= SECR N class =

The SECR N class was a type of 2 @-@ 6 @-@ 0 (" mogul ") steam locomotive designed in 1914 by Richard Maunsell for mixed @-@ traffic duties on the South Eastern and Chatham Railway (SECR) . Built between 1917 and 1934 , it was the first non @-@ Great Western Railway (GWR) type to use and improve upon the basic design principles established by GWR Chief Mechanical Engineer (CME) George Jackson Churchward . The N class was based on the GWR 4300 Class design , improved with Midland Railway concepts .

The N class was mechanically similar to the SECR K class 2 @-@ 6 @-@ 4 passenger tank engine , also by Maunsell . It influenced future 2 @-@ 6 @-@ 0 development in Britain and provided the basis for the 3 @-@ cylinder N1 class of 1922 . Production was delayed by the outbreak of the First World War in 1914 , and the first N class rolled out of Ashford Works in 1917 , three years after design work was completed . The class replaced obsolete 0 @-@ 6 @-@ 0s as part of the SECR 's fleet standardisation , as they used parts interchangeable with those of other classes .

Eighty N class locomotives were built in three batches between the First and Second World Wars . Fifty were assembled from kits of parts made at the Royal Arsenal , Woolwich , giving rise to the nickname of " Woolworths " . They worked over most of the Southern Railway (SR) network , and were used by the Southern Region of British Railways (BR) until the last was withdrawn in 1966 . One N class locomotive is preserved on the Swanage Railway in Dorset , undergoing overhaul .

= = Background = =

Three factors dictated the type of locomotive that could run on the South Eastern and Chatham Railway (SECR) : increased freight and passenger train loadings , poor track quality , and weak , lightly built bridges . An increasing number of passengers used the SECR to reach the cross @-@ Channel ferries at Dover and Folkestone between 1910 and 1913 , and heavy goods trains between Tonbridge and Hither Green marshalling yard stretched the capabilities of existing locomotives and infrastructure . On the lines of the former London , Chatham and Dover Railway (LCDR) , flint beach pebbles on a bed of ash had been used for ballast . Conventional track ballast has irregular shapes that " lock " together to keep the track in place , whereas the smooth pebbles used by the LCDR failed to prevent track movement under strain . The economies in construction meant that only locomotives with low axle loadings could run safely on the track . These restrictions meant that the SECR was unable to follow a coherent locomotive strategy that reduced costs and increased serviceability . The railway 's Operating Department had to use mismatched classes of underpowered and obsolete 4 @-@ 4 @-@ 0 and 0 @-@ 6 @-@ 0 locomotives because they could run within the restrictions imposed by the infrastructure . This meant frequent double @-@ heading that increased operational costs .

Richard Maunsell was appointed CME of the SECR in 1913 , following the retirement of Harry Wainwright due to ill health . Wainwright left a legacy of competent but unspectacular locomotives that struggled to cope with the increased train lengths and loadings . Maunsell took control of the short @-@ term situation by improving existing designs , and he introduced new engines to progressively replace obsolete classes . New designs could also cut costs on the SECR , as one capable mixed @-@ traffic locomotive could undertake the work of two separate passenger or freight types . The first new design was to become Maunsell 's N class 2 @-@ 6 @-@ 0 .

= = Design and construction = =

For detailed information on numbering variations , see : Livery and numbering

The N class was designed by Maunsell in 1914 to provide a sturdy mixed @-@ traffic locomotive with high route availability . Intended to replace several obsolete 0 @-@ 6 @-@ 0 types , the N class was the first step in the SECR 's fleet standardisation programme , which also included the K class 2 @-@ 6 @-@ 4T passenger tank locomotive . Maunsell enlisted the help of former GWR engineer Harold Holcroft , who suggested that a 2 @-@ 6 @-@ 0 wheel arrangement would allow

the class to run on the poor @-@ quality track in north Kent . This arrangement allowed for a longer wheelbase with leading axle to permit greater stability at speed on tight track curves , which had constrained the size of locomotives operating on the SECR . A longer locomotive could also accommodate a larger boiler than an 0 @-@ 6 @-@ 0 , giving the N class sufficient power to avoid double @-@ heading of locomotives on heavier trains .

The N class incorporated the principles of power and reliability established by George Churchward , using a Belpaire firebox that sloped downwards towards the cab instead of a round @-@ topped version , a regulator located in the smokebox , long @-@ travel valves for free running up to 70 mph (110 km / h) , a sharply tapered and domeless boiler , and a right @-@ hand driving position . These features are attributed to Holcroft , who worked on the GWR 4300 class before joining the SECR . The boiler was intended to become a standard component for use on future SECR locomotive designs , thereby reducing building times and improving organisation at the works . The size was constrained by the heavier axle @-@ loading of Maunsell ? s proposed 2 @-@ 6 @-@ 4 tank locomotive variant of the N class , the K class , and was consequently smaller than was otherwise possible on the 2 @-@ 6 @-@ 0 chassis . The need to reduce overall weight also meant that the latter would feature lightly braced frames .

Maunsell 's Chief Locomotive Draughtsman , James Clayton , brought functional Midland Railway influences to the design , such as the shape of the cab and the drumhead @-@ type smokebox , which sat on a saddle that was of wider diameter than the fully lagged and clad boiler . Clayton was also responsible for the tender and chimney designs . Snifting valves were provided to prevent vacuum formation in the cylinders when the locomotive was stationary , and the outside Walschaerts valve gear incorporated single slide @-@ bars and piston tail rods . Innovations added by Maunsell 's team included steam @-@ powered locomotive brakes , locating the boiler water top feed inside a dome @-@ like cover with external clackboxes and water feed pipes mounted on either side , and a new type of superheater that segregated saturated and superheated steam . Maunsell also incorporated a screw reverser to control valve events , which was easier to maintain than the complex steam reverser configuration of previous SECR designs . All components were standardised for interchange with similar locomotive classes to ease maintenance and reduce production costs .

= = = SECR batch = = =

For a detailed examination of the modifications made to No. 822 , see : SR N1 class .

Production of the first batch was delayed by the outbreak of the First World War . Assembly began towards the end of the war and the first locomotive , No. 810 , emerged from Ashford Works for proving trials in July 1917 , one month after the first K class tank , whose design was derived from the N class . Entering service in August 1917 , No. 810 was trialled for three years before another 15 locomotives (Nos. 811 ? 825) were ordered in 1919 . These were built between 1920 and 1923 ; their construction delayed by a backlog of repairs caused by the war . The first left Ashford Works in June 1920 , featuring a greater superheating surface area within the boiler as a result of operational experience with No. 810 . All locomotives were equipped with 3 @,@ 500 @-@ imperial @-@ gallon (15 @,@ 911 l) tenders .

In 1922 modifications were made to No. 822 during assembly . This was because production delays at Ashford prevented the building of a proposed 3 @-@ cylinder design drawn @-@ up in 1919 . Maunsell and Holcroft revised No. 822 's cylinder arrangement to accommodate a third inside cylinder fitted between the frames . The outside cylinders were also reduced to 16 in × 26 in (406 mm × 660 mm) diameter to accommodate the inside cylinder and its associated valve linkages . The differences between No. 822 and the rest of the N class meant that this locomotive was re @-@ designated as the 1919 proposal , becoming the prototype of the SR N1 class when completed in March 1923 .

= = = " Woolwich " batch = = =

The first batch of the N class proved successful in service , and few problems were encountered after settling @-@ in . The Ministry of Supply drew up a contract for a second batch to the same specification ? to be built at the Royal Arsenal , Woolwich . The government backing came as part of a proposal to nationalise the railways , which would require a standard fleet of locomotives to promote economies in production and maintenance . The nationalisation proposal was abandoned ; instead , the government passed the 1921 Railways Act , which grouped the railways into the " Big Four " in 1923 . Building of the second batch went ahead to retain skilled labour at Woolwich , but the fabrication of 119 boilers for allocation to the kits of parts was contracted @-@ out because of limited production capacity at Woolwich and Ashford ; the North British Locomotive Company built 85 , Robert Stephenson and Company 20 , and Kitson & Co . 14 . By 1924 , the prefabricated components stored at Woolwich formed 100 complete N class kits for purchase from the government .

The newly created Southern Railway , which had absorbed the SECR in the 1923 " Grouping " , undertook trials in the spring of 1924 to compare the performance of its freight locomotives . Because the Ns were designed to haul both freight and passenger traffic , Maunsell , as the newly appointed Chief Mechanical Engineer of the Southern Railway , decided to compare the design with the N1 , LSWR S15 and LB & SCR K classes in trials that involved hauling trains of 65 loaded wagons . Although the S15 was superior in freight haulage capacity and operational economy , the N class ? good all @-@ round performance on passenger and freight meant that the type was adopted as the company 's standard mixed @-@ traffic design . The Southern Railway subsequently bought fifty " Woolwich " kits for assembly at Ashford between June 1924 and August 1925 . These were identical to the SECR batch and were given numbers in the series A826 ? A875 . The Midland Great Western Railway of Ireland bought 12 kits prior to absorption by the Great Southern and Western Railway , which bought an extra 15 . The latter 15 locomotives were divided into eight GSR Class 372 with 5 @-@ foot @-@ 6 @-@ inch (1 @.@ 676 m) driving wheels and six GSR Class 393 with 6 @-@ foot @-@ 0 @-@ inch (1 @.@ 829 m) driving wheels : the final kit was kept for spares .

The Metropolitan Railway bought six kits for conversion to the Metropolitan Railway K Class 2 @-@ 6 @-@ 4T tank engines , which were similar in outline to the SECR K class . The remaining 17 complete kits at Woolwich were bought by the Southern Railway , and formed the basis of later locomotive classes such as the three @-@ cylinder SR W class 2 @-@ 6 @-@ 4 tank locomotive . The prototype W class was produced in 1932 from N class parts with the addition of water tanks , a coal bunker , a rear bogie and a third cylinder between the frames . Woolwich also stocked a surplus of N class bogie components , and these were bought by the Southern for rebuilding the LB & SCR E1 class 0 @-@ 6 @-@ 0 tanks into the E1R class 0 @-@ 6 @-@ 2 tanks .

= = = Southern Railway batch = = =

In 1932 , the Southern Railway ordered a final batch of 15 locomotives (Nos. 1400 ? 1414) to expand class availability on the Southern Railway 's network . These were built at Ashford works and differed from the previous 65 in a number of ways . The cabs of the final eight locomotives (Nos. 1407 ? 1414) were fitted for left @-@ hand driving , which was adopted as standard by the Southern Railway . The original N class chimney was replaced with the lower @-@ profile version used on the U1 class , which increased route availability by allowing the locomotives to pass under lower bridges and tunnels . Maunsell had begun to research smoke deflection techniques to improve driver visibility on the King Arthur class between 1926 and 1927 , which resulted in the adoption of a standard smoke deflector design for the Southern Railway . A smaller version was fitted to Nos. 1400 ? 1414 during building .

Before entering service , the batch was attached to 4 @,@ 000 @-@ imperial @-@ gallon (18 @,@ 184 l) tenders to increase operational range over the Southern Railway 's long Western section routes . Despite this advantage , tenders fitted to the eight left @-@ hand drive examples were intended for use with right @-@ hand drive locomotives . This resulted in the location of the fireman 's fittings on the " wrong " side of the cab . The design also necessitated the addition of a

step to the footplate , as the boiler backhead was lower than the fall @-@ plate that connected the tender and cab floors . The new batch incorporated a new set of footsteps beneath the front buffer beam , modified slide @-@ bars and the dome was redesigned to incorporate the regulator to ease access during routine maintenance .

= = = N class construction history = = =

= = Operational details = =

The N class was used to haul services over most of the SECR network and became a familiar sight on the difficult cross @-@ country route between Tonbridge and Reading , on which the steep gradients had taxed the company 's 4 @-@ 4 @-@ 0 and 0 @-@ 6 @-@ 0 designs . The success of the 2 @-@ 6 @-@ 0 in traversing this route was due to their higher @-@ capacity tapered boilers that produced an ample supply of steam , and the small 5 ft 6 in (1 @.@ 68 m) driving wheels that delivered considerable tractive effort when climbing gradients such as the 1 in 100 between Gomshall and Shalford .

After " The Grouping " in 1923 , the N class remained on the former SECR network , which was incorporated into the Southern Railway 's Eastern section . Typical services included Ramsgate , Ashford and Hither Green freights , and Cannon Street to Dover passenger trains . The spring of 1924 saw Nos. A815 and A825 transferred to the former LSWR mainline between Waterloo and Guildford for trials . These proved successful , and paved the way for the allocation of most of the Woolwich batch to the Southern Railway 's Western section . The type regularly replaced Dugald Drummond 's ageing LSWR T9 class 4 @-@ 4 @-@ 0s on portions of the Atlantic Coast Express over the steeply graded mainlines west of Exeter .

The N class was also successful on the Central section , where they worked alongside L. B. Billinton 's LB & SCR K class 2 @-@ 6 @-@ 0s . However the large cylinder and cab sizes of the N class prevented use of the type on the Eastern section 's Tonbridge ? Hastings line . The route 's narrow bridges and tunnels were unable to accommodate the class , and provided justification for using the narrower 3 @-@ cylinder N1 class 2 @-@ 6 @-@ 0 on the route . Despite these restrictions , the class was capable of hauling heavy loads at moderate speeds , a useful attribute that was exploited throughout the Second World War . The entire class came into British Railways ' ownership in 1948 and could be seen in most areas of the Southern Region .

= = = Performance of the class and modifications = = =

When introduced in 1917 , the N class proved adept at hauling both passenger and freight services on the SECR . They were well liked by crews who appreciated the general robustness of the design , although the lightly built frames caused excessive vibration and rough riding on the footplate when worked hard . Despite there being little wrong with the original design , the N class ? full steaming potential was not realised because of the failure to capitalise upon a larger boiler , which was a direct consequence of Maunsell ? s standardisation policy . Instead , the SECR batch was trial @-@ fitted with " stovepipe " chimneys in an attempt to improve draughting . This was initially applied to No. 812 in 1921 , although two more were fitted to Nos. 817 and 819 during building because of a shortage of chimneys at Ashford Works . The chimney fitted to No. 819 was transferred to No. 818 sometime between 1921 and 1924 , though all " stovepipes " had been replaced with the standard N class type by April 1927 . Another trial saw the addition of a second slidebar to No. 825 , which gave better support to the valve gear and helped protect it from spillage from the driving wheel sander fillers .

The quality of the original design was such that No . A866 was put on display at the British Empire Exhibition at Wembley from May to November 1925 , and no class @-@ wide modifications were made until 1934 . This was when the SECR and Woolwich batches began to receive new domes and front footsteps during overhauls and general repairs . These were the same design as those

used on Nos. 1400 ? 1414 , and were intended to standardise components between the batches . The SECR and Woolwich batches also received smoke deflectors to prevent drifting smoke from obscuring the driver 's vision ahead . The U1 chimneys replaced the standard N class type on the earlier locomotives , which , along with the removal of the piston tail rods on the earlier batches , created a truly standardised appearance .

In 1937 , Maunsell 's replacement Oliver Bulleid saw no need to improve draughting of the class , and spared them from trials with Lemaître multiple @-@ jet blastpipes and wide @-@ diameter chimneys . However , he had Maunsell 's smokebox @-@ mounted anti @-@ vacuum snifting valves removed at the end of the Second World War in an effort to reduce maintenance . Bulleid also had eight new 4 @,@ 000 @-@ imperial @-@ gallon (18 @,@ 184 l) tenders built specially for the left @-@ hand drive locomotives . In 1947 , No. 1831 was given electric lighting and converted to oil @-@ burning as part of government @-@ backed fuel trials in anticipation of a post @-@ war coal shortage , though it was reverted to coal @-@ firing in December 1948 .

The class was heavily used by British Railways : 29 locomotives required replacement cylinders between 1955 and 1961 due to excessive wear . Frames were occasionally replaced due to stress caused by heavy use , and the steam circuit was revised when new cylinders were fitted : the inside steam pipes of Maunsell 's original design were replaced by outside steam pipes emerging from the smokebox , behind the smoke deflectors . From 1957 , some of the locomotives had larger @-@ diameter BR Standard Class 4 chimneys fitted to improve draughting with poor @-@ quality coal , though the decline of steam on the Southern Region precluded use on the entire class . Crew reports maintained that the latter modifications cut fuel and water consumption . The final set of modifications constituted the fitting of new injectors and Automatic Warning System (AWS) equipment in 1957 and 1959 respectively .

= = = Experiments = = =

Although sufficient for the Southern Railway 's needs , the N class was an ideal test @-@ bed for experiments with new steam technology . The first experiment entailed fitting a Worthington feed pump to No . A819 in 1924 . The trial was moderately successful , and the pump remained in use until removal in 1927 . In June 1930 , No . A816 was withdrawn from service for the application of experimental Anderson steam conservation equipment at Eastleigh Works . This was designed by a Scottish marine draughtsman , Mr. A.P.H. Anderson , who proposed the use of a fan system to condense spent steam and improve draughting of the fire on long @-@ distance runs in regions with poor access to water .

No . A816 emerged from Eastleigh in August 1931 for trials , but was stopped when temperature variations within the condensing equipment caused water leakage . Modifications were made to improve the draughting of the locomotive , incorporating a box @-@ like chimney attached to the condenser array by pipes . No . A816 was released for more trials , and produced performances well @-@ below those displayed by the unmodified members of the class . The experiment was ended when the system 's developers ran out of money , and the locomotive was converted back to standard form between May and August 1935 , re @-@ entering service as No. 1816 .

The final experiment with performance enhancement began in October 1933 , when No. 1850 had its Walschaerts valve gear replaced with J.T. Marshall valve gear at Eastleigh Works . The engine was trialled on the Western section , where the gear showed promise at slower speeds , with reduced consumption of coal and water . Problems were encountered at speeds over 50 mph (80 km / h) , at which a severe " knocking " sound was reported by the footplate crew . When trialled on a Basingstoke ? Waterloo semi @-@ fast (a high @-@ speed passenger train that stops at selected intermediate stations) , the valve gear disintegrated near Woking . After immediate withdrawal from traffic , the locomotive had its Walschaerts valve gear re @-@ fitted and No. 1850 re @-@ entered traffic in April 1934 .

= = = Withdrawal = = =

Suitable work for the class began to decline after completion of the Kent Coast route electrification in 1959 . The reduction of work precipitated a phased reduction of the class that began with the withdrawal of No. 31409 in November 1962 . The withdrawal programme intensified after boundary changes on the Southern Region placed the lines west of Salisbury under Western Region control in 1963 . Class members based at Exmouth Junction shed were withdrawn in 1964 , whilst the Southern Region 's allocation was gradually replaced by Bulleid 's Light Pacifics . The last operational members of the class were Nos. 31405 and 31408 ; both were withdrawn in June 1966 .

= = Accidents and incidents = =

On 4 April 1958 , locomotive No. 31867 was hauling a parcels train that overran signals and collided with an electric multiple unit at Gloucester Road Junction , Croydon , Surrey . Nine people were injured .

= = Livery and numbering = =

= = = SECR and Southern Railway = = =

N class locomotives were initially painted in an unlined dark grey livery with white lettering and numbering . This Maunsell grey livery was introduced by the SECR as a wartime economy measure . After Grouping in 1923 , the Southern Railway replaced the different liveries of the constituent companies with a standard sage green livery (the colour was that previously used by Robert Urie on the LSWR) with black and white lining , primrose yellow numbering and " Southern " on the tender . This livery was first applied to No. 825 .

From 1925 , the class was repainted in a darker olive green livery , introduced by Maunsell , with plain white lining , black borders and primrose yellow markings . In 1939 , shortly after the start of the Second World War , locomotives Nos. 1413 and 1850 were painted in unlined olive green because of labour shortages . In 1941 , Nos. 1821 , 1825 , 1847 , 1878 and 1403 were run in unlined olive green with Bulleid 's gilt block lettering . Labour and paint shortages during the Second World War meant that all N class locomotives were painted in plain black by 1945 . In 1946 , two locomotives , Nos. 1817 and 1854 , were repainted in Bulleid 's malachite green livery , with yellow and black lining and " Sunshine " yellow lettering .

The 15 locomotives built by Ashford Works for the SECR between August 1917 and December 1923 were numbered 810 ? 824 . The Royal Arsenal batch of 50 locomotives purchased by the newly formed Southern Railway from 1923 were numbered A825 ? A875 ; the numbers followed consecutively from the Ashford batch but with a prefix " A " to denote a locomotive allocated for overhaul at Ashford Works . The prefix was gradually applied to the SECR batch . From 1928 , a new system was adopted where all Southern Railway locomotives were renumbered into one sequence . The SECR and Woolwich N class batches became Nos. 1810 ? 1875 . The final batch of 15 locomotives , built between 1932 and 1934 , were numbered 1400 ? 1414 from new .

= = = British Railways = = =

The class was absorbed by British Railways in 1948 , and initially given the power classification 4MT in 1949 . Under British Railways ownership , the class was reclassified from 4MT to 4P5FB in 1953 ; the " B " denoting the brake power rating when used on unfitted (non @-@ vacuum braked) goods trains . The locomotives at first retained their Southern Railway livery , but with " British Railways " painted on the tender in Bulleid block lettering . Eight locomotives had light repairs prior to 1950 and were given an " S " prefix to the Southern number (e.g. s1405) . From 1949 to 1950 N class locomotives were repainted in the British Railways mixed @-@ traffic lined black livery with red , cream and grey lining and the British Railways crest on the tender . Numbering was changed to

the British Railways standard numbering system : the series 31810 ? 31875 was allocated to the earlier locomotives , and 31400 ? 31414 to the final 15 .

= = Operational assessment and preservation = =

The N class was the first to combine Churchward design principles with the best practices of other railways ; it was an important step in the development of the British 2 @-@ 6 @-@ 0 , providing inspiration for the LMS Hughes Crab of 1926 and subsequent Maunsell designs . The locomotives were well received by crews , who nicknamed them " Woolworths " , because the majority were fabricated from cheaply produced parts from Woolwich . The robustness and reliability of the design ensured that their sphere of operation was expanded to cover most of the Southern Railway network . The utility of the N class as capable mixed @-@ traffic locomotives ensured their continued use until withdrawal in 1966 .

One member of the class is preserved , No . (3) 1874 , which was rescued in March 1974 from the Woodham Brothers scrapyard in Barry , Vale of Glamorgan , South Wales . One of the " Woolwich " batch , this locomotive was bought and restored for use on the Mid @-@ Hants Railway ; it was steamed for the first time in preservation in 1977 , and was operational at the railway 's re @-@ opening as a heritage attraction in April 1977 . The locomotive was withdrawn in 1998 due to problems that require firebox reconstruction . In 2012 the locomotive was repainted into its SR Wartime Black guise of 1874 for the first time in decades . The locomotive was moved from the Mid @-@ Hants Railway to the Swanage Railway in 2014 along with U Classes 31806 and 31625 . In August 2014 the overhaul to return 31874 to operational condition began .

= = Models = =

Bachmann Branchline make a model of the N class in OO gauge . [Graham Farish] make a model of the N class in [N gauge]