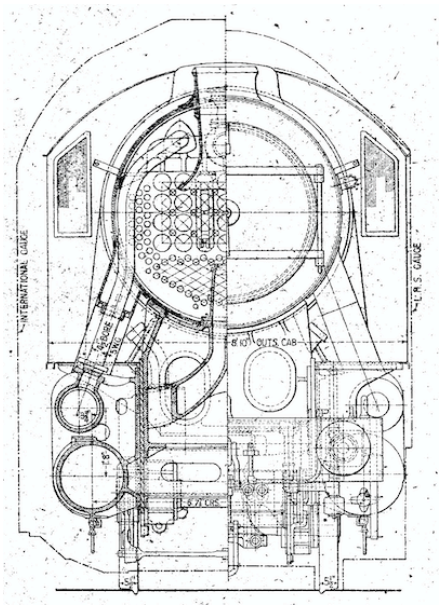
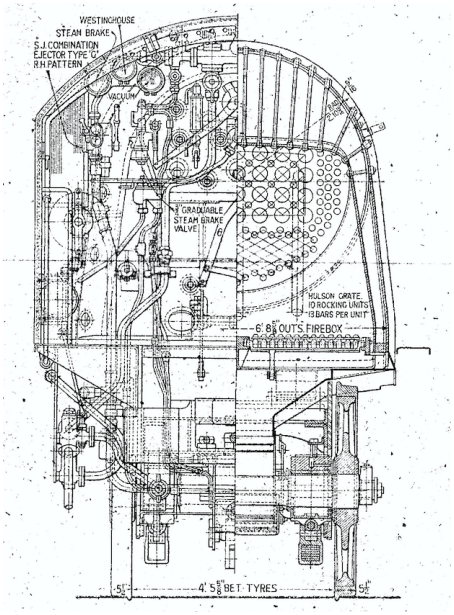
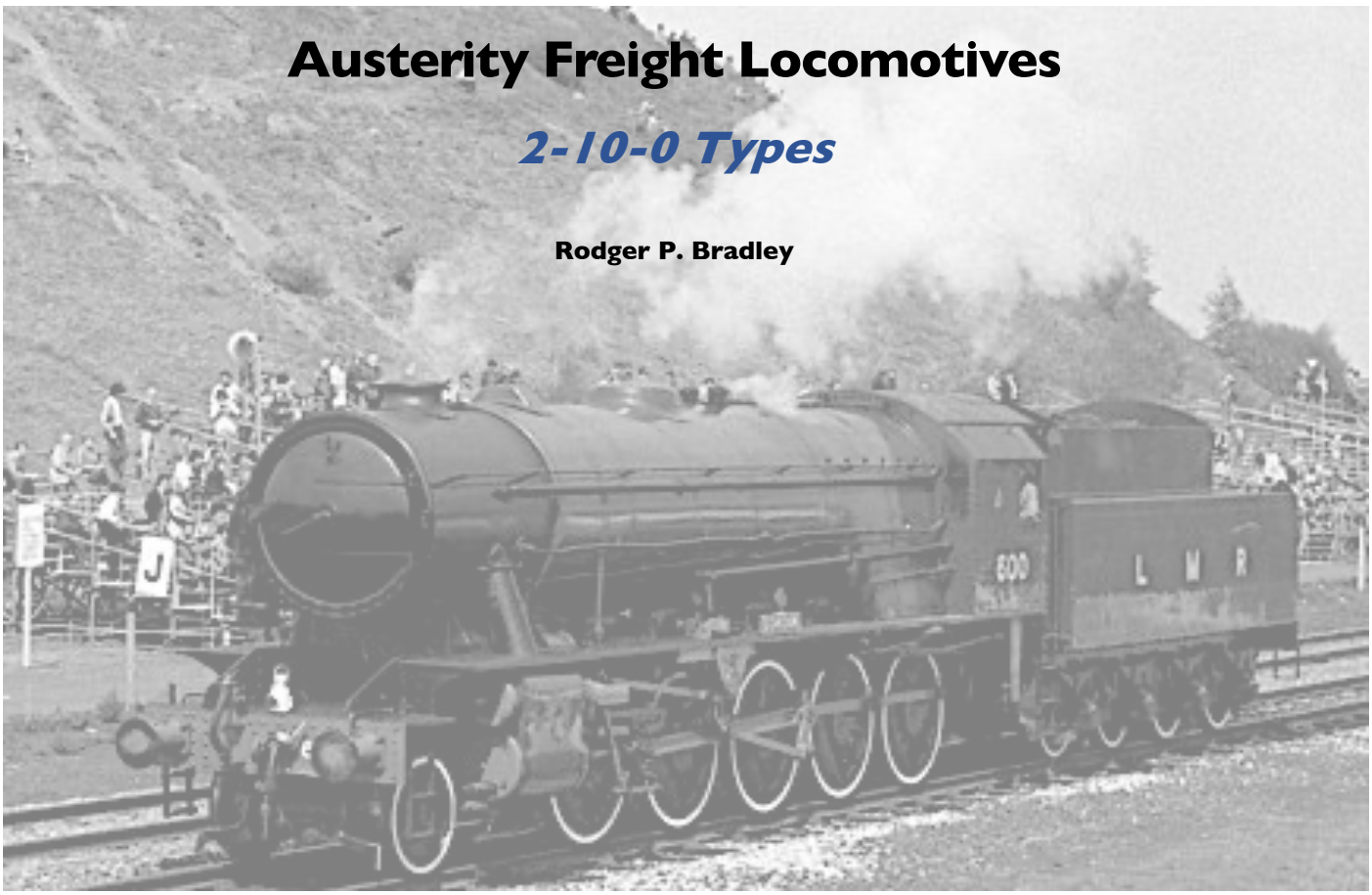




Austerity Freight Locomotives

2-10-0 Types

Rodger P. Bradley

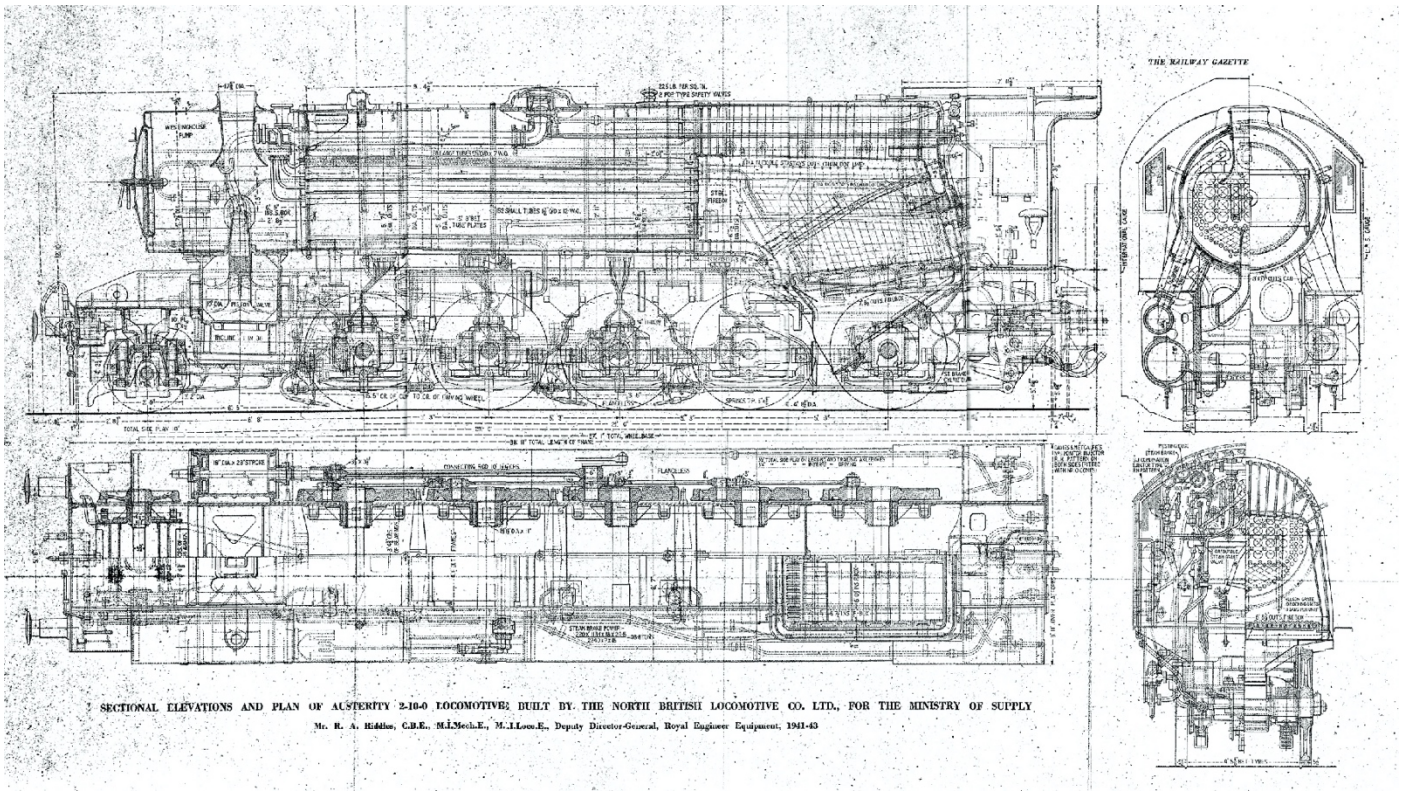


The 'Austerity' or WD 2-10-0, together with its companion design, the 2-8-0 was a product of the Second World War for the Ministry of Supply. Responsibility for the design rested with Robert Riddles, who later adapted many of the principles evolved in the Austerity types to the successful BR Standard series. The order was placed with North British Locomotive Co. in Glasgow, who of course had many years of design and mass production of steam types. So, it may well be that they had significant input into design and construction processes, as had happened many times in the past.

From some viewpoints however, the 2-10-0s in particular seem to have been regarded as second-rate machines. as compared with BR Standard 9Fs say. Their very name was from the outset something of a disadvantage, and on being painted plain black in British Railways days, whatever they lacked by way of prestige or appearance, they made up for in haulage capability. Although it should be borne in mind that they were given the same power classification of '8F' as the 2-8-0 types, and exerted the same tractive effort – 34,215lbs.

Amongst the guiding principles in the design of the 2-10-0 was that it should be capable of "mass production", hence the simplicity of both construction and maintenance. Many components that would in conventional steam locomotives have been supplied in either cast or forged steel, were, in these engines, fabricated. Such items as spring hanger brackets and axlebox hornguides were manufactured in this way.

The WD 2-10-0s were only the third example of ten-coupled locomotives in this country. The first being the Great Eastern's "Decapod", which was converted unsuccessfully in 1906 into an 0-8-0 tender type. The second example was still running at the time the WD 'Austerities' were introduced – this was the LMSR 0-10-0 No. 2290 used for banking on the Lickey Incline. However, the only similarity between either of these examples and the MOS type was the coupled wheel arrangement. Both of the earlier types were designed with a specific purpose in mind, whereas the WD 2-10-0 was intended for use on all types of freight duties over varying qualities of permanent way, and even in the restricted confines of marshalling yards. Its very light axle loading, together with the flangeless centre pair of driving wheels were a considerable advantage when running over lightweight track, or tight curves.



SECTIONAL ELEVATIONS AND PLAN OF AUSTERITY 2-10-0 LOCOMOTIVE, BUILT BY THE NORTH BRITISH LOCOMOTIVE CO. LTD., FOR THE MINISTRY OF SUPPLY
Mr. R. A. Riddles, C.B.E., M.I.Mech.E., M.I.Loco.E., Deputy Director-General, Royal Engineer Equipment, 1941-45

Leading dimensions of these locomotives are given in the table below:-

Class;	**8F; WD**
Wheel arrangement;	2-10-0
Wheel diameter (coupled);	4ft 8 ½ ins
Bogie wheel diameter;	3ft 2ins
Tender wheel diameter;	3ft 2ins
Overall length (engine & tender);	67ft 6 ¼ ins
Overall width;	8ft 10ins
Overall height (from rail);	12ft 11ins

Cylinders;	**No.;**	**2**
	Size;	19ins x 28ins
Boiler barrel diameter;	5ft 7 1/8 ins, increasing to 5ft 9 7/8 ins	
Boiler tubes;	Small;	152 (1 3/8 ins o.d. x 12 s.w.g.)
	Large;	28 (5 1/8 ins o.d. x 7 s.w.g.)
Working pressure;	225 p.s.i.	
Heating surface;	Large tubes;	589 sq ft
	Small tubes;	1170 sq ft
	Firebox;	192 sq ft
	Total evaporative;	1951 sq ft
	Superheater;	423 sq ft
Length between tubeplates;	15ft 8ins	
Firebox (o/s);	7ft 3 1/2ins long x 6ft 8 5/8in wide	
Grate area;	40 sq ft	
Tractive effort;	34,215 lbs (at 85% boiler pressure)	
Brake % engine & tender;	50.19	
Fuel capacities;	Coal;	9 tons
	Water;	5000 gallons

		Tons	Cwt
Weights in working order;	Engine;	78	6
	Tender;	55	10
	Total;	133	16

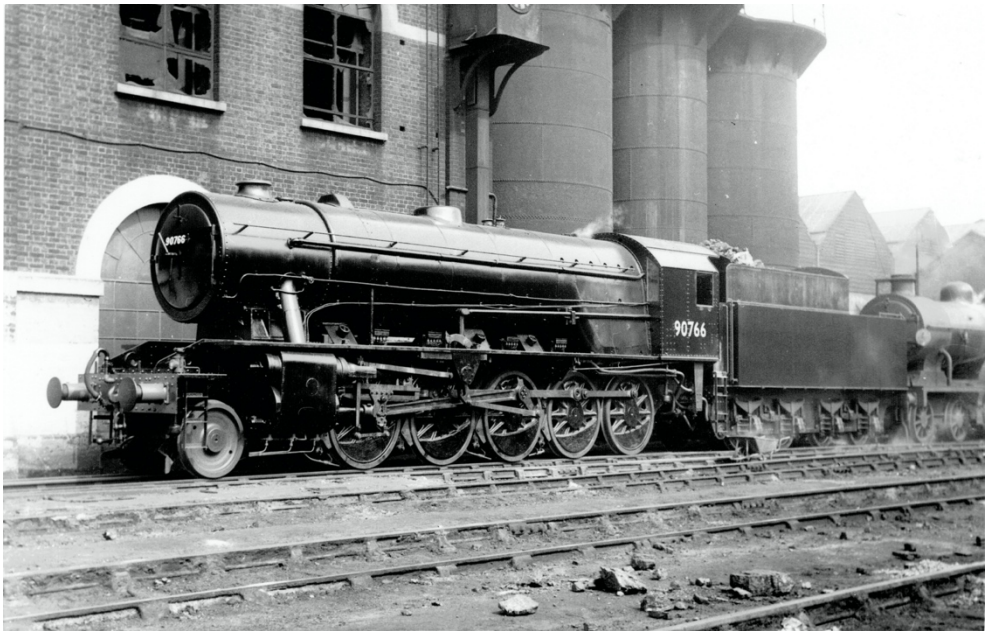
Bogie axle load;	Tons	Cwt
	11	3

Axle Load (coupled);	Tons	Cwt	Tons	Cwt	Tons	Cwt	Tons	Cwt	Tons	Cwt
	13	8	13	8	13	9	13	9	13	9

Tender axle load;	Tons	Cwt	Tons	Cwt	Tons	Cwt	Tons	Cwt
	14	0	13	17	13	16	13	17

Structural Details

The parallel boilers for these locomotives were made in three rings from 11/16 ins thick steel plate, having a tensile strength of 25 – 30 tons/ sq in. In addition, the round topped, combustion chamber type firebox was also built up from steel plates. This was to some degree an economy measure, although experimental work with steel was under way, but by tradition, locomotive fireboxes were made from copper that during the war period was an expensive option. Two further departures from traditional practice wore made in the construction of the firebox; these were the fitting of three, 3ins o.d. arch tubes in the firebox, and the inclusion of a 'Hulson' type rocking grate. The arch tubes, connected under the brick arch to the front of the firebox and over the firehole at the back, was designed to promote better water circulation. The rocking grate, in common with later designs was designed to enable easier disposa1 of the fire over ashpits and assist the fireman in preventing the build-up of clinker. It was 6ft 7 ½ ins long by 6ft 0 ¾ ins wide, with ten rocking units having 13 firebars each, and connected through mechanical linkage to an operating lever in the cab. It was claimed in fact that with this arrangement a fire could be dropped in 5 to 10 minutes – it is unknown whether that claim was ever proved. A self-cleaning hopper type ashpan was also fitted.



An impressively clean looking WD 2-10-0 No. 90766 – sporting its second British Railways running number. This example was built by North British Locomotive Co. in July 1945, to Works No. 25636. *Photo: Historical Railway Images*

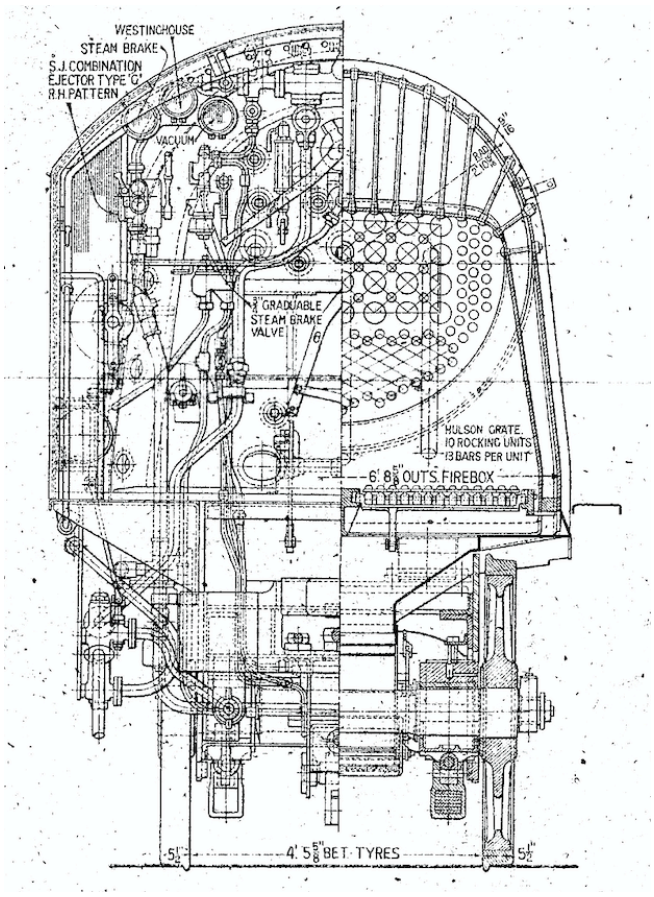
separated the firebox and smokebox tubeplates, and into this volume of slightly over 400 cubic ft. were accommodated the 152 small tubes and 28 superheater flues.

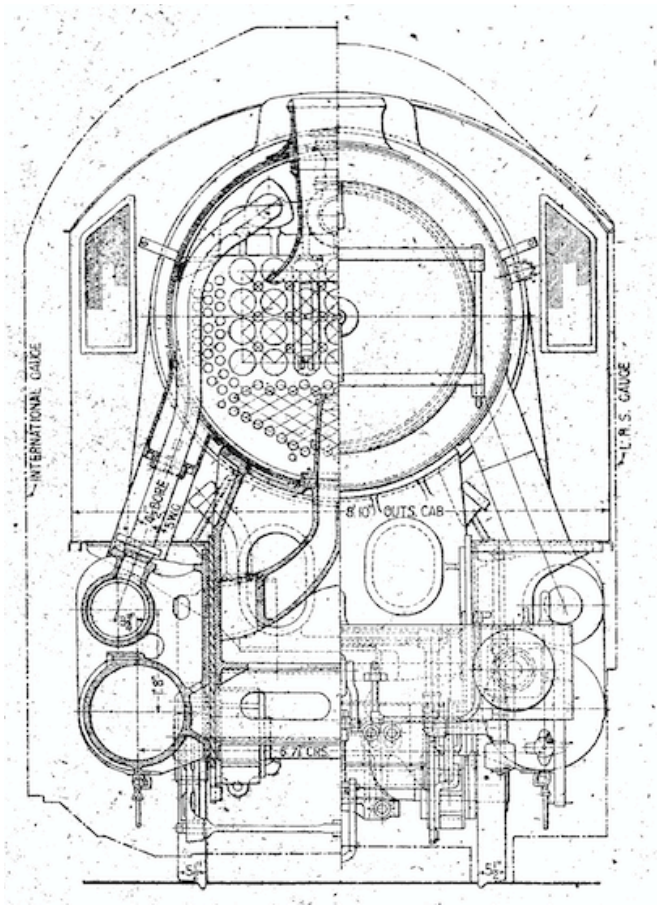
These latter were designed to house elements supplied by the Superheater Co. Ltd. - one of the few "off the peg" features. A substantial total evaporative heating surface of 2,374 sq ft was attained, including 192 sq ft provided by the firebox.

The cylindrical smokebox was formed from 3/8ins steel plate, with an inside diameter of the smokebox was 5ft 7 7/8ins, with a length of 6ft 5ins and attached to a cast iron saddle. The blast pipe, taking the exhaust steam from the cylinders was 5 1/8ins diameter and positioned 2ft 8 1/2ins from the tubeplate. Amongst the few castings used in the locomotive, was the cast iron 17 5/8ins diameter chimney.

The smokebox itself was unlagged, although the boiler proper and firebox was insulated with asbestos mattresses. The firebox/boiler throatplate was however lagged with a material described as "plastic magnesia". *(This is a form of cement created from magnesite, or magnesium carbonate that has been heated, often used to produce refractory bricks – so a logical choice for the throatplate perhaps. This material was also used in flooring, fireproofing, fire extinguishing compositions, cosmetics,*

Flexible stays of 7/8ins dia. incorporating ball and socket joints were provided for the combustion chamber, installed in the first three rows of' the roof, and the "breaking zone" of' the water space stays. The remaining stays – also 7/8ins dia. were rigid, maintaining a water space of 3ins between the inner firebox wrapper and 9/16ins outer. The backplate and firehole was formed from 9/16ins plate, with the tubeplate and throatplate from 3/8ins thick steel. A distance of 15ft 8ins





dusting powder, and toothpaste!!). With insulation and cladding applied the outside boiler diameter was 6ft 0 3/8ins, which was just 4 ins more than that of the smokebox hence the unusual joint at that point.

The steam dome was positioned some 9ft 4 7/8ins from the first cladding band, on the second boiler ring, and housed the regulator valve. Ample steam space was provided in this boiler design, with the water feed clacks mounted on the first ring of the boiler, between the first and second cleading bands. The regulator was actuated in the conventional, manner, through a gland on the firebox backplate; the locomotive was driven from the left-hand side. A 2ins diameter steam pipe from the steam dome supplied a manifold mounted on the firebox back, above the regulator, for the operation of auxiliaries and the steam brake.

At the front end of the locomotive, as built, on the right side of the smokebox a Westinghouse Mk KL2A air pump was fitted, for operation of air-braked trains when on overseas service. The air reservoirs were mounted out of sight between the frames, which seems an odd place to locate them, especially if the concern was about ease of maintenance and operation.

An increasing awareness of' the advantages to be gained from oil burning locomotives was creeping over railway operators and manufacturers at that time, hence the makers' claim in this case for ease of conversion. If a loco was to be converted from coal to oil, for home or overseas, there was a suggested process to follow. Firstly provide a false bottom to the ashpan, then provide a blanking plate to cover the firehole, fitted into the slides normally holding the fire doors, and fix the two oil burner nozzles at the bottom front of the firebox. Alternatively, the burners could have been fitted to the observation hole in the firehole blanking plate, with the modifications to the ashpan as before. Hence, the choice was available of a two or three burner arrangement at minimal cost.

The mainframes were 11/16 ins steel, and some 38ft 11ins long, maintained at 4ft 1 1/2ins apart with fabricated steel stretchers. Also fabricated were the welded on hornguides and spring hanger brackets. The axleboxes themselves were in all cases plain bearing types with "pressed in brasses". The coupled wheel boxes were 8 1/2ins x 11ins, with the leading truck 6 1/4ins x11ins. The wheels themselves were a departure from traditional practice, with, in the case of the coupled wheels, heavy duty cast-iron centres, and only the flangeless driving wheels being provided with cast steel centres. Steel tyres were fitted to all. The pony truck wheels were 3ft 2ins diameter discs and rolled with the tyres in one piece – a monobloc style assembly. Springing of the coupled wheels was through underhung leaf springs of 3ft 6ins length consisting of seven leaves 5ins wide by 5/8ins thick. No compensation was provided, or allowance for adjustment due to wear.

The cylinders, smokebox saddle and blast pipe were all in cast-iron, with exhaust passages cast integral with the saddle. Cast iron was also used for the front-end cylinder covers, though cast steel was employed for the rear covers for extra strength in supporting the crosshead slidebars. Two 4 1/2ins bore steam pipes from the superheater dry header passed outside the smokebox and through the running plates to the 10ins diameter piston valves, which were arranged for inside admission. The decision to use only two outside cylinders was obviously based on economy of cost of both construction and maintenance, having only two sets of valve gear outside the frames. The centre of the cylinders, which were inclined at an angle of 1 in 36 (1 ½°), was 15ft 5ins from the driving wheel centres.

The 14ins throw cranks were connected to a 10ft 1 1/2ins long connecting rod, which was the only fluted item in the motion, and all valve gear bearings were plain, with joints in the coupling rods at the 2nd, driving and 3rd axles. The piston rod was 3 1/4ins in diameter, with the piston head containing three rings was screwed on to the leading end.

In order to accommodate quite sharp curves, sideplay was allowed for on the leading and trailing axleboxes, amounting to 1/2ins, but on the intermediate and driving axleboxes, this was reduced to 1/4ins. The leading truck playing an important role in this, was effectively simple in design, of the three-pin swing link type. With these elements in place, a 4 ½ chain curve (297ft) was the sharpest radius negotiable.

Last but not least amongst the engine components; the brake gear and sanding arrangements. The latter was arranged to provide forward sanding only on the leading coupled wheels, with both forward and backward sanding on the driving

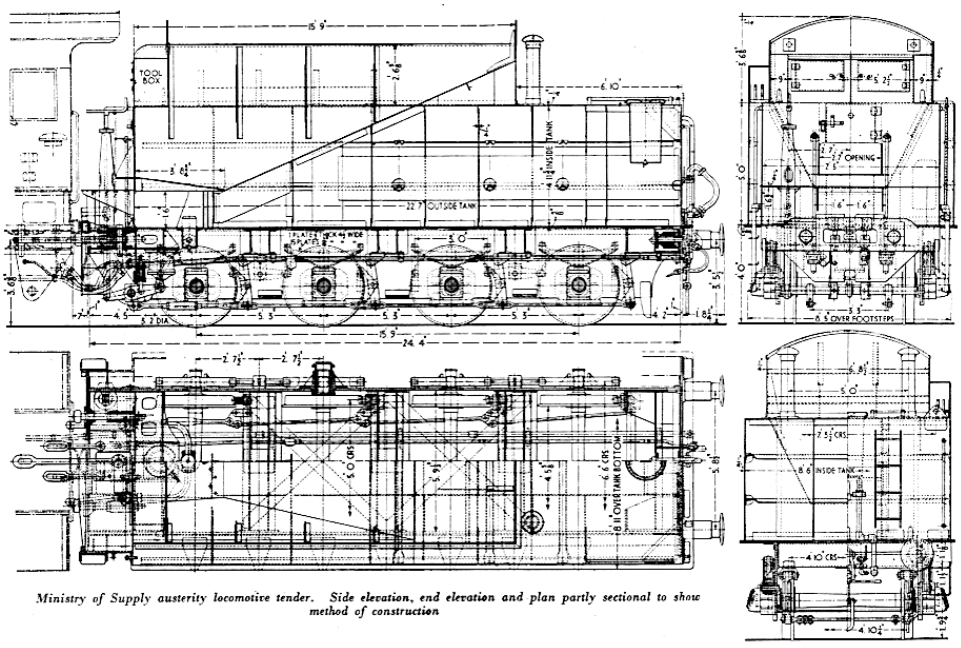
Seen at Motherwell Shed in 1958, a bedraggled and filthy looking WD 2-10-0 No. 90768, in its 10th year of service with BR's Scottish Region. *Photo: RuthAS - Own work, CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=5872826*

wheels. Brake shoes were placed ahead of the first four pairs of coupled wheels only, and connected through a simple mechanical linkage to a 12ins diameter steam brake cylinder located under the drag beam behind the rear coupled wheels.

Construction of the locomotives' upper works involved the use of both rivetting and welding techniques, and in general, platework and superstructure was provided in as economical a manner as possible. Footsteps for example were fabricated from steel strip, whilst the running boards were constructed of 3/16ins thick steel sheet. A further saving in weight, and thus in costs, was made on construction of the cab, where 1/8ins thick steel sheet was used, and cabside windows being unceremoniously provided as square cut-outs. Forward lookouts too, in the spectacle plate, dispensed with any smoothing curvature in the corners. In total, weight savings achieved in this design were succesful in providing a 2-10-0 type of only 78tons 6cwt in working order, with the light axle loadings of either 13tons 9cwt or 13tons 8cwt.

Tenders

With the tender, again simplicity of the design is obvious in its appearance, differing in a number of aspects from what was a standard approach before, not least amongst which was the narrow bunker mounted on top of the 5ft high water tank. The bunker held some 9tons of coal, with a 5000 gallons water capacity tank in a tender having an overall length of 24ft 4ins and a width of 8ft 11ins and mounted on an eight-wheel underframe. The 3ft 2ins diameter wheels were the same rolled steel disc type used for the locomotive's pony truck.



Ministry of Supply austerity locomotive tender. Side elevation, end elevation and plan partly sectional to show method of construction

Interestingly, although the engine's wheels were not provided with compensated springing, the tender was, and had 3ft long overhung springs built up from one plate 1/2ins thick by 4 1/2ins wide, and 15plates 7/16ins thick by 4 1/2ins wide. The wheel spacing of 5ft 3ins between each of the four axles was identical with the locomotive, using plain bearing axleboxes mounted outside the frames. Brakes on the tender were applied to the rear of each wheel and connected mechanically through linkages to the steam cylinder mounted centrally, immediately behind the drawbar. Axle loads for the tender varied from 13tons 16cwt to 14tons, with a fully loaded weight of 55 1/2tons.

The water tank and bunker were constructed almost exclusively of either 1/4ins or 3/8ins steel plate, in a very simple box-like style. Water from the tank was supplied to the boiler via flexible connections and two Davies & Metcalfe No.11 injectors mounted under the loco cab – one on each side. Fall plates fitted between engine and tender covered the gap of 7ins between the two, with strap type steps to the cab attached to the leading end of the tender.

Having inset sides to the coal space, it was suggested that better visibility would be obtained when running tender first, although this also meant that fire tools had to be carried 'outside', in a rack on the tank top. One common feature of British locomotive types at this time was the ability to pick up water from troughs between the running rails, when travelling at speed, via a specially designed scoop. As such instances were rare overseas, where it was thought that these locomotives would see most service, no such facility was originally provided.

Such then were the general mechanical features of this design, which in its very simplicity offered a locomotive of robust quality for the varied nature of the roads, rather than the loads, over which it was intended to work. It was conceived during wartime when non-ferrous metals, castings, etc., were needed more urgently elsewhere - and maybe this locomotive could be said to have been built from odds and ends, but it was still a good, sound design and assembly. Despite the fact that government would not sanction the use of traditional materials in certain quarters, a successful new locomotive type did take to the rails. Although in numbers, far fewer than had been anticipated – only 25 saw service on British Railways, many were transported to Europe as countries and rail networks began rebuilding after the war.

Livery

For those engines used in Britain, this is the easiest livery to describe, being quite simply black. Rather than describe which areas were so treated, it would be far easier to outline the bits that weren't! Bufferbeams ani stocks were red, with cabside numbers in pale straw. All motionwork was bright finished. The lion and wheel emblems (both 1949 and 1956 versions) were positioned in the centre of the tender bodysides. No lining was ever applied to any loco. in this class running on B.R.

Construction & Operation

These locomotives were ordered from North British Loco. Co. on 30th March 1944, to their Order L948, totalling 50 locomotives. This was in fact a follow-on order to L945 placed earlier, for 100 locomotives of the same type, by the Ministry of Supply (MOS). Originally, the 50 locomotives were to be numbered 3750 - 99, but a Ministry directive was issued to the effect that 70,000 was to be added to their running numbers. (Works numbers 25596-25645).

British Railways purchased 25 of these locomotives from the MOS in 1948, numbered 73774-96/8/9 (Works numbers; 25620-42/4/5). They were all allocated to the Scottish Region, for working coal and mineral trains, principally in Southern Scotland on the Lanarkshire coalfields. Though by the late 1950s a number were working through to Aberdeen on coal trains from Thornton to Craiginches Down Yard.

In June 1957 2-10-0 No. 601 "Kitchener" was noted at Polmadie Shed, where it was on loan from the Longmoor Military Railway. It had by that time been converted to oil burning by North British Loco., and by November 1957 had moved south to Carlisle Kingmoor for a few days trial running, before returning south to Longmoor.

Despite the restricted nature of their daily duties, one of the class No. 90764 found its way south of the border in 1950 to the Rugby Test Plant, whilst controlled road tests were carried out in 1953/4 with engine No. 90772, on the Scottish Region, between Carlisle and Hurlford, near Kilmarnock.

Captured in Motherwell Locomotive Yard. With a dominating back-drop of spoil heaps, ex-WD 2-10-0 No. 73798 'North British' stands at Motherwell Depot.

By Ben Brooksbank, CC BY-SA 2.0, https://commons.wikimedia.org/w/index.php?curid=18368067

These tests were carried out in company with WD 2-8-0 locomotive No. 90464, and ultimately became the subject of the BTC Test Bulletin No. 7.

It seems however that before the tests took place the steaming of 90772 was poor, and the blastpipe nozzle was reduced to 4 7/8ins diameter in order to try and improve its performance. The LM Region Mobile Test Units were employed for the 178.6 miles out and home test runs each day and were temporarily based at Carlisle (Durran Hill) depot. Data from the results of these tests showed the 2-10-0 type was a better riding engine than the 2-8-0, with a greater range of working. Superiority in coal consumption was also achieved over the sister type, though this was attributed to the fact that for any given power output, the increased grate area of the 2-10-0 resulted in a lower firing rate per square foot by comparison. Having said that and given the impression that the 2-10-0 had the edge over the 2-8-0, one is left wondering why no more were obtained, though of course by the time the results were published, the BR Standard series 2-10-0 was already taking to the rails.

I suppose it could be argued that the very fact of the 2-10-0's greater size tending towards increased maintenance costs, could be a disadvantage, although this too could be contradicted by the results achieved by the BR Standard 9F. Random examinations of maintenance/in works records for the WD 2-10-0 showed that some were better performing in service, and more reliable machines than others. For instance, 90752 entered Cowlairs Works for a general repair on 1st March 1951, and between then and 20th September 1961, visited the works no less than 26 times – about 2 ½ times a year!! Loco No. 90764 on the other fared much better, paying only 12 visits to works between 5th July 1951 and 6th September 1961. Of course, not all "in works" visits were heavy repairs, various other matters were attended to under the guises of "Not Classified-Engine Only", "heavy Intermediate", "Light Intermediate", etc., etc.

Last but not least I should mention the tender numbers. These were designated type BR5 by British Railways, and the numbers allocated were 734-758, which, as is obvious, amounts to five more than the number of locomotives – i.e., 30 instead of 25. There is no obvious reason to account for this, unless the five were kept as spare in the event of an accident to one or more of those actually paired with locomotives. On the other hand, it may be that it was originally intended to allocate the numbers to cover five tenders that were never bought from the MOS.

All 25 of those taken into BR stock were built between June and September 1945, whilst engines 90753 and 90754 were the first to be withdrawn in July 1961, whilst the last 14 were all withdrawn as a batch in January 1963. The following table lists numbers, dates built and withdrawn, and the first BR allocations from 1950.

As shown in the table below, four locos were allocated to 68A Carlisle Kingmoor, which at that time was included with the Scottish Region, whilst almost half the stock – 12 locos – were allocated to 66B Motherwell.

Running Numbers						
Order No.	**Works No.**	**Original**	**BR**	**Built**	**Original allocation**	**Withdrawn**
L948	25620	73774	90750	Jun-45	66B	May-62
L948	25621	73775	90751	Jun-45	68A	Jan-63
L948	25622	73776	90752	Jun-45	66B	13/61
L948	25623	73777	90753	Jun-45	64D	Jul-61
L948	25624	73778	90754	Jun-45	66B	Jul-61
L948	25625	73779	90755	Jun-45	65F	Jan-63
L948	25626	73780	90756	Jun-45	66B	Jan-63
L948	25627	73781	90757	Jun-45	65F	Jan-63
L948	25628	73782	90758	Jun-45	66B	Jan-63
L948	25629	73783	90759	Jun-45	65F	Jan-63
L948	25630	73784	90760	Jun-45	66B	May-62
L948	25631	73785	90761	Jun-45	66B	Dec-62
L948	25632	73786	90762	Jun-45	66B	Jan-63
L948	25633	73787	90763	Jun-45	68A	Dec-62
L948	25634	73788	90764	Jul-45	Rugby Test Plant	May-62
L948	25635	73789	90765	Jul-45	65F	Dec-62
L948	25636	73790	90766	Jul-45	66B	Jan-63
L948	25637	73791	90767	Jul-45	68A	Jan-63
L948	25638	73792	90768	Jul-45	64D	Sep-62
L948	25639	73793	90769	Aug-45	68A	Jan-63
L948	25640	73794	90770	Aug-45	66B	Jan-63
L948	25641	73795	90771	Aug-45	66B	Jan-63
L948	25642	73796	90772	Aug-45	66B	Jan-63
L948	25644	73798	90773	Aug-45	68A	Jan-63
L948	25645	73799	90774	Sep-45	68A	Dec-62

After Life & Preservation

In order to understand why so few were rescued for preservation, it is important to recall that they were intended for wartime service with the British Army overseas, and most ended up in either France, Belgium, the Netherlands, Greece or the Middle East as the allies landed in France in 1944. Many locomotives were used in the south of the Netherlands during the English occupation, but around October 1945 the locomotives were taken out of service and stored.

In the Netherlands, after the surrender of the German army in May 1945, these war locomotives were used to get rail traffic moving again and were a welcome addition to the country's decimated stock of steam locomotives. They entered service in the Spring of 1946, as Class 5000 WD, with 60 on hire from the UK MOS, with a further 43 added to the class later, taking the total to 103.

Netherlands Railways 2-10-0 No. 5020 of the N.S. series 5000/5100, with a freight train near Susteren , this locomotive was previously WD No. 73691, built by North British in 1944, and carrying Works No. 25477. *Photo:151460 / collectie Het Utrechts Archief - https://hetutrechtsarchief.nl/beeld/6E1C4CEE90CD5F91BD06D57D322CBEA0 , CC0, https://commons.wikimedia.org/w/index.php?curid=86464064*

Of course, there was some modification, including lowering the boiler pressure, and modifications to the chimney design which, apparently, was carried out to try and prevent coal particles from landing on the footplate crews.

At the beginning of 1946 it was decided that the Dutch Railways would hire some sixty locomotives as NS 5001-5060 for pulling freight trains. Later this number was supplemented with 43 locomotives so that the series NS 5001-5103 was created. They were in operation between 1948 and 1952, when they were all withdrawn. One of the class - North British works number 25601, from order L948, and numbered 5085 in Holland, has been preserved and now resides in the railway museum in Utrecht. As a tribute to its wartime past it has been repainted green, renumbered 73755 and named "Longmoor", complete with Royal Engineers badge.

The four locomotives sent to Syria, became CFS Class 150.6, but none of these have survived. But the 16 locomotives sent to Greece have fared a little better. In fact they were stored in Egypt by the British Army, and it was from there that they were transported to Greece, where, just as in The Netherlands, the locomotive fleet was in very short supply.

On service in Greece they were numbered 951-966 as Class Λβ in Hellenic State Railways service, of which 6 survived, and as of today, although there are a couple in 'derelict' state, two - Λβ962 and Λβ964 - have operated mainline tours on the Drama to Xanthi line. They continued in daily use until well into the 1970s, and in 1984, number Λβ951 returned to the UK, and is preserved on North Norfolk Railway, in operation as No. 90775, sporting the name: "The Royal Norfolk Regiment".

A sister engine to 73672, also from Greece, Λβ960 is undergoing major overhaul, also with the intention of returning to steam, on the North Yorkshire Moors Railway.

Last but not least, and perhaps the most well known, is the loco that was out to work on the Longmoor Military Railway – No. 600 – "Gordon", which was originally numbered 73651, and is now at home on the Severn Valley Railway. This loco was actually the second engine built from the very first order in 1943 and brings the total that have been preserved to four, which, considering that this was in some ways the less popular locomotive, is a good result.

Rescued from the scrapheap and on display in the Netherlands Railway Museum in Utrecht, is the 1,000th WD locomotive sent overseas to support the rebuilding of Europe and its infrastructure after the war, and later leased by Netherlands Railways. Shown here is 73755 on display in Utrecht, named "Longmoor", and displaying its "Royal Engineers" badge.

Photo: Maurits90 - Own work, CC0, https://commons.wikimedia.org/w/index.php?curid=34343853

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