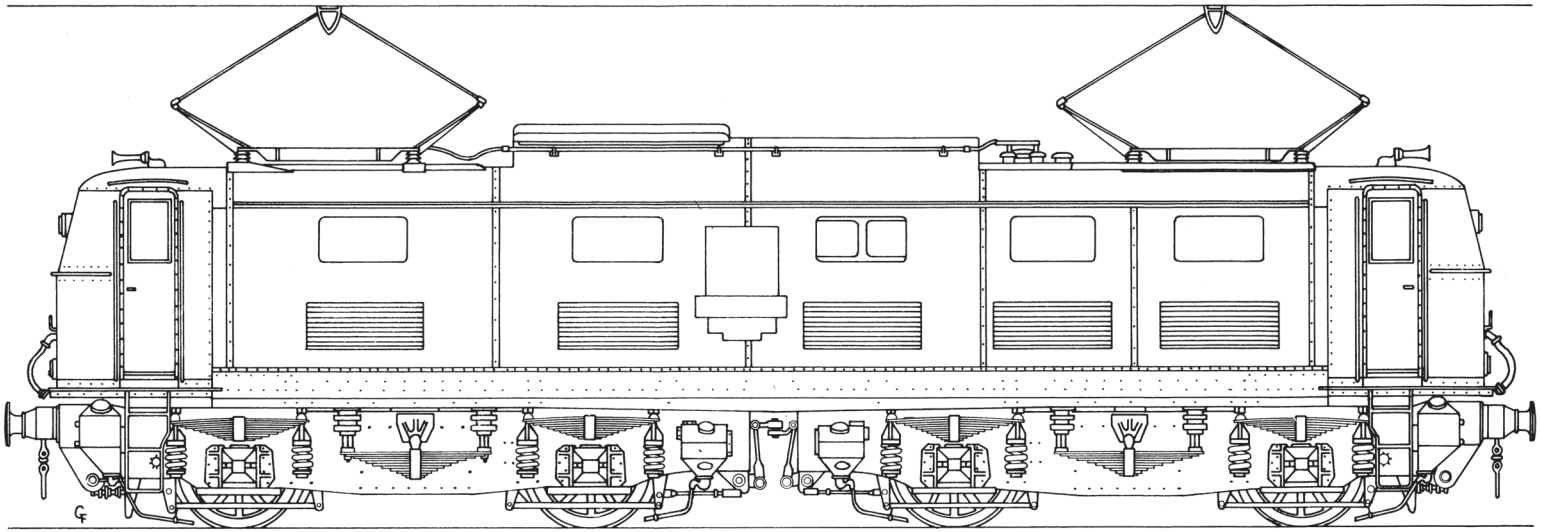

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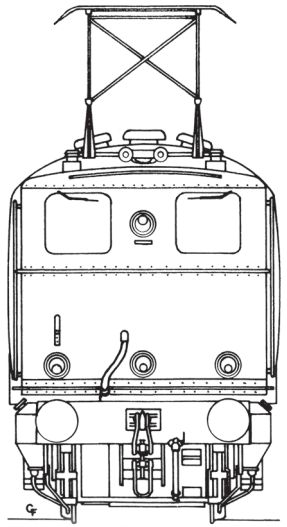

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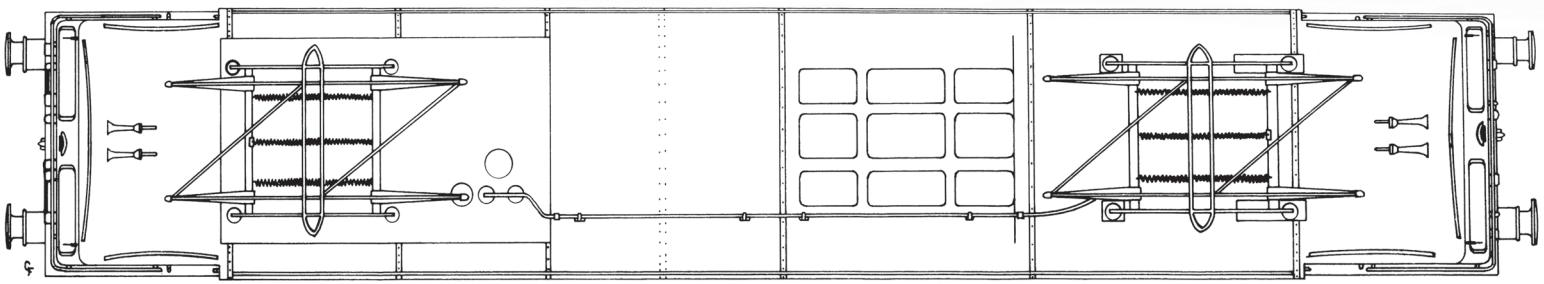
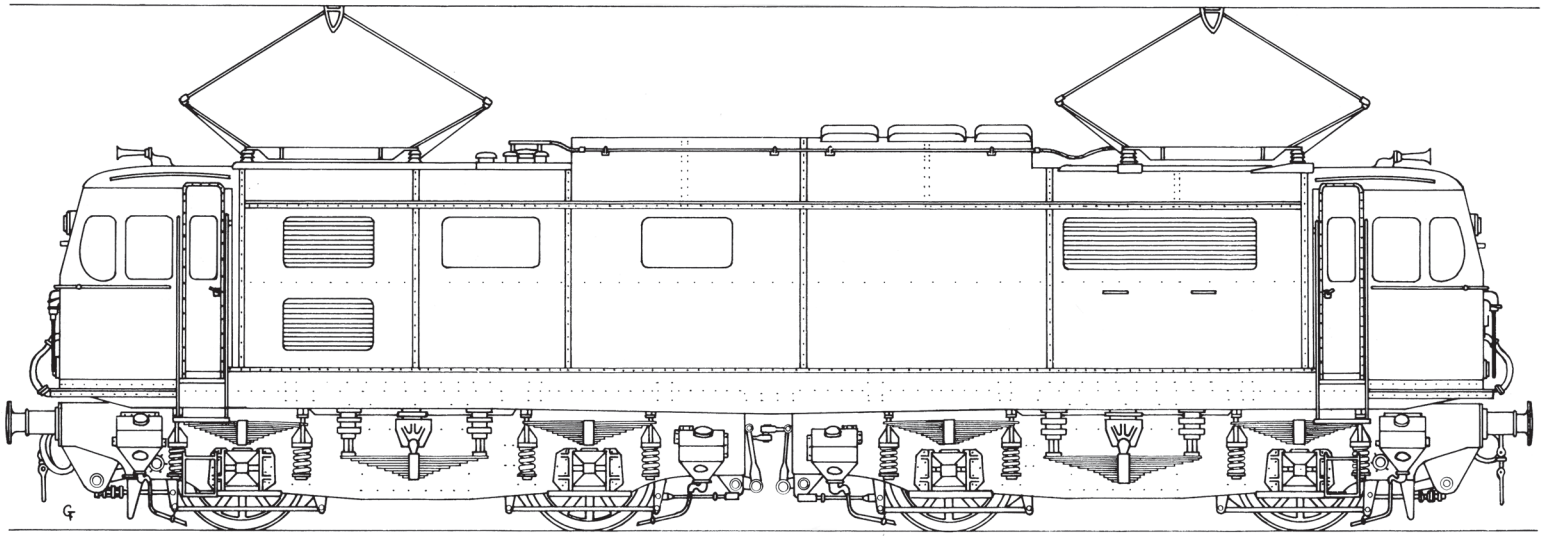


DWG: 3

The drawings are reproduced in exact OO gauge 1:76 - 4mm to the foot scale



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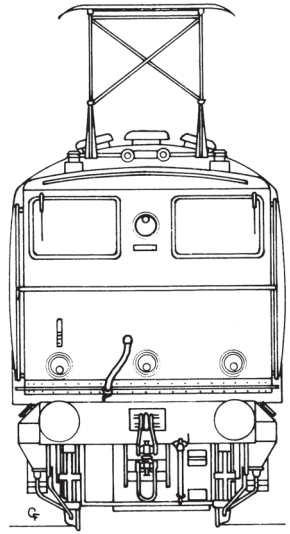

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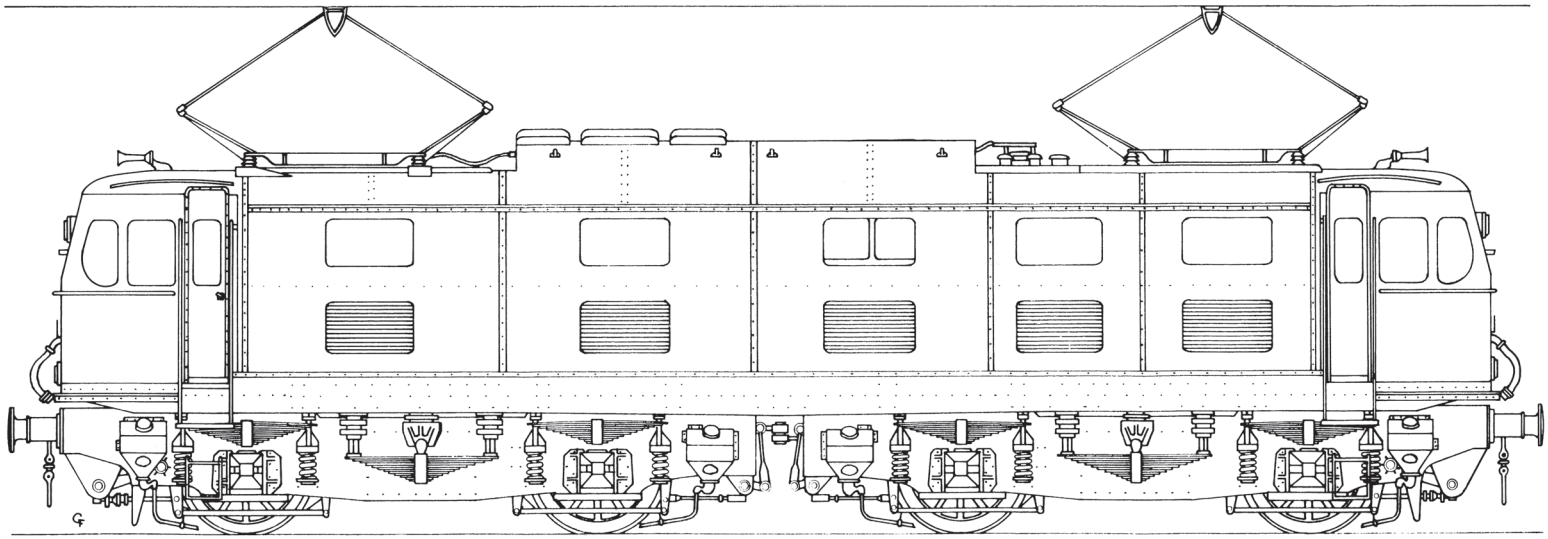

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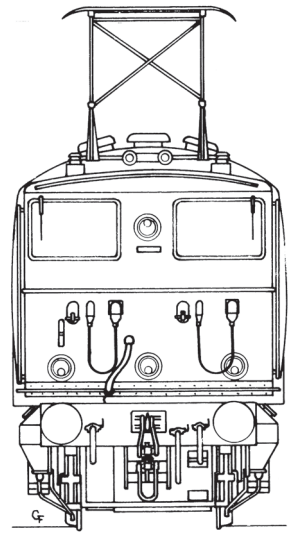


DWG: 8

DWG 1: *Roof detail of LNER prototype Bo-Bo No. 6000.*

DWG 2: *Side elevation of LNER prototype Bo-Bo No. 6000 with pantographs raised.*

DWG 3: *Class EM1, Class 76 roof detail.*

DWG 4: *Class 76 side elevation of 'B' side - fitted with multiple control equipment.*

DWG 5: *Class 76 side elevation, showing side 'A'.*

DWG 6: *Front end layout of prototype loco No. LNER 6000.*

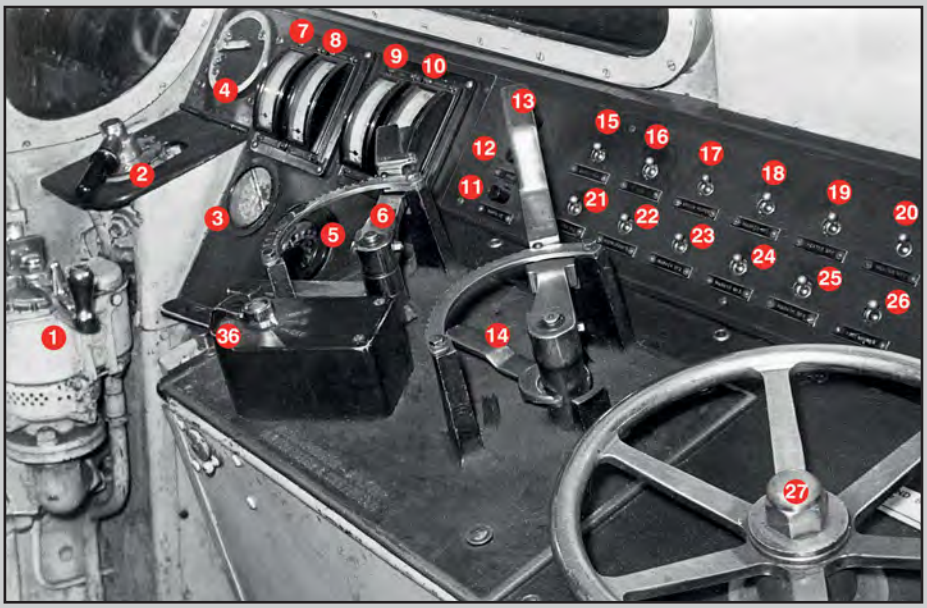
DWG 7: *Class 76 front end layout, showing vacuum brakes and steam heat, applicable to locos 26046-26057.*

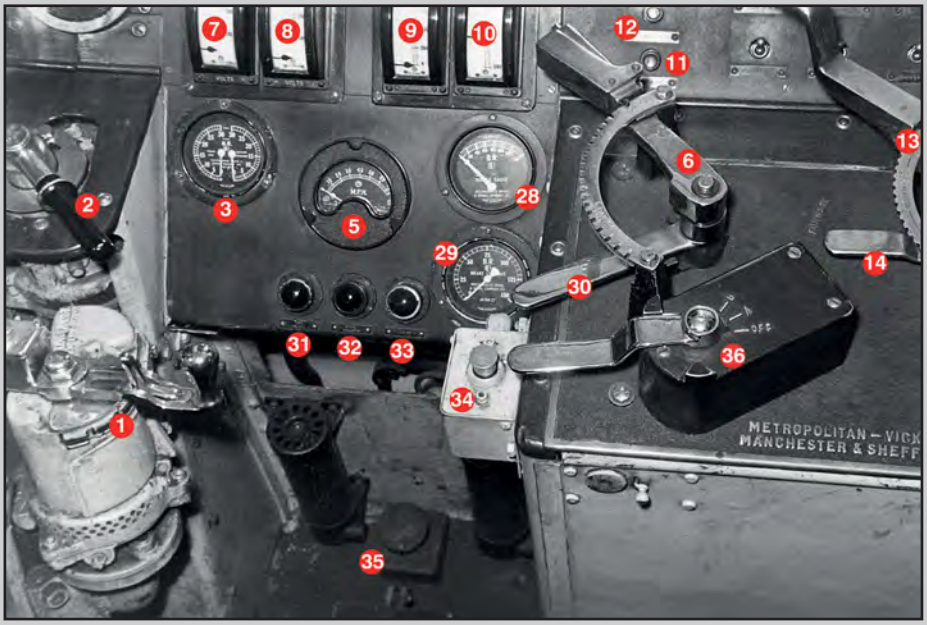
DWG 8: *Class 76 front end layout showing dual brakes and multiple control jumpers.*

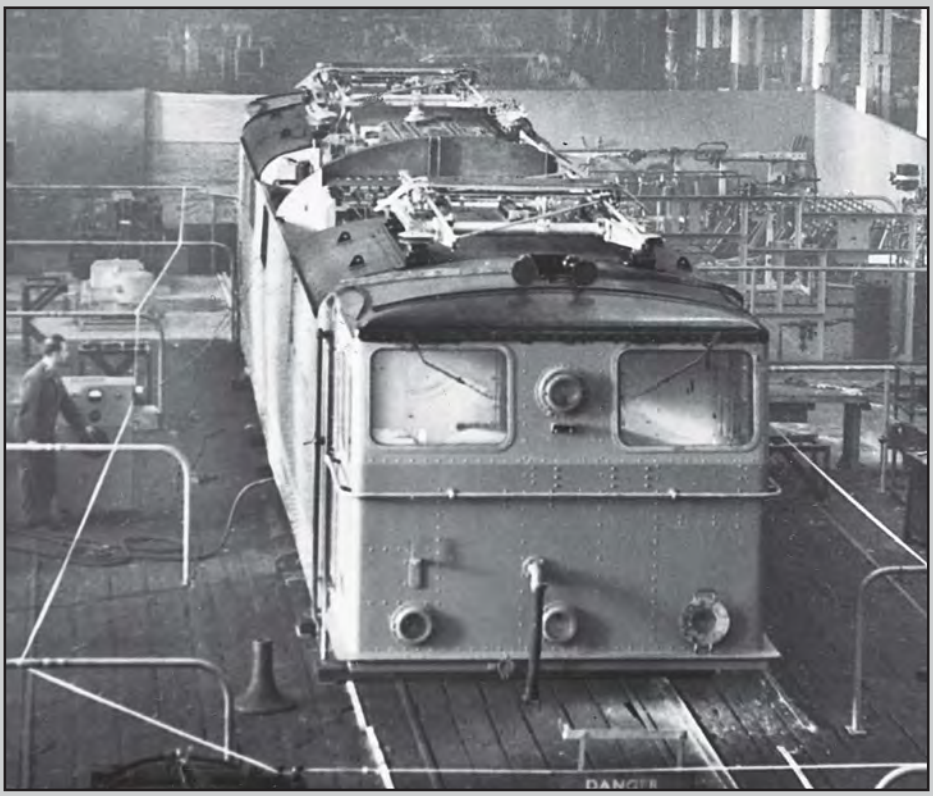
Left: *Fleet production of the LNER Bo-Bo 1,500V dc locos commenced at Gorton Works in the new year of 1950, with some seven locos seen in various stages of assembly in mid-March. Several of the early built locos were transferred by rail to Dukinfield Works in a near complete condition for the installation of electrical equipment and some static testing, before returning to Gorton for completion and painting. This view shows five locos under various stages of construction with two pairs of bogies under assembly in the foreground.* **CJM-Collection**

Below: *The pioneer member of the production fleet, No. 26001 was taken to Dukinfield Works in mid-April 1950 for electrical work to be carried out, returning to Gorton some eight weeks later, when this image was recorded of the loco in the final assembly bay, but prior to painting. The locos first major outing was in October when it was hauled over the Woodhead route before being hauled south to Ilford where it could perform dynamic tests over the Shenfield line as well as brake performance trials on Brentwood bank.* **CJM-Collection**

Right Top and Right Middle: *Class EM1 cab controls. 1: Train brake valve, 2: Straight air brake valve (loco only), 3: Vacuum brake gauge, 4: Weight transfer switch, 5: Speedometer, 6: Power controller, 7: Line voltage indicator (0-1,500V), 8: Traction motor voltage, 9: Field bogie ammeter (leading), 10: Armature (bogie) ammeter (trailing), 11: Pantograph up button, 12: Reset button, 13: Regen controller, 14: Master key (forward/reverse), 15: Supply MG switch, 16: Cab light switch, 17: Window heater switch, 18: Marker light switch, 19: Heater No. 1 switch, 20: Heater No. 2 switch, 21: Exciter MG switch, 22: Instrument light switch, 23: Marker light No. 2 switch, 24: Marker light No. 3 switch, 25: Marker light No. 4 switch, 26: Foot warmer switch, 27: Handbrake wheel, 28: Duplex gauge (main reservoir and brake pipe pressure, 29: Brake cylinder pressure gauge, 30: Series/parallel combination lever, 31: Line switch warning light (red), 32: Weight transfer indicator light (green), 33: Boiler warning light (blue), 34: Horn button (single note), 35: Sand button, with deadmans pedal to the forward (out of picture). 36: Control switch. With special thanks to Keith Lewis for information and help. Both:* **CJM**







Right: *The near complete body of loco No. 26008 is seen in the main erecting shop at Gorton, prior to being mounted on a pair of bogies, while electrical testing was being carried out. Just a thin cord stops passers by from entering the area, unlike today when the test area would be enclosed in mesh with entry warning alarms! The photo is dated 4 November 1950.* **CJM-Collection**

Number	TOPS Number	Date Renumber	TOPS Renumber	Date Renumber	Name	Date Named	Built By	Works Number	Works Renumber	Introduced	Original Depot
26000					*Tommy*	06/52-02/68	LNER Doncaster			Mar-41	39A
26001	76001	Feb-74					BR Gorton	1004	1008	Oct-50	39A
26002	76002	Apr-74					BR Gorton	1005	1009	Oct-50	39A
26003	76003	Mar-72	76036	Oct-76			BR Gorton	1006	1010	Nov-50	39A
26004	76004	Feb-74					BR Gorton	1007	1011	Feb-51	39A
26005							BR Gorton	1008	1012	Jan-51	39A
26006	76006	Jan-74					BR Gorton	1009	1013	Jan-51	39A
26007	76007	Feb-74					BR Gorton	1010	1014	Feb-51	39A
26008	76008	Nov-72					BR Gorton	1011	1015	Mar-51	39A
26009	76009	Apr-74					BR Gorton	1012	1016	Mar-51	39A
26010	76010	Feb-73					BR Gorton	1013	1017	Mar-51	39A
26011	76011	Jul-73					BR Gorton	1014	1018	May-51	39A
26012	76012	Apr-73					BR Gorton	1015	1019	May-51	39A
26013	76013	Sep-72					BR Gorton	1016	1020	May-51	39A
26014	76014	Feb-74					BR Gorton	1017	1021	May-51	39A
26015	76015	Nov-72					BR Gorton	1018	1022	Jul-51	39A
26016	76016	Mar-73					BR Gorton	1019	1023	Jul-51	39A
26017							BR Gorton	1020	1024	Jul-51	39A
26018	76018	Feb-74	76035	Jun-76			BR Gorton	1021	1025	Sep-51	39A
26019							BR Gorton	1022	1026	Sep-51	39A
26020	76020	Feb-74					BR Gorton	1023	1027	Feb-51	39A
26021	76021	Jun-73					BR Gorton	1024	1028	Oct-51	39A
26022	76022	Apr-72					BR Gorton	1025	1029	Sep-51	39A
26023	76023	Sep-73					BR Gorton	1026	1030	Sep-51	39A
26024	76024	Nov-73					BR Gorton	1027	1031	Sep-51	39A
26025	76025	Aug-72					BR Gorton	1032		Jan-52	39A
26026	76026	Feb-74					BR Gorton	1033		Jan-52	39A
26027	76027	Jan-74					BR Gorton	1034		Jan-52	39A
26028	76028	Nov-73					BR Gorton	1035		Jan-52	39A
26029	76029	Feb-74					BR Gorton	1036	1032	Dec-51	39A
26030	76030	Dec-72					BR Gorton	1037	1033	Dec-51	39A
26031							BR Gorton	1038		Jan-52	39A
26032	76032	Jan-72					BR Gorton	1039		Jan-52	39A
26033	76033	Jan-74					BR Gorton	1040		Jan-52	39A
26034	76034	Oct-73					BR Gorton	1041		Jan-52	39A
26035							BR Groton	1042		Jan-52	39A
26036	76036	Jan-74	76003	Oct-76			BR Gorton	1043		Feb-52	39A
26037	76037	Mar-72					BR Gorton	1044		Feb-52	39A
26038	76038	Oct-72	76050	Oct-76			BR Gorton	1045		Apr-52	36B
26039	76039	Mar-74	76048	Oct-76			BR Gorton	1046		Apr-52	36B
26040	76040	Feb-74					BR Gorton	1047		Apr-52	36B
26041	76041	Mar-74					BR Gorton	1048		Apr-52	36B
26042							BR Gorton	1049		May-52	36B
26043	76043	Apr-72					BR Gorton	1050		May-52	36B
26044	76044	Mar-72	76031	Mar-76			BR Gorton	1051		Jun-52	36B
26045							BR Gorton	1052		Jun-52	36B
26046	76046	Feb-74			*Archimedes*	05/59-C/68	BR Gorton	1053		Aug-52	36B
26047	76047	Feb-74			*Diomedes*	09/60-C/68	BR Gorton	1054		Aug-52	36B
26048	76048	May-72	76039	Oct-76	*Hector*	03/60-C/68	BR Gorton	1055		Sep-52	36B
26049	76049	Aug-72			*Jason*	07/60-C/68	BR Gorton	1056		Oct-52	36B
26050	76050	Nov-71	76038	Nov-76	*Stentor*	08/60-C/68	BR Gorton	1057		Nov-52	36B
26051	76051	Feb-74			*Mentor*	06/59-C/68	BR Gorton	1058		Jan-53	36B
26052	76052	Feb-74			*Nestor*	08/61-C/68	BR Gorton	1059		Jan-53	39A
26053	76053	Mar-74			*Perseus*	10/60-C/68	BR Gorton	1060		Mar-53	39A
26054	76054	Dec-73			*Pluto*	04/61-C/68	BR Gorton	1061		Apr-53	39A
26055	76055	Feb-74			*Prometheus*	06/59-C/68	BR Gorton	1062		Jun-53	39A
26056	76056	Feb-74			*Triton*	07/59-C/68	BR Gorton	1063		Jul-53	39A
26057	76057	Jul-72			*Ulysses*	04/60-C/70	BR Gorton	1064		Aug-53	39A

Key to above table

9C	Reddish	39A	Gorton	P	Preserved
36B	Mexborough	C	Cut up	RS	Reddish

Left: *The Dutch railway staff, especially the driver's became very attached to the UK loco 6000 working in their country and after it was repatriated to the UK, the staff arranged for and funded its naming* **Tommy**, *after the nick name for the British soldiers fighting the Second World War in Europe. The loco was named in a ceremony at Liverpool Street station on 30 June 1952, when Mr F. Q. den Hollender of the Dutch Railways unveiled the cast brass plate. Attached below the main nameplate was a secondary plate reading "So named by drivers of The Netherlands State Railways to whom this locomotive was loaned 1947-1952.".*
CJM-Collection

Date Withdrawn	Final Depot	Disposal Code	Disposal Detail	Date Cut Up	Notes
Mar-70	9C	C	BREL Crewe	Nov-72	Loaned to Netherlands Railway 09/47-03/52, Numbered: 6701 03/41-06/46, numbered 6000: 06/46-04/52
Nov-80	RS	C	C F Booth, Rotherham	May-83	Stored: (U) 07/68, R/I: 09/68
Jun-78	RS	C	C F Booth, Rotherham	Dec-83	Stored: (U) 07/68, R/I: 09/68, Stored: (U) 07/77
Jul-81	RS	C	C F Booth, Rotherham	May-83	Stored: (U) 08/80
Jun-78	RS	C	C F Booth, Rotherham	Jan-84	Stored: (U) 07/68, R/I: 09/68, Withdrawn: 02/77, R/I: 08/77
Mar-70	RS	C	BREL Crewe	Aug-71	Stored: (U) 07/68, R/I: 09/68
Jul-81	RS	C	C F Booth, Rotherham	May-83	
Jul-81	RS	C	C F Booth, Rotherham	Jun-83	
Jul-81	RS	C	C F Booth, Rotherham	Jun-83	
Jul-81	RS	C	C F Booth, Rotherham	Jul-83	
Jul-81	RS	C	C F Booth, Rotherham	Jun-83	
Jul-81	RS	C	C F Booth, Rotherham	Jun-83	
Jul-81	RS	C	C F Booth, Rotherham	Jul-83	
Jul-81	RS	C	C F Booth, Rotherham	May-83	
Jul-81	RS	C	C F Booth, Rotherham	May-83	
Jul-81	RS	C	C F Booth, Rotherham	Mar-83	
Jul-81	RS	C	C F Booth, Rotherham	Apr-83	
Mar-70	RS	C	BR Reddish, by J Cashmore	Oct-71	
Jul-81	RS	C	C F Booth, Rotherham	Jun-83	
Oct-71	RS	C	BREL Crewe	May-72	Stored: (U) 02/70
Aug-77	RS	P	National Railway Museum, York	-	Stored: (U) 07/77
Jul-81	RS	C	C F Booth, Rotherham	Mar-83	
Jul-81	RS	C	C F Booth, Rotherham	May-83	
Jul-81	RS	C	C F Booth, Rotherham	Apr-83	
Jul-81	RS	C	C F Booth, Rotherham	Jun-83	
Jul-81	RS	C	C F Booth, Rotherham	Mar-83	
Jul-81	RS	C	C F Booth, Rotherham	Jul-83	
Jul-81	RS	C	C F Booth, Rotherham	Mar-83	
Jul-81	RS	C	C F Booth, Rotherham	Jun-83	
Jul-81	RS	C	Coopers Metals, Brightside	Apr-83	
Jul-81	RS	C	C F Booth, Rotherham	Apr-83	
Oct-71	RS	C	BREL Crewe	May-72	
Jul-81	RS	C	Coopers Metals, Brightside	Mar-83	
Jul-81	RS	C	Coopers Metals, Brightside	Mar-83	Stored: (U) 06/80, R/I: 09/80
Jul-81	RS	C	C F Booth, Rotherham	Mar-83	
Mar-70	RS	C	BR Reddish, by J Cashmore	Oct-71	Stored: (U) 06/68, R/I: 09/68
Jul-81	RS	C	V Berry, Leicester	May-83	Stored: (U) 08/80
Jul-81	RS	C	V Berry, Leicester	Apr-83	Withdrawn: 10/71, R/I: 11/71
Feb-77	RS	C	C F Booth, Rotherham	Feb-84	
Feb-77	RS	C	C F Booth, Rotherham	Feb-84	
Jul-81	RS	C	V Berry, Leicester	May-83	Stored: (S) 08/80, R/I: 11/80
Nov-80	RS	C	C F Booth, Rotherham	Mar-83	Stored: (U) 04/80
Mar-70	RS	C	BR Reddish, by J Cashmore	Oct-71	Stored: (U) 05/68
Jun-78	RS	C	C F Booth, Rotherham	Feb-84	Stored: (U) 07/77
Jul-81	RS	C	Coopers Metals, Brightside	Feb-84	Stored: (U) 06/80, R/I: 09/80
Nov-71	RS	C	BREL Crewe	Apr-72	
Nov-80	RS	C	C F Booth, Rotherham	Mar-83	Stored: (U) 08/80
Nov-80	RS	C	C F Booth, Rotherham	May-83	Stored: (U) 09/80
Jul-81	RS	C	C F Booth, Rotherham	Jun-83	1 Cab preserved at Liverpool Road Museum, Manchester
Nov-80	RS	C	C F Booth, Rotherham	Mar-83	Stored: (S) 08/80, Stored: (U) 09/80
Jul-81	RS	C	C F Booth, Rotherham	May-83	Stored: (U) 06/80, R/I: 09/80
Jul-81	RS	C	C F Booth, Rotherham	Mar-83	Stored: (S) 06/80, R/I: 08/80
Jun-78	RS	C	C F Booth, Rotherham	Feb-84	Stored: (U) 07/77
Nov-80	RS	C	C F Booth, Rotherham	Mar-83	Stored: (U) 06/80, R/I: 09/80
Jul-81	RS	C	C F Booth, Rotherham	May-83	Stored: (S) 07/77, R/I: 03/78, Stored: (S) 07/80, R/I: 09/80
Feb-77	RS	C	C F Booth, Rotherham	Feb-84	
Jun-78	RS	C	BR Reddish, by C F Booth	Mar-83	Stored: (U) 03/78
Feb-77	RS	C	C F Booth, Rotherham	Mar-83	

This Page: *As far back as 1948 George Dow, who sat on the BTC naming Committee, put forward that the 12 boiler fitted (passenger) EM1 class Bo-Bo locomotives, should be named and put forward a list of Greek Gods. The suggestion was turned down, but the list remained on file, several further attempts were made and eventually after the route passed to London Midland control it was agreed to name the EM1 passenger locos after Gods and the EM2 fleet after Goddesses. Gorton foundry then produced the plates which were fitted without ceremony at Gorton. A small selection are illustrated.* **CJM-C**

Above: *The Manchester-Sheffield-Wath electric railway progressively opened between 1952-54. The EM1s emerged in black livery with large Lion on Wheel badges on the side. No. 26003 is seen with a Tinsley bound freight at Hazelhead in October 1954.* **CJM-Collection**

Left: *The pioneer of the build, No. 26000* **Tommy** *was always unique in terms of body structure having much smaller cabs with no side windows, revised front end and bodyside layout. In immaculate BR lined black livery the loco is seen at Gorton.* **CJM-Collection**

Below: *There was never any shortage of winter snow on the cross-Pennine route in which to capture the Woodhead electric's. On 26 February 1955, No. 26020 passes Penistone West with an 'up' general freight. This loco, which was later preserved at the NRM, featured in a large number of illustrations of the class.* **K. Field**

Above: *The Woodhead electric's always looked very smart in their black livery, especially when lined out in red. In this stunning summer 1954 illustration at Dinting shed Nos. 26022, 26015 and an unidentified loco stable between duties.* **www.colour-rail.com / W. Oliver**

Below: *In January 1952, soon after commencement of electric services, the second loco of the production design No. 26002 crosses Barnsley Junction, Penistone powering a long coal train, formed of wooden bodied four-wheel wagons. This locomotive was delivered to Wath in late 1951 after a period of dynamic testing in the London area based at Ilford, which saw the loco operate both passenger and freight consists in the Shenfield area.* **CJM-C**

Above: *By the mid 1950s BR green livery replaced the rather drab, especially when dirty, black colour scheme. This improved the look of the design, especially in nice sunny conditions as demonstrated here by No. 26030 passing Torside. With the main road crossing the railway at this location, it became a popular location to see and photograph the class.* **www.colour-rail.com**

Below: *Like all other locomotive classes the EM1s had small yellow panels applied from the early 1960s to answer the perceived risk that track staff and the public crossing the line at crossings would not see an approaching train with a dark front! Two yellow panelled examples Nos. 26029 on the left and 26023 on the right pass near Penistone on 6 July 1964. The loco on the right is in a loop track, allowing a more important freight to pass. The bland front end layout is clearly visible in this view, with just the coupling on the buffer beam and a vacuum pipe on the front end bodywork.* **CJM-Collection**

Above: *The historic No. E26000 lost its cast* **Tommy** *nameplates in February 1968 during a repaint at Gorton Works. Thankfully the plates were saved and one is now part of the National Collection. In green livery with small yellow ends No. E26000 departs from Sheffield Victoria in 1969 bound for Manchester.* **www.colour-rail.com / P. Hughes**

Right Middle: *The 12 passenger dedicated Class EM1s were immediately identifiably by the presence of a steam heat pipe on the buffer beam and of course the presence of a cast nameplate on the side. In green livery with no yellow warning end, No. 26049* **Jason** *approaches Hadfield with a mixed freight in mid 1962.* **CJM-Collection**

Right Below: *Another of the boiler fitted passenger EM1s relegated to freight duties is No. 26054* **Pluto**, *seen passing Penistone with a mineral train on 24 July 1964. This locomotive was delivered in April 1953 and gained its cast nameplates in April 1961. It remained operational at Reddish until late in 1980, apart from a couple of periods in store during the 1970s.* **CJM-Collection**

Above: *Looking in very tatty condition, No. E26017 powers a loaded coal train past the reservoir at Torside on 14 September 1979.* **CJM**

Left: *A view which clearly shows the two different body side window and grille arrangements, with four locos lined up at Wath with No. 26045 nearest the camera.* **www.colour-rail.com**

Below: *Performing the job it was designed to undertake, hauling passenger trains on the Manchester to Sheffield route. No. 26055* **Prometheus** *is seen on 3 June 1966 near Godley working the 14.10 Manchester to Sheffield.* **F. Wilde**

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Above: *A number of the Class EM1s, later classified 76 under the TOPS system were painted in early blue livery, sporting small yellow warning panels and a Lion on Wheel bodyside badge. One such loco was No. E26018 seen passing Deepcar with a coal train in summer 1969.* **www.colour-rail.com / P. Hughes**

Left: *Early blue-liveried No. 26002 stands at Wath in the late 1960s with a green small yellow panel and a rail blue with full yellow end example, showing the wide diversity of liveries found at this time.* **www.rail-online.co.uk**

Below: *The always popular No. 26020, used in many early publicity pictures and now preserved at the NRM, York is seen carrying early blue livery with a small yellow warning panel end at Reddish on 29 May 1969. In the background is a Class 506 Manchester-Glossop EMU, which were also based at Reddish.* **www.rail-online.co.uk**

Above: *The steam era BR Lion holding Wheel British Railways roundel always looked large on the side of the EM1, later Class 76 locos. To many this was the most impressive livery carried by these interesting locomotives. No. E26019 passes the closed Wombwell Central station in May 1970 with a long rake of 4-wheel flats. Wombwell Central station was opened by the South Yorkshire Railway in September 1851 with the shown 'double pavilion' style structure opening in the mid 1880s. The station closed to rail traffic on 29 June 1959.* **www.colour-rail.com**

Below: *A classic image of the Woodhead line in action in the late 1960s with early blue-liveried No. E25050* **Stentor** *hauling a trans-Pennine service formed on five Mk1 coaches, one in maroon, three in blue-grey and one in green livery. The train is seen passing Thurgoland near Barnsley.* **www.colour-rail.com**

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Brake and MU Fact File

Locos retaining vacuum brakes
76001-76005, 76040-76054
Locos fitted with dual brakes
76006-76030
Locos fitted with air brakes
76031-76039
Locos fitted with multiple control equipment
76006-76039

Above: *Standard full yellow warning ends started to be applied to the EM1, Class 76 fleet from the mid 1960s, which just somehow did not suit the body profile of these locos. No. E26015 showing full yellow ends on early blue is seen near Thurgoland in 1969 hauling a most unusual train, formed of eight brake vans and what looks to be some new perhaps non-UK wagons marshalled between.* **www.colour-rail.com / P. Hughes**

Below: *Carrying its pre-TOPS number but fitted with dual brake and multiple working systems, No. E26024 in mid-1960s rail blue with a full yellow end and grey roof, passes Deepcar in 1969 at the head of a MGR coal train. It was for powering this type of train that the air brake system was installed.* **www.colour-rail.com / P. Hughes**

Above: *One of the original passenger-equipped EM1s No. E26057* **Ulysses**, *carrying standard rail blue livery but with its original number with an 'E' prefix and still sporting its cast nameplate as late as 1970, is seen passing Penistone at the head of a special freight transporting large steel girders, who's length span more than one wagon. After the passenger services ceased on the Manchester-Sheffield route, the passenger locos were used for normal freight operations.* **www.colour-rail.com / P. Hughes**

Below: *Carrying its five-digit TOPS number, 76006 and full rail blue corporate livery, this dual brake fitted example, equipped with multiple control equipment passes through Sheffield Victoria in 1978 at the head of a long freight service. This loco was completed at the end of December 1950 and remained in traffic until July 1981, eventually being broken up by C F Booth of Rotherham in May 1983.* **www.colour-rail.com / P. Hughes**

Above: *The Manchester-Sheffield-Wath line, passing over the Pennines was almost guaranteed to have snow every winter, giving difficult operating conditions. However the 1,500V locos performed well with few failures caused by the ingress of snow. At just before 11.00 on the morning of 31 January 1980, multiple fitted Class 76s Nos. 76026 and 76010 pass through Penistone station at the head of a 36 vehicle MGR air braked coal train.* **CJM**

Below: *With a short vacuum fitted coal train behind, No. 76003 approaches Penistone station from the Sheffield direction in a heavy snow storm during the morning of 31 January 1980. This loco was built as No. 26036 and was renumbered as 76036 in January 1974. It was further renumbered to 76003 on 22 October 1976 when like brake fitted locos were numerically grouped together.* **CJM**

Left Top: *As heavier air braked trains were introduced over the Woodhead route, so the use of double headed Class 76s increased, using the locos multiple control facilities. On 9 June 1977, Nos. 76028 and 76027 approach Woodhead with a westbound oil train formed of bogie vehicles.* **Tom Heavyside**

Left Middle: *As modernisation spread across the Pennine route in the years prior to diversion of services and route closure, some container trains were recorded. On 23 June 1977 Nos. 76034 and 76037 pass Torside with a Ford car company containerised parts train.* **www.rail-online.co.uk**

Below: *With the demise of the Class 76s, came several requests to use fleet members on railtour trains. On 16 September 1978, Deadmans Handle Railtours operated the AC/DC tour from Birmingham to Manchester powered by a Class 84 and a Class 25 on different sections. From Manchester Piccadilly over the Pennine route to Sheffield, Tinsley and Woodburn Junction and return to Manchester the train was powered by Class 76s No. 76013 and 76021. In this view the train is seen at Wadsley Bridge station.* **Norman E. Preedy**

Above *One of the most popular locations to see and photograph Class 76s in later days was at Guide Bridge, where sizeable stabling sidings for both diesel and electric traction was located at the east end of the station. Over most weekends up to 20 Class 76s could be found on shed, together with examples of Classes 24, 37, 40 and 47 diesel locos. On 15 October 1977 at least seven Class 76s and two Class 40s share depot space.* **Norman E. Preedy**

Above: *Reddish depot was opened to look after the Woodhead electric locomotives and DC electric multiple unit fleet used on the Manchester to Hadfield/Glossop route. In addition the depot also looked after a number of diesel locos. Upon closure of the Woodhead route the depot was demolished. Another of the former passenger locos No. 76053 is seen parked outside the end of the depot on 31 August 1980, when according to official BR paperwork the loco was stored, being reinstated just a few days later.* **Tom Heavyside**

Below: *In addition to Reddish, a large number of Class 76s could usually be found, especially at weekends at Wath, where frequently a long line of stabled locos could be found between the depot and running lines. This view of the shed taken in June 1977 shows nine Class 76s, two Class 37s and a Class 47 awaiting their next tour of duty.* **CJM**

Above: *Long after it was removed from front line passenger work, former boiler-fitted No. 76046 is seen arriving at Rotherwood Siding on 21 April 1979 powering a return Great Western Society charter from Dinting to Paddington, formed of preserved GWR stock. A Class 31 took over the train from here to take it to Paddington.* **John Whiteley**

Left Middle: *In the months prior to closure the Woodhead route was visited by a number of charters. Also on 21 April 1979, Nos. 76014 and 76030 arrive at Tinsley Yard with LCGB special from Liverpool to Cleethorpes.* **John Whiteley**

Below: *Vacuum brake only No. 76047 approaches Torside on 23 June 1977 powering train 8M29, the 11.05 Mansfield to Garston loaded coal, formed of four-wheel wagons. This was another of the former passenger locos, once named* **Diomedes.** **www.rail-online.co.uk**

Right: *The end of the line for three more Class 76s. On 27 April 1983, Class 37 No. 37265 hauls withdrawn Class 76s Nos. 76054, 76010 and 76039 from Reddish depot to C F Booth of Rotherham. The train is seen nearing Chinley heading towards Sheffield. It will be seen that the loco at the rear of the train is missing of one of its cabs.* **John Whiteley**

Above and Right: *No. 26020 was something of a celebrity loco from building, as it was selected by the BTC to be the example of modern electric traction showed off at the 1951 Festival of Britain exhibition on the South Bank in London. The loco was on display in London from February to November 1951 and then returned to Gorton works and commissioned for service. When a Class 76 was selected for display at the NRM York, the same loco, by then numbered 76020 was selected. It was transferred to BREL Doncaster in August 1977 where the above picture was taken. It was then restored to original lined black and transferred to the NRM York a year later. Since being part of the National Collection, No. 26020 has from time to time been exhibited around the country, one such event was Bold power station open day on 29 May 1980, where the loco is seen right attached to a BR standard brake van*
CJM / Tom Heavyside

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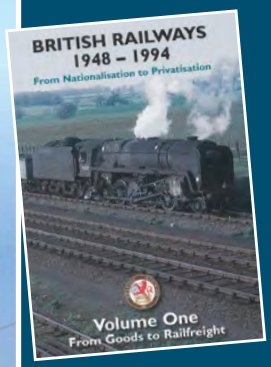

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BR Co-Co – EM2 Class 77

After British engineers gauged the riding qualities of the prototype EM1, when it operated on the Netherlands Railway (NS) in the 1940s, concern was expressed about operating the design at passenger speeds. It was subsequently decided that if a fleet of similar locomotives mounted on a Co-Co wheel arrangement was built, these would be more stable for higher speed running.

Initially, a fleet of 27 Co-Co locos was envisaged classified as EM2, later as BR Class 77, however as the EM1 production progressed, alterations to the bogies considerably improved the ride quality. Train heating boilers were also fitted to the final 12 members, and this eventually led to the reduction of the EM2 design to just seven locomotives.

Power and control equipment was again supplied by Metropolitan Vickers and produced 2,300hp (1,715kW). Construction of the EM2 locomotives was carried out at Gorton Works after the completion of the EM1s, some smaller fittings were interchangeable between the two designs.

The six-wheel bogies used under the EM2 design were a descendant of those on the LMSR prototype diesel-electrics Nos. 10000 and 10001.

One of the most significant changes from the EM1 to the EM2 build was that the buffing and draw gear on EM1s was mounted on the front of the bogie, whereas on the EM2s, this was fitted on to the body superstructure.

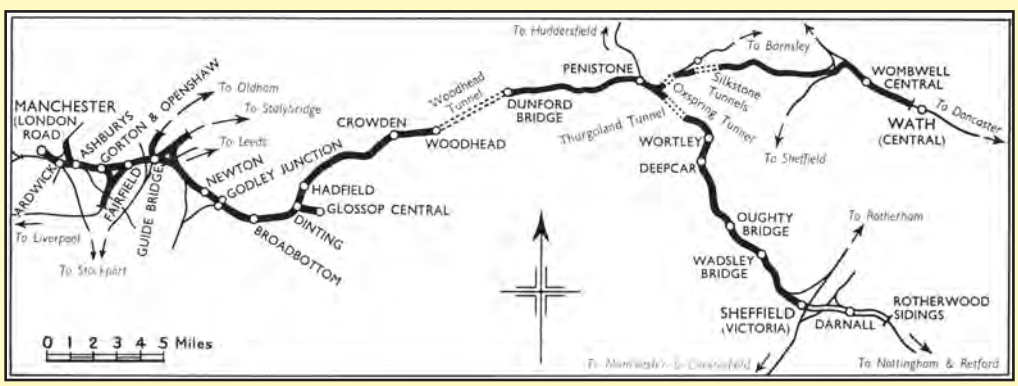
The fleet entered service from 1954 and operated the express passenger services between Manchester and Sheffield, being based at and receiving maintenance at Reddish depot.

In the late 1960s, BR decided that all Cross-Pennine passenger services should be rerouted via the Hope Valley line, which would effectively render the Class 77s as surplus, in 1970 the decision was put into practice.

As the seven locomotives were comparatively modern and in no way life-expired, a decision was made to store the fleet for possible sale. After a short period, the Netherlands Railway (NS), who were interested in some 'new' motive power, purchased the entire fleet and shipped them to Holland where major rebuilding to NS standards took place, including moving the driving position from the left to right side of the cab.

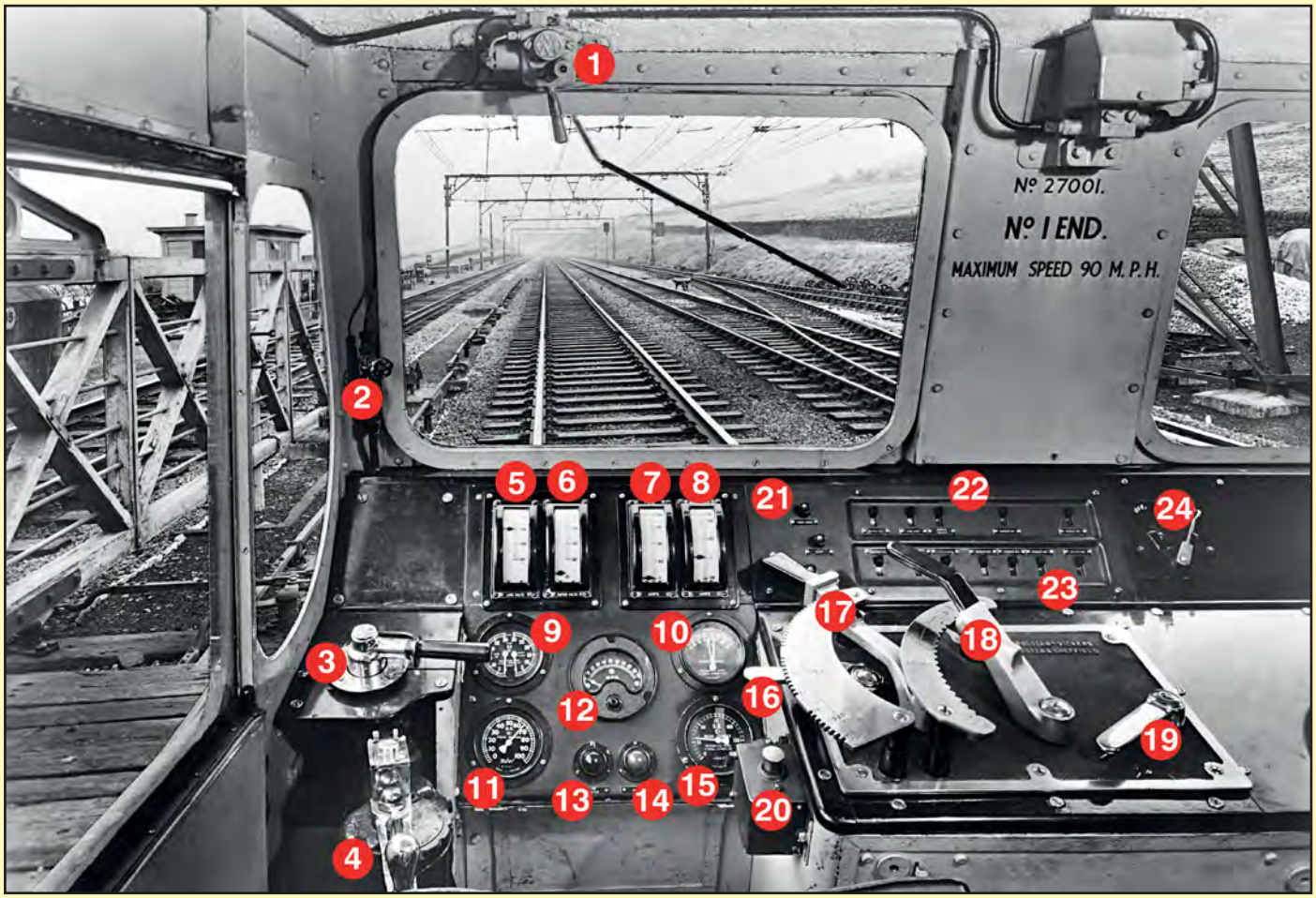
Although seven locomotives made the journey to Holland, only six were required for service, the seventh being broken up for spares. Once operating on the NS, the machines proved to be very reliable and became popular with the operating authorities. The fleet remained in operation with the Netherlands Railway until 1986.

After withdrawal two locos returned to the UK for preservation. No. 27000 by the EM2 Locomotive Society and is kept at the Midland Railway Centre, Butterley, and No. 27001 which is on display at the Manchester Museum of Science and Industry. No. 27003 (NS 1501) is preserved in the Netherlands by Werkgroep 1501. ■



Above: *The EM2 fleet were constructed at Gorton Works between mid 1953 and the end of 1954. Here No. 27001 is seen under advanced assembly, seen sharing works space with steam loco overhauls.*
Kenneth Field / Rail Archive Stephenson

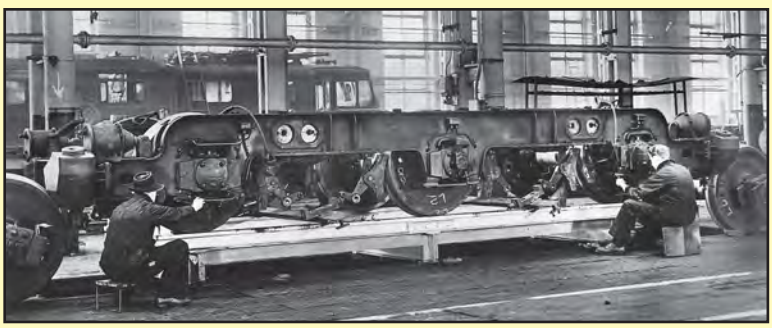
Left: *System map for the Manchester-Sheffield-Wath electrification project, including the spur to Glossop.*
CJM-Collection



Above: *Class EM2 driving cab. 1: Windscreen wiper motor, 2: Windscreen wiper valve, 3: Straight air brake valve, 4: Train brake valve, 5: Line volt indicator, 6: Motor volt indicator, 7: Field amps, 8: Armature amps, 9: Vacuum gauge, 10: Main reservoir and brake pipe pressure gauge, 11: Steam heat gauge, 12: Speedometer, 13: Line switch light, 14: Boiler warning light, 15: Brake cylinder gauge, 16: Master switch (forward/reverse), 17: Power controller (series, series-parallel, parallel), 18: Re-gen brake controller, 19: Weakfield switch, 20: Horn button, 21: Pantograph up, reset and pantograph down buttons, 22: Heat, MG, marker and light switches, 23: Heat, footwarmer, and marker light switches, 24: Control key (turns on cab).* **CJM**

Above: *A stunning British Railways colour poster produced for the opening of the Woodhead route over the Pennines, proclaiming 'Britain's first all-electric main line' and showing a freight powered by an EM1 and a passenger by an EM2 loco.* **CJM-Collection**

Below: *Class EM2 bogie under overhaul at Gorton Works.* **CJM-Collection**



Technical Description

Number range:	27000-27006
Former class type:	EM2
Built by:	BR Gorton
Introduced:	1953-54
Wheel arrangement:	Co-Co
Weight:	102 tons
Height - pan down:	13ft (3.96m)
Width:	8ft 10in (2.69m)
Length:	59ft (17.98m)
Min curve negotiable:	6 chains (120.66m)
Maximum speed:	90mph (145km/h)
Wheelbase:	46ft 2in (12.85m)
Bogie wheelbase:	15ft 10in (4.82m)
Bogie pivot centres:	30ft 6in (9.30m)
Wheel diameter:	3ft 7in (1.09m)
Brake type:	Vacuum
Sanding equipment:	Pneumatic
Heating Type:	Steam - Bastian & Allen
Route availability:	8
Coupling restriction:	Not multiple fitted
Horsepower:	2,300hp (1,715kW)
Tractive effort (maximum):	45,0001b (200kN)
Number of traction motors:	6
Traction motor type:	MV 146
Control system:	Electro-pneumatic
Gear ratio:	17:64
Pantograph type:	MV cross arm
Nominal supply voltage:	1,500V dc overhead

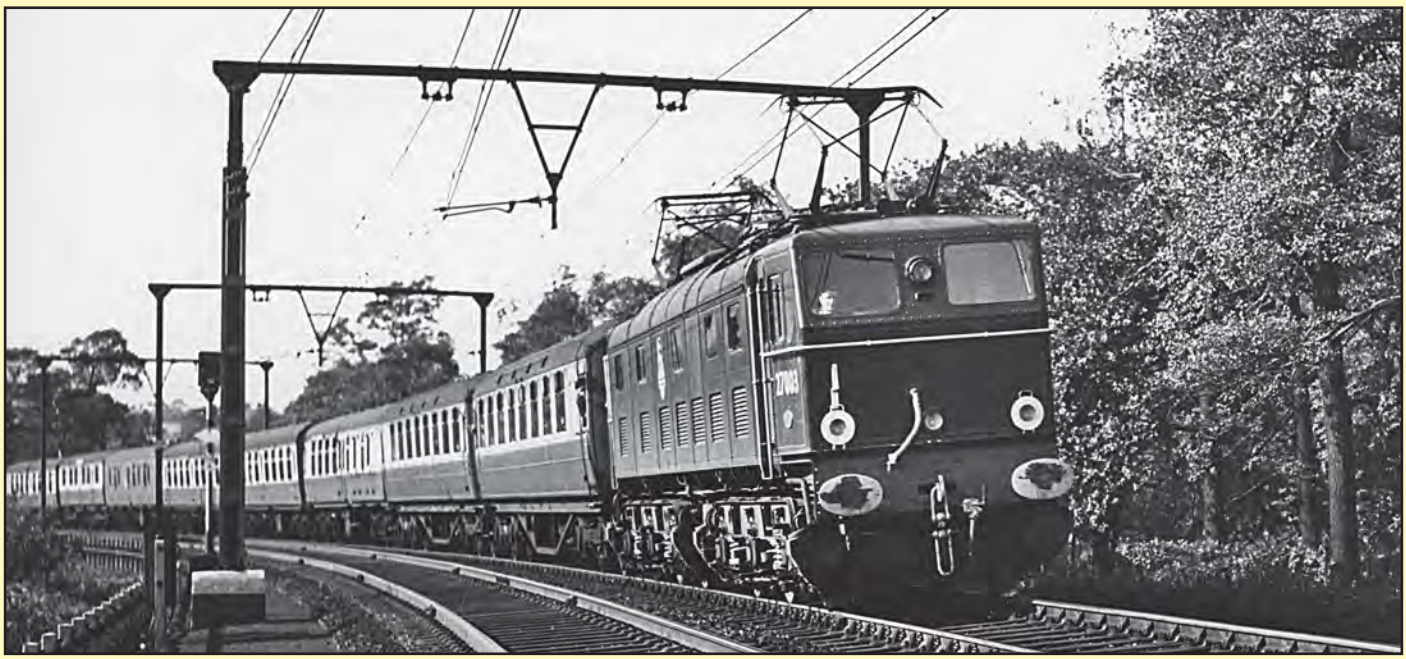
Above: *Images of Class EM2 and EM1 locos operating together are very rare, the two classes could not operate in multiple and thus had to work in tandem, with a crew on each loco, unless the second loco was being hauled 'dead in train'. With both locos having their pantographs raised, obviously both locos were staffed in this image of No. 27001 and 26023 powering a freight train in March 1954 as a running in turn for the then new EM2.* **Kenneth Field / Rail Archive Stephenson**

Below: *In the days prior to the application of goddess nameplates, well polished Class EM2 No. 27002 accelerates away from the speed restriction through Penistone station with the Ian Allan Trains Illustrated 'Pennine Pullman' charter from London Marylebone on 12 May 1956. The train was powered by A4 No. 60014 as far as Sheffield Victoria, from where the EM2 took over as far as Ashburys. Here D11/1 'Director' Nos. 62664 and 62662 took over to Rotherwood via Todmorden, before the same A4 powered the train back to London Kings Cross.* **Kenneth Field / Rail Archive Stephenson**

Number	Name	Date Named	Built By	Works Number	Introduced	Original Depot	Date Withdrawn	Final Depot	Disposal Code
E27000	*Electra*	08/59-09/67	Metro Vickers/BR Gorton	1065	Dec-53	36B	Sep-68	9C	E/P
E27001	*Ariadne*	10/59-09/68	Metro Vickers/BR Gorton	1066	Mar-54	36B	Sep-68	9C	E/P
E27002	*Aurora*	06/59-09/68	Metro Vickers/BR Gorton	1067	May-54	36B	Sep-68	9C	E/C
E27003	*Diana*	06/61-09/68	Metro Vickers/BR Gorton	1068	Aug-54	39A	Sep-68	9C	E/P
E27004	*Juno*	06/59-09/68	Metro Vickers/BR Gorton	1069	Sep-54	39A	Sep-68	9C	E/C
E27005	*Minerva*	05/59-09/68	Metro Vickers/BR Gorton	1070	Dec-54	39A	Sep-68	9C	E/C
E27006	*Pandora*	05/59-09/68	Metro Vickers/BR Gorton	1071	Dec-54	39A	Sep-68	9C	E/C

Above: *The first of the Class EM2 passenger locos No. 27000 emerges from the three mile (4.6km) long Woodhead 3 tunnel, opened in 1954 with a trans-Pennine passenger service in the summer of 1956.* **www.colour-rail.com**

Below: *Looking impressive at speed near Penistone in the spring of 1955, No. 27003, later named* **Diana** *in June 1961 powers one of the crack Manchester-Sheffield passenger services, formed of a mixed rake of blood and custard passenger stock.* **CJM-Collection**

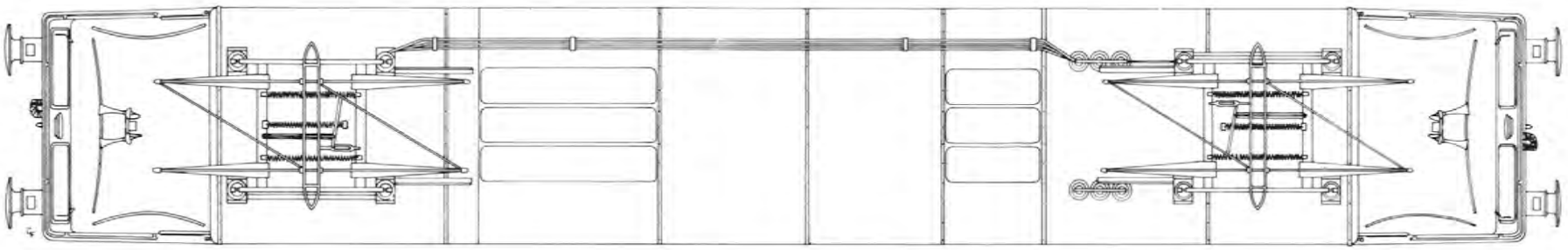


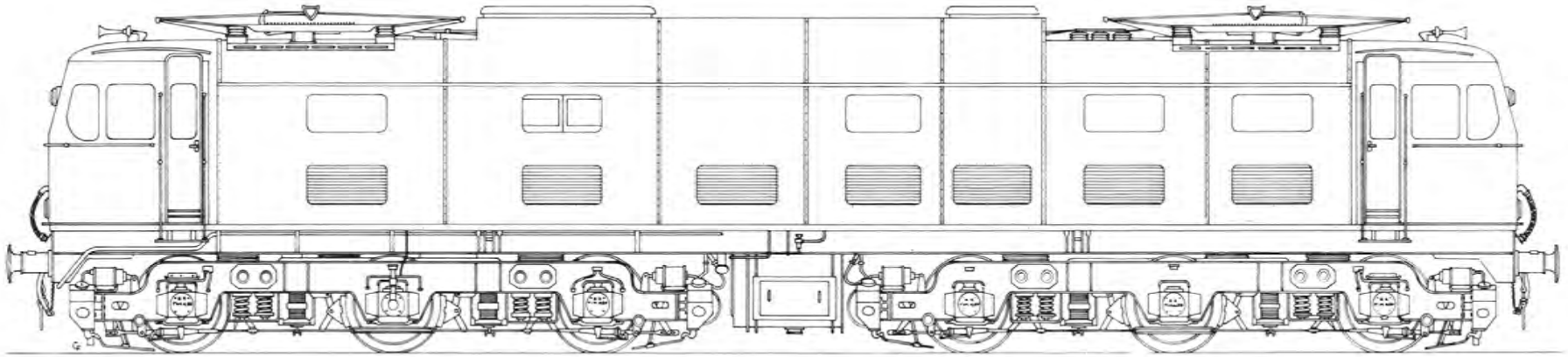
Disposal Detail	Date Cut Up	Notes
EM2 Locomotive Society at Midland Railway Butterley	-	Exported to NS in 09/69 and renumbered 1502
Museum of Science & Industry, Manchester	-	Exported to NS in 09/69 and renumbered 1505
Cut Tilburg Works, Nederlands Spoorwegen	Feb-85	Exported to NS in 09/69 and renumbered 1506
Werkgroep 1501, Rotterdam	-	Exported to NS in 09/69 and renumbered 1501
Cut Tilburg Works, Nederlands Spoorwegen	Oct-86	Exported to NS in 09/69 and renumbered 1503
Cut Tilburg Works, Nederlands Spoorwegen	Jun-71	Exported to NS in 09/69 to provide spare parts
Cut Tilburg Works, Nederlands Spoorwegen	Oct-86	Exported to NS in 09/69 and renumbered 1504

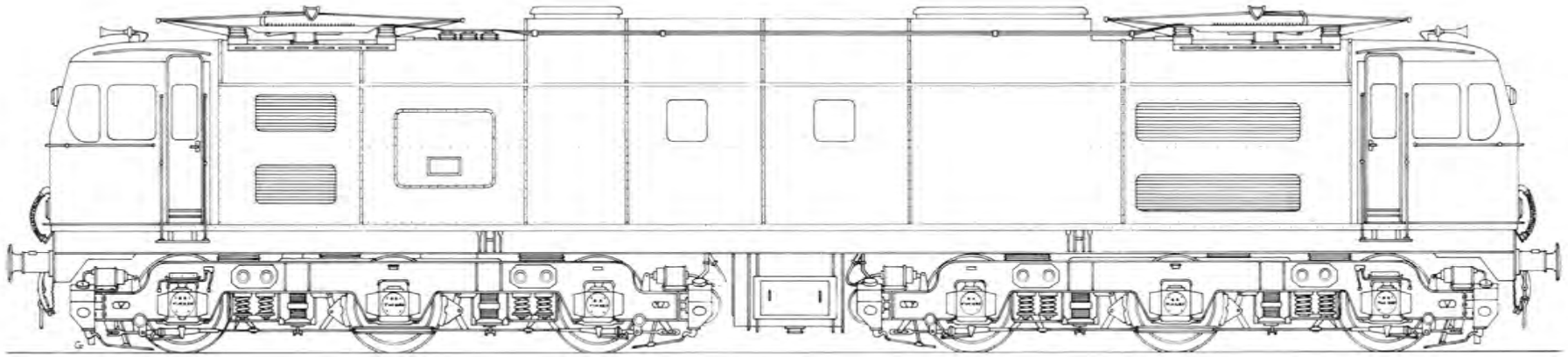
Table Key

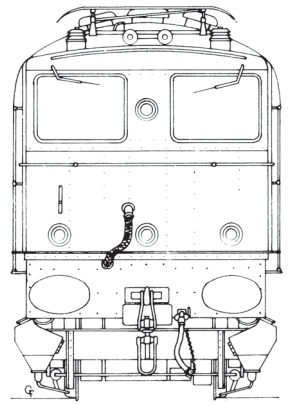
AF - Ashford	P - Preserved
C - Cut up	9C - Reddish
E - Exported	36B - Mexborough
	39A - Gorton

Class EM2 – 77









Left Top : *Class EM2 roof detail.*

Left Middle : *Class EM2 bodyside detail side 'A'.*

Left Bottom : *Class EM2 bodyside detail side 'B'.*

Below: *Class EM2 front end detail.*

All drawings applicable to operation in the UK.

The drawings are reproduced in exact OO gauge 1:76 - 4mm to the foot scale

Right: *Painted in all-over black livery, with a large Lion on Wheel bodyside motif, No. 27003 departs from Manchester London Road on 18 March 1955 with the 14.10 departure to London Marylebone via the Great Central route.* **CJM-Collection**

Left: *As well as powering the London services from Manchester by way of the Pennine route, the EM2s were rostered to operate cross-country trains over the line. On 25 November 1954, No. 27003 is captured near Godley in charge of the 09.43 Cleethorpes to Manchester express.* **CJM-Collection**

Below: *On 29 September 1954, the 14.10 service from Manchester London Road to London Marylebone powered by No. 27002 is seen near Wortley station, on the Penistone to Sheffield section.* **CJM-Collection**

Above: *Following the end of passenger services over the Woodhead route, the entire EM2 class, now classified as 77 were stored in March 1968, firstly at Reddish and then at Bury, from where the fleet were sold to the Dutch Railways in September 1969. In late 1968 No. E27000 and E27005 are seen stored out of use at Bury steam depot.* **www.rail-online.co.uk**

Left Middle: *Painted in late 1950s BR lined green livery, No. 27001 sits light loco at Manchester London Road, waiting to shunt and attach to a cross-Pennine service. By the look of the buffer beam, this loco was operating without steam heat.* **www.rail-online.co.uk**

Left Below: *Showing lined-green livery with a small yellow warning end and sporting the name* **Minerva** *after the goddess of Wisdom, No. 27005 is seen at Guide Bridge with a service bound for Sheffield formed of a mix of LMS and BR Mk1 stock. Guide Bridge was always a popular location to observe and record Class 76 and 77 locos with the passenger service calling at the station and local yards being host to many of the small Class 76 fleet.* **www.colour-rail.com**

Above: *In immaculate lined green livery, with large Lion on Wheel bodyside motif, silver bogies and a red buffer beam No. 27000 is seen at Reddish just following a repaint from its original black livery.* **CJM-Collection**

Right: *Carrying its name* **Pandora**, *No. 27006, the final member of the fleet, is seen at Guide Bridge on 2 June 1961 with a daily Liverpool to Harwich boat rain. At this time this service changed from steam to electric power at Guide Bridge for the run over the Pennines. Forward from Sheffield the train was rostered either another steam locomotive or a type 2 or type 3 diesel.* **CJM-Collection**

Below: *Looking rather tatty in green livery with a yellow warning panel, No. 27002* **Aurora** *arrives at Sheffield Victoria on 25 August 1962 with the 16.10 Manchester London Road to Hull service. A local Sheffield-based diesel would take this service forward, while the EM2 would take over a service back to Manchester.* **CJM-C**

Above: *Although allocated to Reddish depot, any major attention or classified overhaul was undertaken at Gorton Works, the factory which built the locomotives several years before. Spotting records from the period shows that usually at least two of the smaller EM1s and one of the larger EM2s was at Gorton at one time. In this view we see EM2 No. 27001* **Ariadne** *in company with an ex-LMS 'Jinty' acting as works pilot.* **CJM-Collection**

Below: *Painted in early 'electric blue' livery without a yellow warning end, No. 27004 carrying the* **Juno** *nameplate is seen near Penistone in the summer of 1964. This loco like the rest of the fleet was sold to the Dutch Railways NS, where it was rebuilt as 1500 class No. 1503.* **CJM-Collection**

Right Top: *The BTC early 'electric blue' livery, slightly lighter than the subsequent BR rail blue introduced from the 1960s, seemed to suit the body profile of the EM2 design. No. 27002* **Aurora** *is seen awaiting the right away from Guide Bridge bound for Sheffield.* **www.colour-rail.com**

Right Middle: *In the mid-1960s a number of classes of main line diesel and electric locomotives were fitted with experimental rotary windscreen wipers to overcome a number of problems reported by drivers that standard wipers did not clear water from the screens at high speed. Fitted with its rotary wiper on the drivers side No. 27002* **Aurora** *painted in early blue with a small yellow warning panel is seen at Manchester on 16 June 1966.* **www.colour-rail.com / T Owen**

Below: *In this image dated 18 April 1964, No. 27002* **Aurora** *has rotary windscreen wipers on both the drivers and non-driving side front windows. The loco is seen with a Manchester to Sheffield express passing Crowden between Torside and Woodhead.* **www.rail-online.co.uk**

Above: *After the Class 77s were withdrawn from the Woodhead route following the end of passenger services, the seven locomotives, which were in good condition and fit for use for several more years were stored, firstly at Reddish and latterley at Bury, while BR sought a purchaser. The Dutch Railways NS who were looking for powerful main line locomotives visited the UK in mid 1969. No. 27002 was demonstrated to the Dutch in the Sheffield area in July 1969 before the entire class were shipped via Harwich to Holland in September. Six of the fleet were overhauled at Tilburg, with one No. 27005 broken up for spares. Reclassified as the Dutch 1500 class the locos were repainted in yellow-grey livery and heavily rebuilt with right side driving controls and revised front ends. No. 1501, the original No. 27003 has just backed on to the 'Loreley Express' for Switzerland at Hook of Holland on 28 May 1971.* **Brian Stephenson**

Left Middle: *Dutch Railways No. 1504 (BR No. 27006) waits to depart from Hook of Holland station on 28 May 1971 with the Trans European Express (TEE) 'Rheingold Express' bound for Geneva (Gare de Cornavin).* **Brian Stephenson**

Left Below: *Between 1971 and the mid-1980s the Dutch 1500 class could be found working in the Tilburg-Eindhoven-Rotterdam-Hook of Holland area with both passenger and freight services. On 17 January 1983, NS No. 1501 (ex-BR No. 27003) is seen at Eindhoven with an evening service for Rotterdam. The front end modifications were quite major to allow operation in Holland, including a new central headlight, two new marker/tail light clusters and revised air connections.* **CJM**

Above: *Dutch Railways No 1504, the original BR No. 27006 departs from Hook of Holland with on 28 May 1971 with the TEE 'Rheingold Express' bound for Geneva. On the right is French built, NS electric No. 1312 waiting to depart with the 'Holland Scandinavia Express'.*
Brian Stephenson

Right: *Many UK enthusiasts joined those from mainland Europe on 15 March 1986 to travel on the RT&P EM2 Farewell Railtour. The train was powered by No. 1501 from Hook of Holland to Amersfoort via Utrecht. No. 1501 then hauled the train back to Utrecht, before 1502 took charge from Utrecht to Amsterdam and Hoorn, before the same loco returned the charter to Hook of Holland. What was reported to be the first appearance of a 1500 Class loco at Hoorn, No. 1502 awaits departure from the station bound for Hook of Holland via Rotterdam. On the far left is some of the stock from the The Museumstoomtram Hoorn Medemblik, a private enthusiast line which operates in the area.*
John Tuffs

Above: *Reunited with its former UK name* **Electra**, *No. 1502 (ex-BR No. 27000) pauses at Amsterdam CS on 15 March 1986 with the RT&T EM2 Farewell Railtour.* **John Tuffs**

Below: *NS 1500 Class No. 1505 is seen at Den Haag on 28 September 1984 after arrival of the 07.28 service from Venlo. No. 1505 was rebuilt from UK Class 77 No. 27001* **Ariadne** *and entered traffic with NS in April 1971. The loco was re-united with its original name in July 1985 by NS enthusiasts. This loco was, after withdrawal in June 1986, returned to the UK and hauled by rail from Harwich to Manchester for permanent display at the Museum of Science and Industry located in Manchester.* **Paul Winter**

Right Top: *With a rake of NS stock behind, No. 1503 is seen at Rotterdam on 28 September 1984 powering the 08.03 Koln to Den Haag service.* **Paul Winter**

Right Middle: *Tilburg, like many mainland European depots had a turntable, on which No. 1501 can be seen in May 1986, not long before it was finally withdrawn and saved by Dutch preservationists Werkgroep 1501.* **CJM**

Below: *No. NS 1502 was after withdrawal sold to the EM2 Loco Society, returned to the UK and is now kept at the Midland Railway Centre, Butterley. After return to the UK, the loco was displayed at several rail open days and is shown here at Crewe Electric Depot on 18 October 1994.* **CJM**

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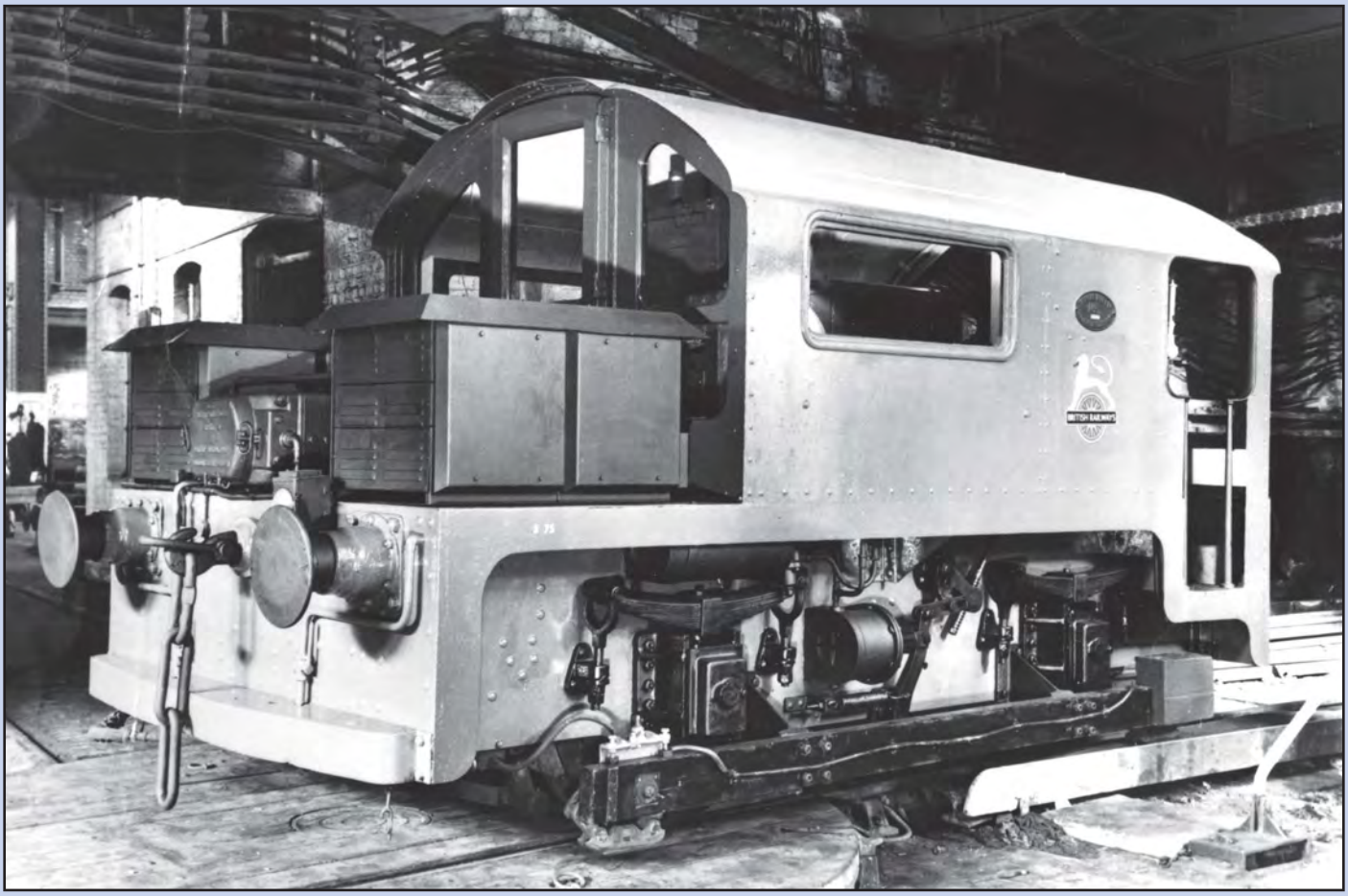
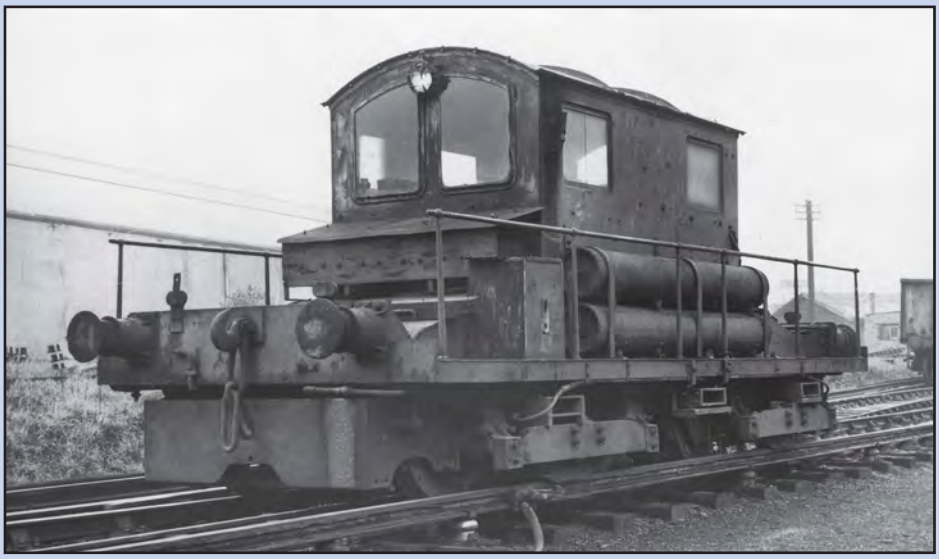
Departmental dc Electric Locos



Above: *Built by Siemens in 1898 for use on the then new Waterloo & City Railway, this tunnel gauge 0-4-0 loco was powered by two Siemens 45 kW traction motors. It was built to shunt coal wagons at the Waterloo & City line power station. It was originally allocated the number 75S by the L&SWR, which remained its identity under the Southern Railway, although some doubts exist as to if it ever carried this identity. Under BR it was numbered DS75. It was withdrawn in May 1968 and is now part of the National Railway Museum collection. Just prior to removal from the Waterloo & City line, No. S75 is seen in the workshops area on the Waterloo & City depot.* **CJM**



Right Middle and Right Below: *Another unique London & South western 'pilot' electric locomotive was No. 74S, built at the workshops at Nine Elms in 1899. It was used as a shunting loco at Durnsford Road power station, Wimbledon. The loco collected power from the third rail supply and could usually be found towards the Earlsfield end of the depot. It was withdrawn in the mid 1960s and broken up for scrap by Cox and Danks of Park Royal in 1968. These two views show both sides of the locomotive at Wimbledon. Both:* **CJM-C**

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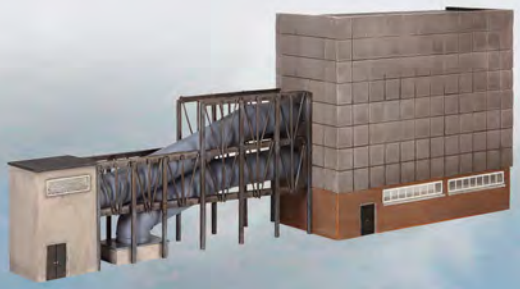

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