

# UNDERGROUND

NUMBER 10

## The 1935 Experimental Tube Stock



# UNDERGROUND

You will remember that one of the co-authors of the article on the 1935 tube stock published in this issue, Brian Hardy, was the author of the authoritative article on the Northern Line extensions, published in the last issue. Society members will have noted that a considerable amount of information on the proposed Northern Line extensions came to light as a direct result of the article. Because of the Society's policy of devoting issues of *Underground* to individual articles, we were not able to publish this new information in this issue, and so Brian, as Editor of *Underground News*, very kindly made space in the February 1982 issue of the *Journal* so that *Underground* readers could bring their copies up-to-date. It has subsequently been agreed that in future, if new information arises as a result of *Underground* articles, as far as possible it will be published in *Underground News*, such that the pages can be reproduced and readily inserted into the relevant copy of *Underground*.

Turning now to the published article in this issue of *Underground*, I am sure that, once again, you will join with me in thanking Brian and Piers Connor for the excellent article on a subject that, again, has been of considerable interest to enthusiasts over the years. Regular readers will remember that Piers has contributed to previous issues, and, like Brian, he is a perfectionist and the quality of the article reflects the time that they have spent on research and drafting. Thanks are also due to all those who helped with information which was incorporated into the final draft.

Future issues have been planned for the rest of 1982. However, I need to be able to plan further ahead than this, and this is where you, the readers, can help. I have mentioned this point before, but need to reiterate here, that I require articles of sufficient length to fill an issue of *Underground*, and I need to know when authors are in the process of drafting such articles. Clearly, I can only consider publishing articles that are complete or very nearly so. Therefore, if you are writing on a subject for a future issue, please let me know as soon as possible. In this way, I hope to maintain the consistently high quality of *Underground* articles.

DAVID HAYWARD

Editor

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Front cover: Head-on view of a streamlined 1935 tube stock car at Ealing Common depot, when new. [L.T.E.]

Back cover: Head-on view of a flat-fronted 1935 tube stock car at Northfields depot, when new. [L.T.E.]

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## THE 1935 EXPERIMENTAL TUBE STOCK

BRIAN HARDY AND PIERS CONNOR

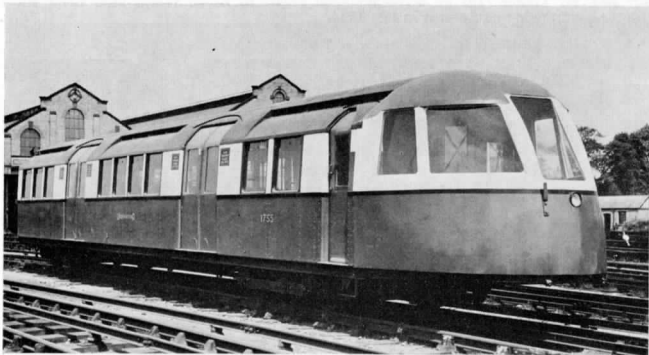
### The High Speed Tube Train

The term "High Speed Train", so familiar to us today in connection with the British Rail main line services, is not new to the London Underground. Following the extension of the Piccadilly Line services into the outer suburbs of London in 1932-33 when trains began running between Uxbridge, Hounslow and Cockfosters, moves were made by the U.E.R.L. (the Underground Electric Railways of London Ltd) towards the introduction of semi-fast services on the longer tube lines similar to those of the present Metropolitan Line north of Baker Street. One area given close attention was in the design of new rolling stock and from late in 1932 designs began to be drawn up for what was called the High Speed Train.

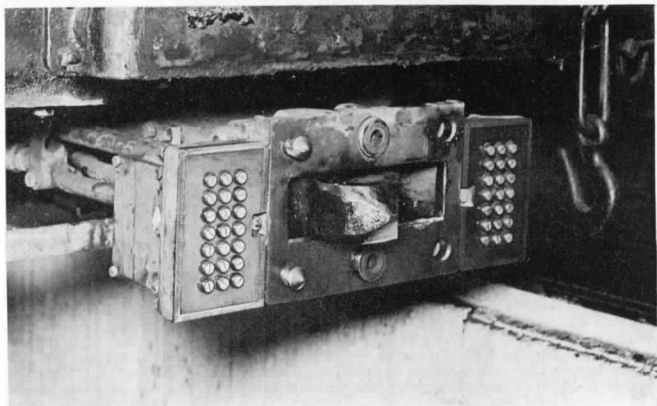
During the early design period a number of radical changes to existing body and equipment design were proposed. The electrical equipment was to be arranged to fit below the car floor, instead of being housed in a compartment behind the cab as on previous tube cars. The car ends were to be streamlined — as was the fashion in vogue then. The cars were to be arranged in semi-permanently coupled units, coupled together with fully automatic couplers to form trains, instead of the individual, manually-coupled standard cars. A further proposal was for a pressure ventilated body built on a welded underframe resting on welded-frame trucks.

To test some of these proposals, a number of trials were carried out on existing cars, one of which involved the fitting of a streamlined cab to a 1923 built Met. C.W.&F.Co. control trailer car No. 1755. This work was completed in January 1933 and the car took part in several trial runs between Hammersmith and Finsbury Park on the Piccadilly Line on the night of Sunday/Monday 30th April/1st May 1933. The test train was formed of Driving Motor car-Control Trailer-Control Trailer-Driving Motor + experimental Control Trailer. The experimental car, 1755 (which became 5245 in September 1933 when renumbered by the L.P.T.B.) was located at its East end and it originated from Ealing Common depot. In July 1933 the experimental cab end was removed and the car reverted to a normal Control Trailer.

Another experiment took place with "Tomlinson" automatic couplers, first tried out on 1928 U.C.C. built Control Trailers 5012 and 5046 on the Piccadilly Line in 1933. The experimental couplers were the forerunners of the Wedgelock automatic coupler, common

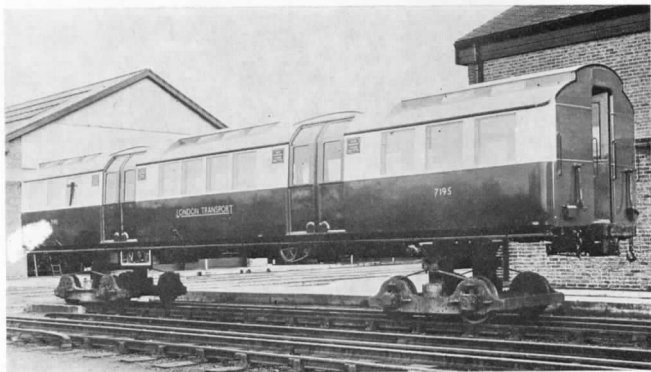


1923 M.C.W. Control Trailer No. 1755 at Ealing Common depot fitted experimentally with a streamlined cab front early in 1933. This car subsequently reverted to standard, was renumbered 5245 in September 1933, and was converted to a Trailer car (75245) in January 1939. After withdrawal from passenger service it was further converted in 1956 to Rail Grinding Car RG803, which still exists at the date of publication. [L.T.E.]



Experimental "Tomlinson" auto coupler fitted to a 1928 U.C.C. Control Trailer. Note that the two air connections are mounted centrally, one at the top and one at the bottom, instead of a row of three at the bottom, as on the standard Wedgelock coupler. Note the lack of covers for the electrical butt connectors. [L.T.E.]

1927 M.C.W. Trailer 7195 on accommodation bogies in Acton Works after being fitted with air conditioning equipment in late 1934. [L.T.E.]

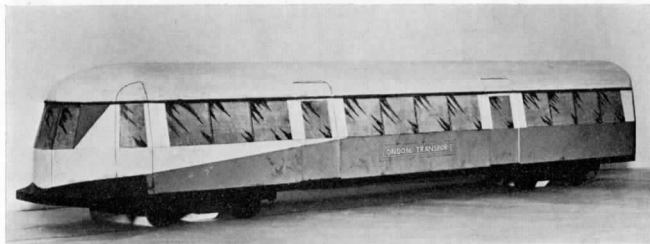


to all L.T. passenger rolling stock today. The two cars fitted with Tomlinson couplers were able to couple mechanically, electrically and pneumatically, and had 32 electrical circuits and two air connections. The electrical contacts were mounted in two groups on either side of the coupler face. The mechanical coupling of the cars was done by impact and the electrical and mechanical connections were made by pushing a button in the cab. Two further Control Trailers on the Bakerloo Line (No. 1944 which became 5140 in June 1935, and 5151 which had already been renumbered from 1955) of 1927 M.C.W. construction, were also fitted with automatic couplers late in 1934. Tomlinson was an American rolling stock engineer, concerned with providing multiple unit operation between tramcars in Boston, Mass., U.S.A. Although it was reasonably satisfactory, his coupler was too light in construction for "railway" work as opposed to "tramway" work, and following a breakaway on Ealing Common bank, it was taken out of passenger service. However, the tests encouraged W. S. Graff-Baker, the Chief Mechanical Engineer, to produce a design for use on Underground cars, and he succeeded in getting Messrs G. D. Peters of Slough to take on the design and manufacture in return for a promise that they would receive, if successful, a very large order for the device.

Another interesting experiment took place in late 1934, when 1927 M.C.W. Trailer car 7195 was fitted with air conditioning equipment. It is open to question whether this experiment can be related to the 1935 stock story, but it is included as the first unit of 1935 stock had air conditioning, of sorts. The main aim of this experiment was really to reduce the amount of noise created in tube cars, with the air conditioning following on from that, as all windows and ventilator openings were sealed up. This included the roof ventilators, and ventilators above the communicating doors and the drop windows in the communicating doors. The main carriage windows were double-glazed. The air conditioning equipment was supplied by Frigidaire Ltd, with most of it being placed underneath the car. Cool air was blown into the car via a cowl running along the centre of the car ceiling. The car entered Acton Works in September 1934 as car 1225 from the Bakerloo Line. It was converted, overhauled and renumbered 7195 in December 1934, and was transferred to the (then) Morden—Edgware Line (now the Northern Line) on 15th December 1934, on which line it ran in service, but only for a short period, covering only 4,896 miles up to mid-April 1935. It did not run again in passenger service in that form, returning to the Bakerloo on 5th November 1935, having been converted back to normal.

Before the final design for the 1935 stock was settled, various models and mock-ups were constructed; one plan was to have single-leaf passenger doors, two down each side of the car with no end single doors at the trailing end. Plans were also drawn up for an enlarged streamlined car which would fit inside a 13ft 6in tunnel. The new tunnel size was proposed for a series of new high-speed, deep level tube lines to be built under London. These plans were still on the drawing board when the Underground railways were taken over in 1933 by the newly-formed London Passenger Transport Board.

Immediately after the formation of the L.P.T.B., plans were drawn up for new extensions to lines and a massive programme of rolling stock renewal and replacement. The plans were known as the 1935-40 New Works Programme. The High Speed Stock, Long Distance Tube Cars or New Suburban Stock as it was variously called by this time, was integrated into the programme as the prototype for the new tube stock planned for the Northern and Bakerloo lines, which was to become known as the 1938 Tube Stock.



Model of a streamlined tube car showing a suggested livery. Also of note is that two single sliding doors only are provided on each side of the passenger saloon. [L.T.E.]

## The High Speed Train Arrives

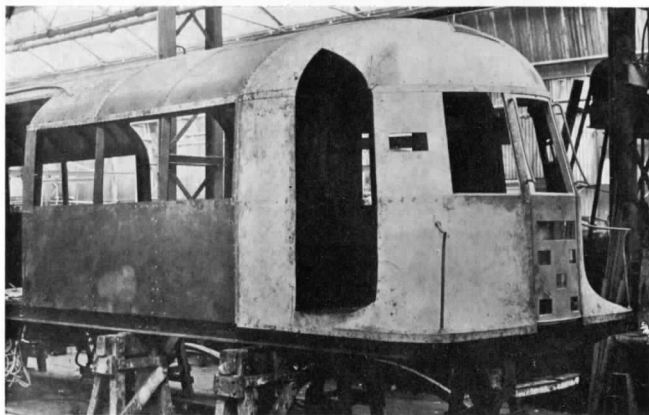
A formal request was submitted to the Board on 30th May 1935 for the expenditure of £50,000 on an experimental six-car high speed tube train. The request was approved and the order for the car bodies was placed with Metropolitan Cammell soon afterwards. The train, consisting of six Motor cars with streamlined (sometimes later called "bull-nosed") cab ends, was made up of three 2-car units which were delivered to the depot at Lillie Bridge in October and November 1936, and then transferred to Ealing Common depot for commissioning.

The electrical equipment was ordered from Allen West and Cromptons (who were commercially connected) after Graff-Baker had persuaded them to re-enter the railway traction field. The other three major traction equipment manufacturers, G.E.C., B.T.-H., and Metropolitan Vickers, promptly shouted "foul" and the orders for the new train were quickly expanded to a total of 24 cars to give four 6-car trains. The last train was partially redesigned to eliminate the streamlined ends and each train was to have equipment by different manufacturers. They were numbered as listed below, with their Lillie Bridge delivery dates (in date order):

10000-11000	2.10.1936	10007-11007	8.5.1937
10001-11001	23.10.1936	10004-11004	21.5.1937
10002-11002	5.11.1936	10008-11008	25.6.1937
10003-11003	5.3.1937	10009-11009	7.8.1937
10006-11006	30.3.1937	10010-11010	2.9.1937
10005-11005	28.4.1937	10011-11011	22.10.1937

Units 10000-11000 to 10008-11008 were those built with the streamlined driving cab ends, while 10009-11009 to 10011-11011 had the flat-fronted cabs, the design of which was subsequently adopted for the main 1938 tube stock fleet. The end bays of all the experimental cars had only three windows per side instead of four, which became standard on 1938 tube stock.

So far as it is known, the first published test run took place on Monday 13th November 1936, on the test tracks between Acton Town and Northfields during the mid-day off-peak period, and such test runs continued on most Mondays to Fridays until 8th January 1937, excluding the Christmas holiday period. On 17th November 1936, a train was made available to the press in Northfields depot for inspection. This was widely reported in the London evening newspapers on 17th November, and the national newspapers the follow-



Streamlined 1935 tube stock car under construction at the Metropolitan-Cammell Works.  
[L.U.R.S. Collection]

ing day. One newspaper optimistically forecast that with these trains, the days of "strap-hanging" would be over, while another described the train as "a streamlined wonder". Nearly all the newspaper reports had photographs of the train and carried extensive descriptions of it. The outstanding features picked up by the press were: air conditioning, quieter and smoother rides, and quick acceleration (2mph per second). The three London evening papers reported that heated grab poles were provided, but no evidence can be found to confirm this.

As originally ordered the first train was given a special classification system, based on the then existing scheme used to identify the direction in which cars faced. Driving cars were classified "A" if they faced west, or "B" if they faced east. Each of the three units of this experimental train therefore had an "A" car and a "B" car. Each unit was also classified "A" (cars 10000-11000), "B" (cars 10001-11001) and "C" (cars 10002-11002). This notation was altered from March 1937 when a new system was introduced where car axles were lettered A, B, C, and D and the end of the car nearest the "A" axle became the "A" end, and the end nearest the "D" axle, the "D" end. Cars with the cab at the "A" end became "A" cars (as with the old system), while the "B" cars became "D" cars. The A, B and C notation used for the first three units delivered was abandoned at this time and was only applied to the other three trains while they were under construction at Metro-Cammell's, using the letters D to M (excluding I).

When the cars arrived at Ealing Common depot each of the contractors supplying the various equipments had staff on site to put the finishing touches and arrange acceptance tests. Apart from the M.V. equipped train which ran as four cars, all acceptance tests were done separately on their own as two-car units. After extensive tests the first of the new trains entered passenger service on 8th April 1937. The official entry into service dates for all the units are listed below, all being on the Piccadilly Line:

10000-11000	8.4.1937	10008-11008	19.7.1937
10002-11002	8.4.1937	10005-11005	3.8.1937
10003-11003	15.4.1937	10001-11001	5.8.1937
10006-11006	1.6.1937	10009-11009	24.1.1938
10007-11007	10.6.1937	10011-11011	24.1.1938
10004-11004	28.6.1937	10010-11010	10.3.1938

When new, the trains were scheduled to work on specified workings only on Mondays to Fridays. Initially, these workings were changed at regular intervals, sometimes week by week, but all started after the morning peak as four-car trains and stabled before the evening peak started. From 26th April 1937, however, the afternoon workings coupled up in service to form six-car trains, working right through the evening peak. This was performed in the eastbound platform at Northfields, with the extra two-car unit starting from Northfields depot.

A second timetable path for an experimental train began from 24th January 1938 on Mondays to Fridays, and was used by four cars of the flat-fronted type. However, this working was short-lived as units 10009-11009 + 10010-11010 were transferred to the Northern Line for gauging purposes, prior to the arrival of the 1938 tube stock, which had by then been ordered. It was transferred to Golders Green on 31st March 1938 and returned to the Piccadilly Line on 4th July 1938. The flat-fronted units were chosen for gauging on the Northern Line as their dimensions were almost identical to the 1938 tube stock.

The known gauging runs took place on the Northern Line as follows:

Wednesday night/Thursday 6th/7th April 1938—

Golders Green—Stockwell via Bank,\* and back.

Friday night/Saturday 8th/9th April 1938—

Golders Green—Morden via Bank,\* and back.

Saturday night/Sunday 9th/10th April 1938—

Golders Green—Kennington loop via Charing Cross, and back.

Thursday night/Friday 14th/15th April 1938—

Golders Green—Edgware, and back.

Saturday night/Sunday 16th/17th April 1938—

Golders Green—Kennington loop via Charing Cross, and back.

Saturday night/Sunday 23rd/24th April 1938—

Golders Green—Mormington Crescent—Highgate, and back.

Note \* Due to noise reduction material then being installed on the southbound line between Golders Green and Camden Town, the test train worked "wrong line" from Golders Green to Euston (City), travelling south on the northbound line.



Car 10000 on the South Ealing test track posing for photographers, when new. Note the lack of opening windows on this unit which was the only one fitted with forced ventilation. [L.T.E.]

A third train became available for service on the Piccadilly Line from 2nd August 1938. When all units had been in service for some months, four paths were made available in the timetable, although it was very rare for them all to be utilised; the one which stabled at Northfields after the morning peak was the one invariably used, because unless the train was working 100%, there was nobody at Cockfosters trained to deal with defects and thus it often had to return empty to Northfields.

### Equipment

There were various types of equipment on the experimental units, originally to have been as follows:

- 10000-11000 Allen West/Crompton Parkinson multi-notch faceplate control, with double glazing and "air-conditioning".
- 10001-11001 As above, without air conditioning.
- 10002-11002 Allen West/Crompton Parkinson straight multi-notch camshaft system.
- 10003-11003 G.E.C. motor-driven camshaft control.
- 10004-11004 G.E.C. motor-driven camshaft control.
- 10005-11005 G.E.C. motor-driven camshaft control.
- 10006-11006 P.C.M. control by B.T.H.
- 10007-11007 P.C.M. control by B.T.H.
- 10008-11008 P.C.M. control by B.T.H.
- 10009-11009 M.V. oil-operated power drum system.
- 10010-11010 M.V. oil-operated power drum system.
- 10011-11011 M.V. oil-operated power drum system.

However, before all the units were completed, there was a shuffling around of some cars and equipment. Units 10003-11003 and 10006-11006 exchanged numbers in March 1936 before delivery, and the equipment finished up as follows:

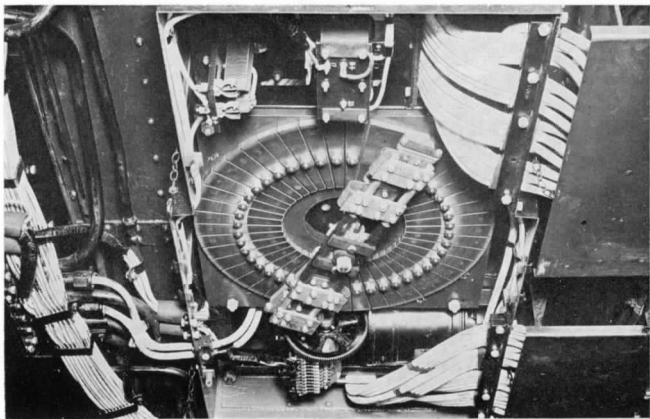
- 10000-11000 Allen West/Crompton Parkinson multi-notch faceplate control, with double glazing. Car 10000 was fitted with air conditioning by J. Stone, and 11000 by R. Crittall.





Interior of car 10000 when new. Note that the car line diagrams are "handed" in that they are appropriate to the direction of travel on each side of the car. This photograph also shows an early design of the ball-type handgrip. [L.T.E.]

Allen West/Crompton Parkinson multi-notch faceplate control unit, as used on 10000-11000, seen from underneath the car floor. [L.T.E.]

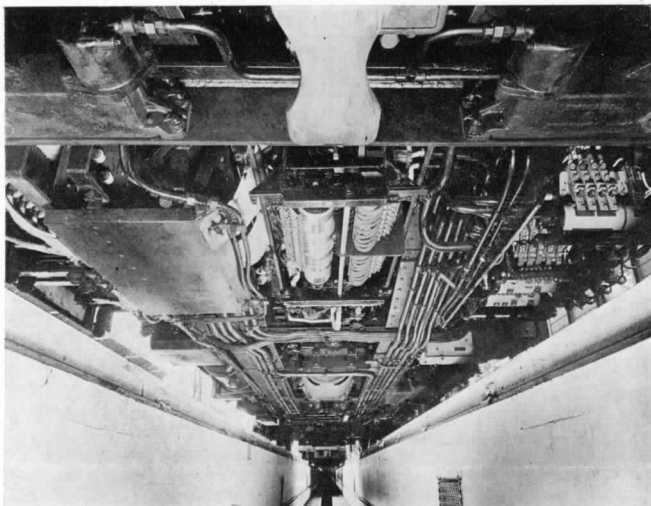




Car 10006 at Northfields depot when new. All 24 cars were delivered having positive shoe beams at the cab ends only. It should be noted that the front cab door extends slightly above cant rail level on this, and some of the other cars. [L.T.E.]

Interior of G.E.C. streamlined Motor Car 10006, looking towards the trailing end of the car. [L.T.E.]



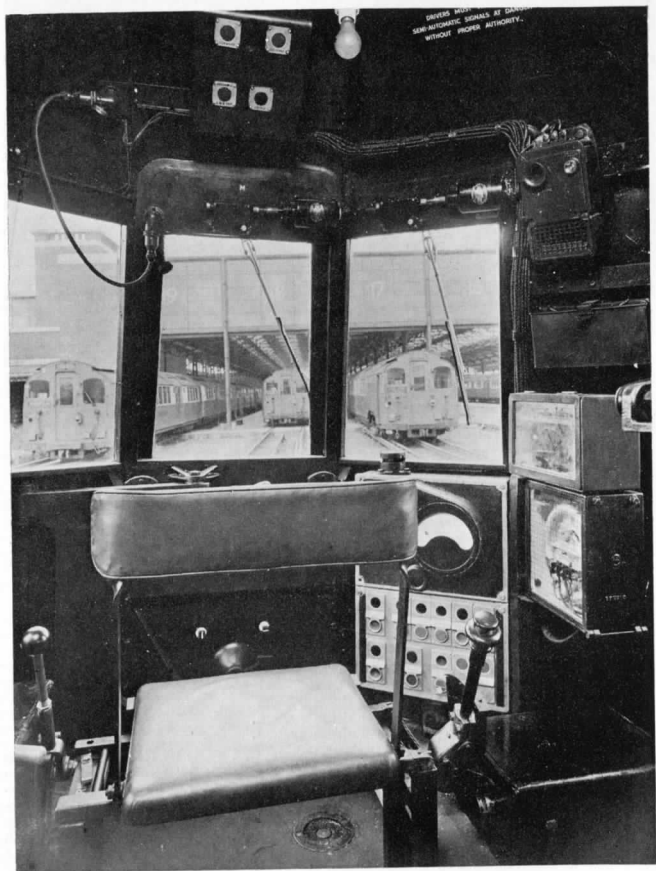


Underfloor view of the camshaft equipment on a G.E.C.-equipped car.

[L.T.E.]

- |             |  |
|-------------|--|
| 10001-11001 | Allen West/Crompton Parkinson straight faceplate control. No air conditioning. |
| 10002-11002 | G.E.C. multi-notch camshaft system.  |
| 10003-11003 | P.C.M. control by B.T.H.   |
| 10004-11004 | G.E.C. staggered multi-notch camshaft control system.                          |
| 10005-11005 | Allen West/Crompton Parkinson straight camshaft system.                        |
| 10006-11006 | G.E.C. staggered multi-notch camshaft control system.                          |
| 10007-11007 | P.C.M. control by B.T.H.   |
| 10008-11008 | P.C.M. control by B.T.H.   |
| 10009-11009 | M.V. oil-operated power drum system.   |
| 10010-11010 | M.V. oil-operated power drum system.   |
| 10011-11011 | M.V. oil-operated power drum system.   |

The traction motors for the experimental trains were all made by Crompton Parkinson and were of type C200. Here again, the approach was made by Graff-Baker's team to motor manufacturers for a traction motor to go under a tube car. The existing manufacturers, G.E.C. and M.V., would not deviate from their standard designs without considerable encouragement and Graff-Baker found a more helpful attitude at Cromptons, who wanted to regain their traction know-how. The C200 motor therefore was designed with a long armature and compact case so that the floor of the tube car had to be raised only a few inches to accommodate it. Subsequently, of course, the traditional makers squealed when they thought that Cromptons were going to get an extremely large exclusive order for traction motors; although it would probably have been impossible for Cromptons to achieve the delivery requirements. Thus the idea was that the design would be owned by London Transport, Cromptons being paid for this design work, but the LT100 motor on 1938 tube stock would then be made to L.T. specification by any motor manufacturer. G.E.C. therefore constructed a large number of the LT100 motor which was a development of the C200.



View of the cab layout of a G.E.C.-equipped 1935 stock car. All streamlined cars had central driver's seats with joystick controls. Motoring was controlled by the joystick in the driver's right hand, and the e.p. brake by the left hand one. The Westinghouse brake was operated by a separate handle to the left of the driver. Note the giant cast hinge on the left of the front cab door. [L.T.E.]

The traditional equipment manufacturers produced only one design for all cars of their train and these were developments of equipment which already existed to a large extent in the case of B.T.H. and to a minor extent in the case of M.V. and G.E.C. Out of the whole deal for new traction equipment eventually settled for new tube and surface stock during the 1936-40 period, B.T.H. received the contract for the tube traction equipment, G.E.C. and Cromptons the contract for tube motors, and M.V. the contract for the traction equipment for the surface stock — their famous Metadyne system — and shared the motors contract with G.E.C. In the end therefore, everyone was happy!

The following is a semi-technical description of the different equipments on the experimental units:

**CROMPTON PARKINSON** had three schemes:

1. Unit 10000-11000 had a series-parallel arrangement using two faceplate controllers, one for each motor circuit cutting out the starting resistances, both faceplates being driven by a 50-volt pilot motor. Each faceplate had 25 segments bridged by the arm which moved in a circle round the segments. The arm made one revolution each for series, parallel and weak-field providing 57 notches for the complete sequence. In addition to the faceplate there was an electro-pneumatically operated camshaft contactor unit which made the necessary power circuit changes from series to parallel. There were interlocks in the camshaft and the contactor group to ensure that the right sequence of switching was maintained. A double-pole line breaker to isolate the equipment in the "off" position was also provided.

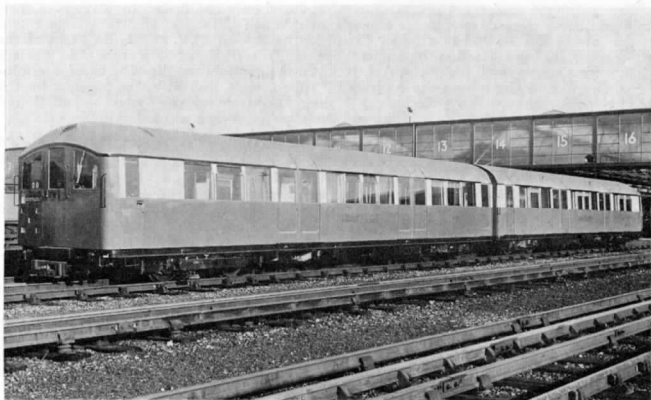
2. Unit 10001-11001: In this equipment, the two motors were in permanent parallel. A faceplate was also used to cut out resistance but because there was no switching from series to parallel, only one faceplate was required, and the interlocking was simplified. The theory at this time was that with increased acceleration the saving in current by series-parallel connection would be offset by the simplification in the switching. (A similar arrangement was suggested for the Tyne & Wear Metro, and has been incorporated on their stock.)

3. Unit 10005-11005: A motor-driven camshaft took the place of the two faceplates for cutting out resistance on a series-parallel combination of the traction motors.

The **GENERAL ELECTRIC COMPANY** (10002/4/6-11002/4/6) also employed a camshaft driven by a series motor energised at 50-volts for series-parallel and weak field connections. The camshaft made three revolutions from "off" to full "weak field", a total of 56 notches. Electro-pneumatic contactors were used to provide line switching and transition. One of the G.E.C. units was arranged to have the motors in permanent parallel with a simplification in switching and a re-arrangement of the resistance steps. One feature of the G.E.C. camshaft was that it was based on time with only an overriding current control if it rose to an excessive value, so that the notching was at virtually a constant rate irrespective of the train loading.

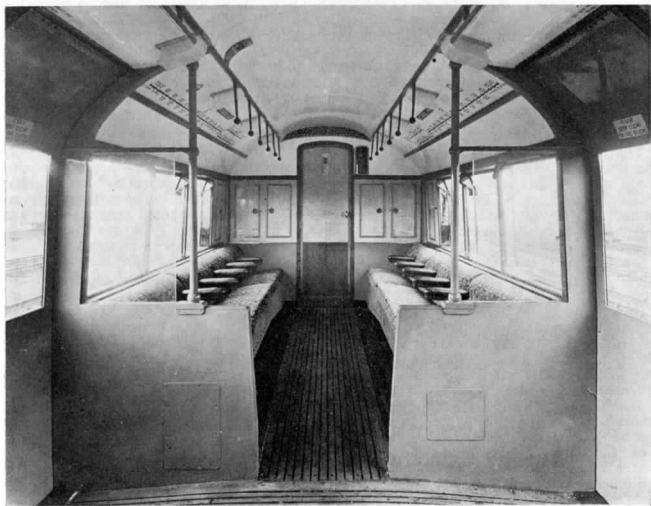
The **BRITISH THOMSON-HOUSTON** scheme (10003/7/8-11003/7/8) was the only one which was based on equipment which had operating experience, since 200 equipments were already working in New York; not with identical equipment but with similar equipment working to the same principles. The main difference between these experimental P.C.M. units was that each piece of switch gear was mounted separately on the underframe, sometimes with its own cover, whereas the subsequent 1938 tube stock equipment was all mounted in an equipment box and designed with this in mind so that sizes and fixing arrangements were different. The method of operation was the same and need not be further described, apart to say that when the power was switched off, the equipment did not have to "run back", unlike all the other schemes.

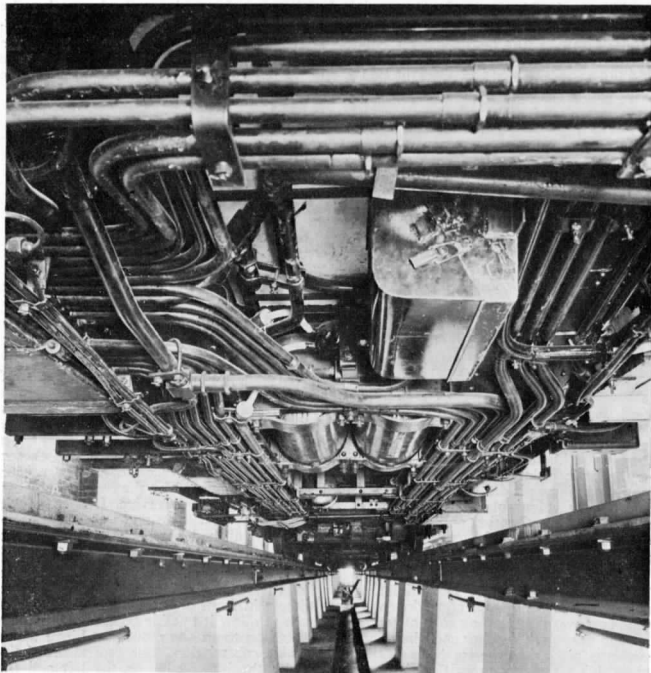
It is interesting to note that an early version of the P.C.M. scheme may have been tried on the Underground during the mid-1920s. A description of a "Pneumatic Camshaft Control" system, using 600-volt control circuits (instead of 50-volts of the P.C.M. system) and a purely air-operated camshaft without the oil damping of the P.C.M. system, appeared in a 1927 publication "Electric Trains" by R. E. Dickenson. A full description, with diagrams, is given, together with the statement that it was fitted to the "later stock" of the London Electric Railway. Obviously Dickenson, who wrote the book in Australia, was referring to the 1926-27 Standard Tube Stock, which had B.T.-H. equipment, but it was of their electro-magnetic design, not the pneumatic camshaft control system. However, it is not unreasonable to assume that B.T.-H. would try to sell their new system to such a large customer as the London Underground and it seems possible that a trial equipment was fitted to a tube car about 1925, which may thus have prompted Dickenson's statement.



The fourth train of the 1935 experimental stock comprised flat-fronted Motor Cars, the design of which was adopted for the following 1938 tube stock fleet. Unit 10009-11009 is seen in Northfields depot when new. [L.T.E.]

Interior of flat-fronted D.M. car, looking towards the driving cab. These cars differed from the streamlined cars in that this bay had one extra seat per side. [L.T.E.]





Underfloor view of the complex layout of conduit and equipment of the flat-fronted experimental train. [L.T.E.]

The METROPOLITAN-VICKERS scheme (10009/10/11-11009/10/11) used an oil-driven power drum for operating all resistance switching with a total of 45 notches. This switching was a combination of cutting out series and parallel steps of the resistance banks, and to avoid sparking, two notches were always in contact. A large number of values were thereby obtained but the heating of the resistance was spread over the whole bank fairly evenly. The drum was driven round slowly and had to be stepped accurately under the control of the current. This equipment gave considerable trouble in spite of these points. Often, the contacts fused and the drum insulation failed. There were in addition, six electro-pneumatic unit switches and an electro-pneumatic reverser.

The "air-conditioning" fitted to unit 10000-11000 was not really air-conditioning in its true sense. It was a forced ventilation system, which was heated in winter. Unfortunately, in the early days of operation, not only did the thermostat fail, but so did the forced ventilation, on one occasion nearly asphyxiating the passengers. After this, it was never used again. It is not known when the car windows were converted to standard.

On all cars at the driving ends, automatic wedgelock couplers were provided, as were roller destination blinds and five square-shaped headlights. Coupling between units was of the semi-permanent bar type. The compressor was fitted to the 10xxx cars and the motor

generator to the 11xxx cars. It was possible for all types of experimental tube stock to be coupled together, but for passenger service the flat-fronted units always worked together.

On all 24 cars, the guard and his controls were located in the driving cabs, hence the cab doors were extended up into the curve of the roof, and hinged at the front, whereas 1938 tube stock cab doors were hinged at the back. The destinations included on the roller blinds (which were the same for all trains) were:

WOOD GREEN  
ARNOS GROVE  
ENFIELD WEST  
COCKFOSTERS  
UXBRIDGE  
RAYNERS LANE  
SOUTH HARROW  
EALING COMMON  
HOUNSLOW  
NORTHFIELDS  
ACTON TOWN  
HAMMERSMITH  
GREEN PARK

The above list is confirmed by an L.T. drawing dated January 1936 of the blind box wiring equipment. The blinds were to be of the same material and style as used on L.P.T.B. buses; i.e., white lettering, black background.

The compressors provided for the stock were of two types, both based on designs used on tramcars and trolleybuses. One type was the Electro-Mechanical Brake Company's 36H4 machine, a four-cylinder reciprocating pump, which was fitted to five units, and the other was the KLL4 rotary compressor made by Bernard Holland Engineering under licence from the Swiss Locomotive Machine Works (S.L.M.). The KLL4 was very quiet compared with the reciprocating pumps traditionally used on railways and it was chosen for the main order of 1938 tube stock and for the "P" class surface stock. Its precision design, coming as it did with the watchmaking tolerances imposed by the Swiss engineers, proved very vulnerable to the rigours of London Underground service. It was quickly affected by dirt, vibration and lubrication failures, and by "make-do-and-mend" maintenance during the Second World War. By the early 1970s all had been replaced by modern reciprocating compressors.

The cars were provided with a number of interesting features, which did not appear on the 1938 production cars. The driving position of the streamlined cars was in the centre of the cab with the connecting doorway immediately in front of the driver. The door of some cars was mounted on rails at top and bottom to allow it to slide back and provide a through passage. On other cars the door was pivoted on to an enormous cast hinge which itself was pivoted to the car body below the nearside cab window. The central armchair-type driving seat had joystick driving controls with the brake stick on the left and the controller stick — complete with deadman push-button — on the right. The brake was electro-pneumatic with mercury retardation control and self-lapping equipment — later to become a standard L.T. feature. The Westinghouse air brake was retained for emergency use and a separate brake handle was provided for the driver.

The driving position made the driver's lookout very poor near the front of the train so, to allow easy coupling, a push-button for slow forward movement (usually called "inching") was provided in a box mounted in the roof over the offside front window. A second button gave "inching reverse". An "inching reverse" button was also provided on the nearside guard's panel. Operation of this allowed forward movement from the rear of the train with side lookout facilities — important for depot shunting movements.

An unusual feature of the guard's controls was the provision of only one "open" button. On all trains built before and since, two open buttons were provided to give some protection against inadvertent opening. On the 1935 stock cars, protection was in the form of a hinged flap over the single button which had to be lifted while the button was pressed.

Those readers familiar with Underground train operation will know that from 1938 a system of "unit isolation" was introduced. Any train of 1938 or later stock which develops a serious pneumatic or electrical defect can be divided into two halves at the middle coupling point — pneumatically by means of air isolating cocks or electrically with a Fault Isolating Switch (F.I.S.). When isolation is completed the good unit is used to push or pull the defective unit to the depot for repair.



On pre-1938 stocks this operation was done on a car basis. Every car had air cocks at each end for pneumatic isolation, while electrical isolation was achieved by physically removing the control jumper between the cars. The 1935 stock, although the prototype for the 1938 stock, retained the isolating cocks between cars and had a special lever at the trailing end of each car which, when operated, pulled out the jumper head from its socket far enough to break the electrical connections, but not far enough to remove the head completely.

The fourth, flat-ended train was much like the 1938 stock. The driver was on the traditional left-hand side of the cab and the end door was hinged. The handbrake was a lever, instead of a wheel as provided on the streamlined cars, and the seat was the tip-up type, long familiar on the District Line and subsequently L.T. standard. The drivers much preferred this train to the streamlined, armchair version.

On all 24 experimental cars, the master controller had five positions: the usual "inch", "series", and "parallel", which is standard on all trains, plus two "weak-field" positions.

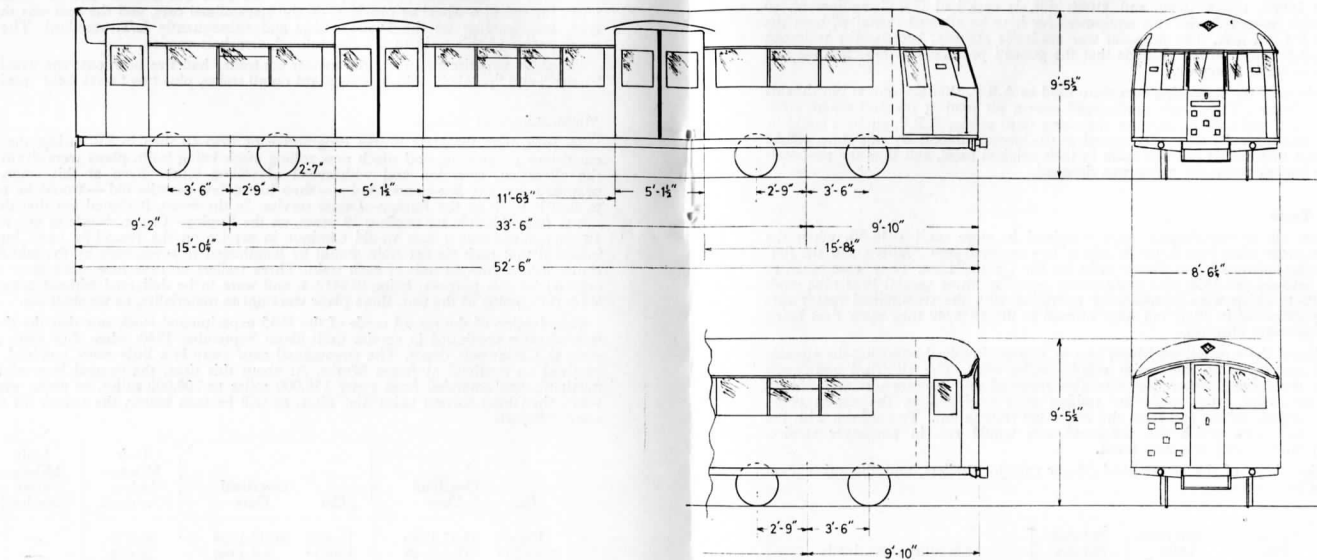
### Modification and Storage

In 1938, with the New Works Programme of 1935-40 then in full swing, the planned extensions progressing and much new rolling stock being built, plans were drawn up for the allocation, retention and withdrawal of rolling stock. Even at this stage, it was proposed that the flat-fronted units — then just a few months old — would be relegated to shuttle work on the Epping—Ongar service. In the event, it turned out that they were not to fulfil this role for another 19 years, on the Epping—Ongar shuttle at any rate. The 18 streamlined motor cars would continue in service on the Piccadilly Line, but it was intended that each six-car train would be lengthened to seven cars by the addition of a trailer in one two-car unit of each train. Three trailers of 1938 tube stock were specially ordered for this purpose, being 012412-4, and were to be delivered without compressors. With the coming of the war, these plans were not to materialise, as we shall see.

Examination of the record cards of the 1935 experimental stock saw that the three flat-fronted units continued in service until about September 1940, when they were put into store at Cockfosters depot. The streamlined cars' story is a little more involved, as they received an overhaul at Acton Works. At about this time, the normal interval between overhauls was extended from every 150,000 miles to 200,000 miles, or about every four years, the (then) current paint life. Thus, as will be seen below, the reason for overhaul seems obscure.

Car	Overhaul Date	Car	Overhaul Date	Unit Mileage before Overhaul	Unit Mileage after Overhaul
10000*	23.12.1939	11000*	30.12.1939	26,450	—
10001*	15.6.1940	11001*	6.7.1940	28,650	—
10002*	20.4.1940	11002*	20.4.1940	42,693	—
10003	3.2.1940	11003	10.2.1940	61,871	11,610
10004	14.10.1939	11004	14.10.1939	51,149	6,767
10005*	10.8.1940	11005*	16.11.1940	38,415	—
10006*	4.5.1940	11006*	18.5.1940	35,573	—
10007	11.11.1939	11007	18.11.1939	59,996	12,737
10008	6.1.1940	11008	13.1.1940	71,008	9,861

Those units marked \* did not work in service again, eventually being stored. It is thought that those that did work in service after overhaul did so only until about September or October 1940, although there were still four paths in the timetable for them to operate. It was apparently difficult for all but the B.T.-H. train to be kept in service. Prior to overhaul, the B.T.-H. train was split into three units to operate with the others, so that one B.T.-H. unit was thus available for three trains. With one B.T.-H. set in a train, there was a good chance that it would get home to Northfields depot without failing in service! It can therefore be seen that it took valuable manpower to make sure that the trains were serviceable and permission was sought for all 24 cars to be stored. The official date of storing all the cars of 1935 stock is given in records as 16th May 1942, although in practice they were stored much earlier.



**1935 TUBE STOCK**

Above: 1st, 2nd, & 3rd trains.

Below: 4th train, with smaller, non-streamlined cab and two extra seats.

By early 1941, the message seems to have gone home that the train crews did not like the streamlined cab layout. A proposal was put forward to redesign two cabs of the streamlined type, so that the driver was on the conventional left hand side. Provision was also made for the driver to be able to drive the train standing up, something he could not do with the original layout. These alterations were carried out slowly during 1941-42 and the finished job, carried out on cars 10004 and 11004, was shown to train drivers' representatives on 21st May 1942. The only external difference was in the cab windows, which were extended up into the roof dome. The intention was that, subject to the drivers' agreement with the new design, the two modified cars would run at each end of a block train with cars 10002, 11002, 10006 and 11006. All six cars had G.E.C. equipment, so matters must have improved with this equipment for it to be allowed to run without the protection of a P.C.M. unit. The proposal was academic anyway, because the trainmen rejected the modifications on the grounds that the guard's position was too cramped and the side cab door let in draughts.

Meanwhile, three of the remaining cars were used as A.R.P. shelters, one at Northfields and two at Cockfosters. They were sandbagged over a pit road at the end where steps down were provided and used initially for sheltering until proper A.R.P. shelters could be provided. Eventually, all the cars were stored at Cockfosters depot. By this time, it had been decided that they would not run again in their original form, and thus the proposals for them to be run as seven-car trains was dropped.

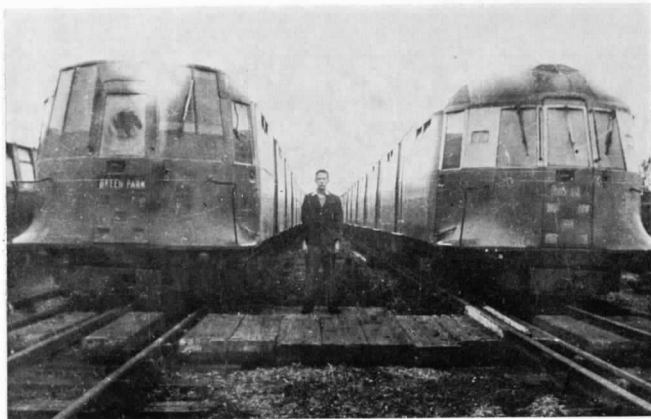
### The Post-War Years

After the war, all 24 experimental cars remained in store until 1948-50, when the streamlined cars were taken into Acton Works to be converted into Trailers, and the flat-fronted units to be converted into shuttle units for the Central Line. They were taken to Acton in pairs between pre-1938 tube stock motor cars. The three special 1938 tube stock Trailers (012412-4) which were intended for operation with the streamlined motor cars were eventually delivered in 1947, but were utilised in the 1938/49 tube stock fleet being fitted with compressors after all.

The conversion of the streamlined Motor cars to Trailers involved removing the streamlined cab ends and replacing them with rebuilt trailer ends. The electrical equipment appertaining to the driving motor cars was also removed and compressors were fitted. Although the conversion work made the trailing ends very similar, the expert could distinguish the normal trailing end from the converted trailing end. To conform with the 1938/49 tube stock with which the converted cars would run in passenger service, passenger open door control was also fitted.

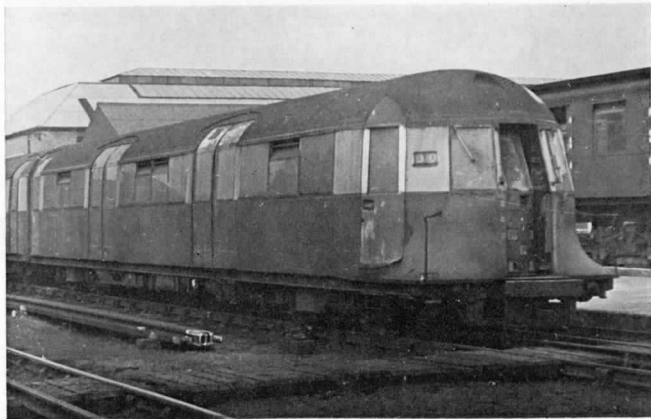
The conversion dates of the streamlined Motor cars to Trailers, and the subsequent overhauls, were as follows:

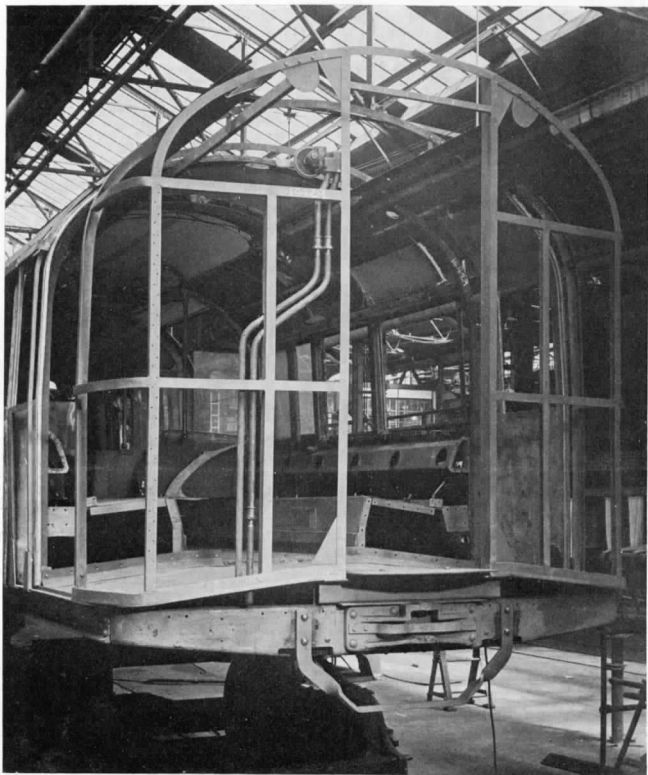
D.M. No.	Trailer No.	Conversion Date	Entered Service	Subsequent Overhauls			
				1.58	10.63	11.67	—
10000	012477	7.5.1951	12.2.1952	2.58	3.64	6.68	—
10001	012478	25.5.1951	7.5.1952	11.56	1.62	9.66	—
10002	012479	20.7.1951	29.3.1952	9.54	10.58	2.65	5.70
10003	012480	18.1.1951	6.4.1951	10.57	5.63	1.67	—
10004	012481	9.2.1951	24.4.1951	11.54	7.61	6.66	8.71
10005	012482	12.10.1950	27.2.1951	12.54	2.62	9.66	9.71
10006	012483	19.2.1951	15.8.1952	6.54	6.58	5.64	4.69
10007	012484	31.8.1950	9.1950	11.54	3.62	8.66	—
10008	012485	30.11.1950	14.7.1952	8.54	12.58	11.64	6.69
11000	012486	20.4.1951	11.5.1951	12.55	2.63	4.67	—
11001	012487	20.6.1951	22.5.1952	9.55	—	—	—
11002	012488	23.9.1951	23.7.1952	11.55	12.61	7.66	—
11003	012489	8.1.1951	12.3.1952	11.54	2.59	6.65	8.70
11004	012490	2.3.1951	28.3.1951	8.58	8.63	8.67	—
11005	012491	3.11.1950	28.5.1952	5.54	8.60	3.66	2.71
11006	012492	30.3.1951	2.9.1952	6.55	9.62	12.66	—
11007	012493	26.9.1950	28.10.1952	9.58	10.64	6.69	—
11008	012494	15.12.1950	24.6.1952				



All 24 cars of the 1935 experimental tube stock were stored at Cockfosters depot during the war. In this 1945 view, 10004 (left) shows its 1942-rebuilt driving cab, which allowed drivers to operate the train standing up, as well as sitting. Drivers, however, never liked the cab and it never ran in service in this form. Their hostility to the design was the main reason for its demise. [J. H. Meredith]

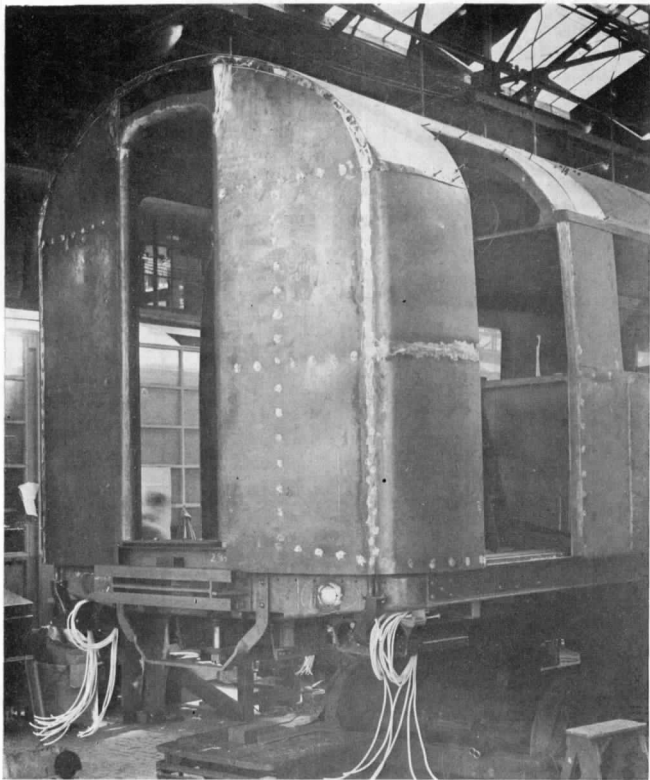
View of streamlined Motor car 11001 in Acton Works Yard on 24th November 1950, having been transferred from Cockfosters for conversion to a Trailer car. Note the centre cab door is slid back in its "open" position. [H. Clarke]





One of the 18 ex-streamlined motor cars being converted to a Trailer in Acton Works, showing the new car end framing at the original driving end. The passenger emergency handle and the connecting pipework can be seen fitted in position. [L.T.E.]

All of the 18 ex-streamlined cars re-entered service as Trailers on the Northern Line, formed between 1938/49 tube stock U.N.D.M.s and 11xxx D.M.s in three-car units. They all remained on the Northern Line until withdrawn, apart from ten that worked on the Bakerloo Line from 1972 to 1976 replacing 1927 vintage trailers, and one on the Piccadilly Line for a few months in 1973. One car, 012488, was damaged beyond repair in a siding collision at Tooting Broadway in October 1960, and was scrapped. However, certain parts



**A later stage in the conversion of a 1935 streamlined Motor car to a Trailer in Acton Works. [L.T.E.]**

from the car were recovered (with D.M. 11103) to be put to use in building a demonstration car with air-door equipment at the Railway Training Centre at White City, which opened in 1963.

After the 1949 tube stock had been delivered, involving many reformations and re-shuffling of rolling stock, the converted Trailers were formed into the following units, although the stabilisation of units was not possible until 1952/53.

Unit	Reformations		
30031-012477-11071			
30032-012478-11089	30032-012478-11067	9.71	
30009-012479-11031	10031-012479-11031	4.73	
30041-012480-11091	10091-012480-11091	8.72	
30015-012481-11051	10051-012481-11051	1.73	
30011-012482-11053	10053-012482-11053	1.73	
30000-012483-11055	10055-012483-11055	8.72	
30042-012484-11083	10083-012484-11083	3.73	
30028-012485-11049	10049-012485-11049	10.72	
30007-012486-11077	10077-012486-11077	7.72	
30021-012487-11041			
30001-012488-11103			
30019-012489-11081	30027-012489-11081	10.72	10271-012489-11081 5.73
30029-012490-11093			
30035-012491-11085			
30016-012492-11017	10017-012492-11017	1.73	
30014-012493-11015	10015-012493-11015	1.73	
30038-012494-11095	10095-012494-11095	4.73	

Line Transfers:

Car No.	Line Transfers				Date Condemned
012477					1.8.73
012478					16.4.72
012479	N to B	12.4.73	B to P	27.4.73	27.10.73
012480	N to B	16.8.72			24.6.74
012481	N to B	10.1.73			6.74
012482	N to B	22.1.73			3.76
012483	N to B	8.8.72			27.6.74
012484	N to B	13.3.73			13.9.74
012485	N to B	12.10.72			25.3.74
012486	N to B	26.7.72			16.11.73
012487					27.6.73
012488					
012489					24.10.76
012490					24.3.74
012491					9.8.73
012492	N to B	30.1.73			11.10.74
012493	N to B	5.1.73			6.74
012494	N to B	4.4.73			13.4.74

Scrapping:

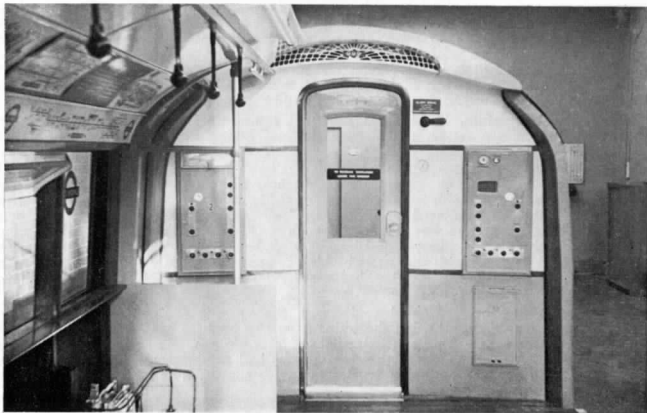
Car No.	Date	Disposal
012477	11.10.73	Ruislip to Birds, Long Marston
012478	31.7.72	Ruislip to Birds, Long Marston
012479	31.1.74	Ruislip to Birds, Long Marston
012480	7.7.74	Ruislip to Birds, Long Marston
012481	14.8.74	Ruislip to Birds, Long Marston
012482	23.3.76	Ruislip to Kings, Newmarket
012483	20.8.74	Ruislip to Birds, Long Marston
012484	22.10.74	Ruislip to Kings, Newmarket
012485	11.6.74	Ruislip to Birds, Long Marston
012486	12.2.74	Ruislip to Birds, Long Marston
012487	15.11.73	Ruislip to Birds, Long Marston
012488	7.10.60	Cut up at Tooting by L. T.
012489	16.2.77	Ruislip to Birds, Long Marston
012490	10.7.74	Ruislip to Birds, Long Marston
012491	15.11.73	Ruislip to Birds, Long Marston
012492	12.11.74	Ruislip to Birds, Long Marston
012493	30.7.74	Ruislip to Birds, Long Marston
012494	10.7.74	Ruislip to Birds, Long Marston

It will thus be seen that the last of the ex-streamlined Trailers ran in service on the Bakerloo Line in March 1976 (012482), and on the Northern Line in October 1976 (012489). This latter car was withdrawn from service after a period of over ten years since its previous overhaul!

### The Flat-Ended Units

The non-streamlined Driving Motor cars of the 1935 tube stock had a more varied career than their streamlined fellows when they came out of storage after the war. Late in 1949 work began on their conversion to operate as two-car shuttle units for the Central Line. The conversion of the six cars involved replacing the automatic couplers at the driving ends with the "ward" mechanical type, this being in common with the pre-1938 tube stock then operating on the main Central Line. Also fitted were air hoses and passenger-open push buttons. The bogies on these six cars had not been modified to 1938 tube stock standard as they had not had an overhaul, so they were replaced with modified bogies from some of the streamlined motor cars (those from 10000, 11000, 10008, 11008, 10003 and 11003 going under 10009, 11009, 10010, 11010, 10011 and 110011 respectively). The M.V. electrical equipment was removed and replaced by the P.C.M. type, which was obtained from 10003/7/8 and 11003/7/8. The guard's control positions were removed from the cabs and were relocated at the trailing end of the passenger saloon, but on the "D" 11xxx cars only — the guard thus operated from one position, irrespective of whether this car was leading or trailing. The semi-permanent bar coupling was retained between cars. Compressors of the KLL4 type were fitted on all six motor cars, giving two compressors on each two-car unit. The destinations provided on the blinds were:

LOUGHTON  
 EPPING  
 ONGAR  
 GRANGE HILL  
 WOODFORD  
 HAINAULT  
 VIA GRANGE HILL  
 SPECIAL



After an overrun in Tooting siding in 1960, parts of cars 012488 and 11103 were subsequently retrieved to construct a demonstration car for guard's equipment at the Railway Training Centre, White City. This view, looking towards the Guard's control panel, shows the style of ventilation grille unique to the 1935 stock, although strangely, 1959 stock D.M. 1183 has grilles of this type. [L.U.R.S.]



Some of the destination blinds that needed replacement were taken out and never replaced, and destination plates from pre-1938 tube stock trains were often seen wedged in a prominent position, with the blind box left empty (see ABC L.T. Railways, Ian Allan, 1966 edition for photographic evidence), although 10011-11011 appeared to have retained blinds right up to the end. The use of the shuttle units was mainly confined to the Loughton—Epping shuttle, and to a lesser extent, the Hainault—Woodford shuttle. The units were converted as follows:

Units	Converted	Entered Service
10009-11009	17.8.50	9.10.50
10010-11010	1.6.50	2.10.50
10011-11011	22.1.50	4. 2. 51

On 17th May 1954, all three units returned to the Piccadilly Line for use on the Holborn—Aldwych shuttle service, but with the passenger door open control disconnected. Whilst in service on 3rd August 1955, driving motor 11010 was damaged in a collision with the stops beyond Aldwych station and much of the driving cab had to be rebuilt at Acton Works. Because of this rebuilding, it reappeared looking more like a 1938 tube stock car, in that the train number bracket was located in the front cab door, and the side cab doors did not extend up into the curve of the roof.

Two of the units returned to the Central Line for the Epping—Ongar shuttle service (which commenced on 18th November 1957) — 10009-11009 on 6th July 1957, and 10010-11010 on 20th August 1957. As two trains were then required for the Epping—Ongar shuttle, and the third shuttle unit had been retained for test train duties, a third spare train was provided by borrowing a three-car train of 1938 tube stock from the Northern Line (10177-012265-11177). It was transferred on 16th November 1957 and returned to the Northern Line on 5th June 1960. This 1938 stock unit was able to operate on its own as a three-car train, having two compressors on the Trailer car and identified as such by having the letter "C" under the car number — one of 69 such units so fitted in the early 1950s.

The third shuttle unit (10011-11011) did not go back to the Central Line as it had been earmarked for some special trials with regenerative braking equipment. Regeneration, where the traction motors become generators during braking and feed current back into the supply system for use by other trains, had already been used on the Metadyne equipped O and P surface stocks since before the war, but the equipment had become unreliable and expensive to maintain. Moves had already begun to re-equip all the O and P stocks with P.C.M. equipment and dispose of the Metadyne machines, but the hope persisted (and still does today) that regeneration could become a viable and reliable system.

Early in 1957 therefore, 10011-11011 unit was moved to Ealing Common depot for preparation to receive a set of B.T.-H. regenerative braking equipment. The equipment was mounted inside the passenger saloons and the brake controllers were modified to take a mercury self-lapping switch which tilted as the driver moved the brake handle. Trial running on the Northfields to Acton Town test track, with the substation at Northfields specially modified to cope with regenerated current, began in May 1957. Early in 1958 the B.T.-H. equipment was replaced by G.E.C. equipment for further trials and finally, a Metropolitan-Vickers system was tested. Although regeneration was not adopted for new stock following these trials, many useful lessons were learned and the B.T.-H. equipment was cannibalised for trials with rheostatic braking systems first tried on a 1960 Tube Stock unit and later, after much modification, became the design basis for the rheostatic system first used on the Victoria Line's 1967 Tube Stock.

Meanwhile, it had been decided to increase the passenger accommodation on the Epping—Ongar line, by lengthening the trains from two to three cars. This was achieved by converting three pre-1938 tube stock trailers of 1927 vintage, one each to be formed in each shuttle unit. As both D.M.s of the shuttle units had compressors, these trailers were converted without compressors being fitted. They were converted as follows:

Previous Number	New Number	Date to Acton	Converted	Entered Service	Formed into Unit
7510	70510	29.10.58	23.12.58	5.60	10011-11011
7511	70511	3.2.58	16.6.58	7.58	10010-11010
7512	70512	3.2.58	8.5.58	6.58	10009-11009



The West end of unit 10011-11011 at Epping, on the Loughton shuttle service, standing next to Worsdell ex-G.E.R. Class F5 (rebuilt from a Class F4) 2-4-2T No. 67202 on the Epping-Ongar push-pull shuttle. [Lens of Sutton

The regenerative test unit (10011-11011) was converted back to normal condition and given its converted Trailer No. 70510 (which had been stored awaiting its parent cars' release from testing duties) in May 1960. The experimental self-lapping brake controllers with their tilting mercury switches were fitted to the rheostatic test unit of 1960 stock and one of them finally ended up in service on the District Line as a trial in an R stock cab.

When transferred back to the Central Line, the passenger-open door control was re-instated on units 10009-11009 and 10010-11010, and was also operative on converted Trailers 70511 and 70512. However, by the time 10011-11011 re-entered service in May 1960, this had been withdrawn from all rolling stock, and converted Trailer 70510 also had its passenger-open door control removed.

The overhaul dates for the shuttle units were as follows:

10009-11009	17.8.50	17.5.58
10010-11010	1.6.50	30.10.56
10011-11011	22.1.50	14.5.60

The cars retained their red livery until unpainted aluminium stock had taken over the main Central Line services. It was then decided that the shuttle units should be painted silver to match, and this was done as follows:

10009-70512-11009	23.11.63
10010-70511-11010	10.8.63
10011-70510-11011	15.5.65

In 1964 the 1927 converted Trailers were fitted with de-icing equipment, being confined to work on probably the most exposed section of the Central Line. Having been repainted from red to silver on overhaul (see above), this in the event was to be their last overhaul, for their unreliability in service caused all three units to be stored out of service at Hainault from 7th December 1966. They were all eventually transferred to Ruislip, 10011-70510-11011 being the last to move.

Late in 1968 plans for the replacement of the 1938 tube stock on the Bakerloo and Northern lines were being formulated, the proposed new stock then being designated 1972 tube stock — and far different in concept from the 1972 tube stock we know today.



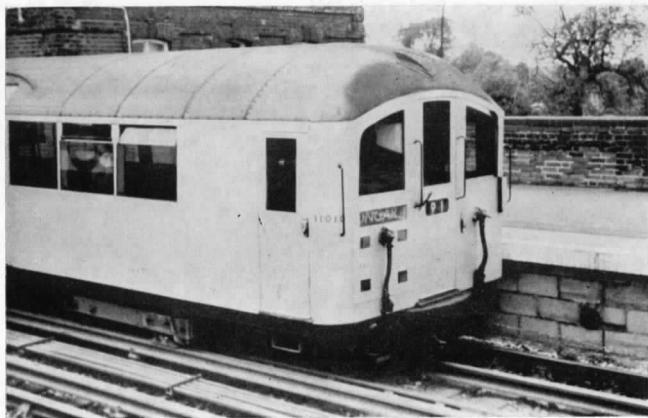
Interior of one of the flat-fronted driving cabs, showing that the cab door is hinged on the opposite side to 1938TS, and that it extends up into the curve of the roof. This was because, when new, the Guard's controls were fitted to the bulkhead (to the right) next to the handbrake. [L.T.E.]



In August 1955, Driving Motor car 11010 was damaged in a collision at Aldwych, causing substantial damage to the cab end, as seen here at Cockfosters depot after having been moved from Aldwych. [L.T.E.]

D.M. 11010 was rebuilt at Acton Works, with 1938 stock type side and front cab doors. The side doors no longer extended up into the roof, while the front door had the number brackets built into it. This view shows 11010 at North Weald, in its rebuilt state.

[R. J. Greenaway]





An interior view of 10011-11011 unit, equipped for regenerative braking tests in 1957, showing the wiring fitted inside the passenger saloon. Note that the line diagrams apply to the Piccadilly Line, being previously used on the Aldwych shuttle, and are above the advert frames, unlike the 1938 tube stock in later days. [L.T.E.]

In the early 1960s, the flat-fronted shuttle units were repainted Silver to match the unpainted Aluminium 1959/62 stock on the main Central Line. This view of unit 10009-11009 at Blake Hall shows the converted 1927 Trailer (70512) which was added in 1959, and the de-icing equipment fitted to it in 1964. [R. W. Sheen]





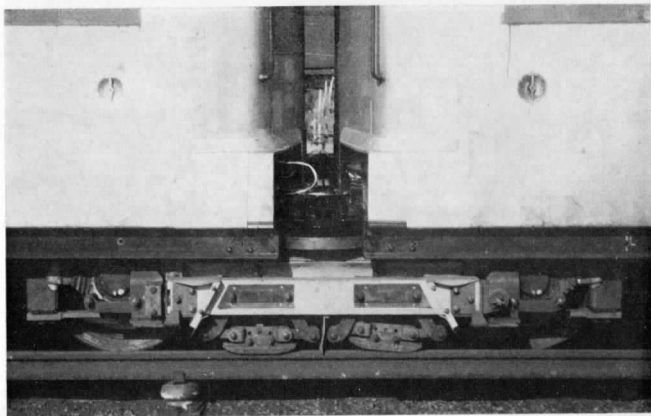
A view of 10011-11011 unit running into Northfields depot, 8th July 1971, on articulation tests. The two bodies mounted on one bogie in the centre can be clearly seen. Note also that the cars are substantially shorter than when new. [R. J. Greenaway

It was proposed that the new trains would be eight cars of similar length to the seven cars they replaced, so that the train formation would be symmetrical. Each train would be formed into two four-car units, each having two cars of each unit formed back-to-back in articulated pairs. Consideration was also given to a six-car train formation of two three-car units but this was abandoned because some station platforms were too sharply curved for the longer cars; similarly, nine-car block articulated trains of equivalent length was also an option, but this was also abandoned because just one car with a defect would render the complete train out of service, rather than one unit as with the existing system.

D.M.s 10010 and 11010 were transferred between pilot motor cars from Ruislip to Acton Works for preliminary tests on 1st November 1968 and 14th April 1969 respectively, and returned on 8th August 1969 and 22nd May 1969 respectively, then being stored for scrap along with sister cars 10009 and 11009, and converted trailers 70511 and 70512. Unit 10011-70510-11011 was taken to Acton Works on 15th May 1969, where the two D.M.s were to become a test unit for articulated coupling between the trailing ends of the cars. The redundant trailer (70510) was taken back to Ruislip on 22nd May 1969 (with 11010) for scrap with the other cars.

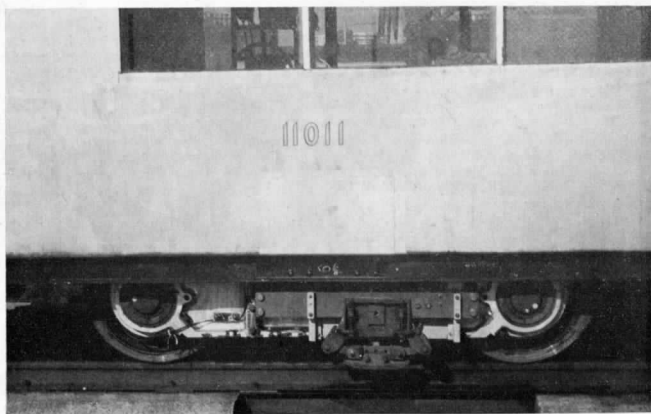
For the articulation tests the cars were made shorter by cutting their trailing ends and mounting them on one specially constructed bogie. Two new cast aluminium bogies of an unusual design each with two new 1967 tube stock type traction motors were fitted at the outer ends, while the pivot points of the central truck were outside the bogie frame. The cars initially remained in painted silver livery and continued to carry their own numbers (10011-11011). All three bogies had metacone secondary suspension, as standard on C69/77 stock.

Extensive testing was carried out during the period 1970-72, including coupling the test unit with a four-car train of 1960 tube stock (3910-4902-4903-3911). Following on from these tests, a mock-up car was then proposed to be built at Acton Works. However, with the Heathrow extension being authorised, attention immediately turned to providing new stock for the Piccadilly Line (the 1973 tube stock, and for which the mock-up was built), transferring the 1959 stock to the Northern Line, and keeping a selected number of 1938 tube stock trains for the Bakerloo Line and the remaining balance of stock for the Northern Line.



A close-up view of the articulated bogie, on which the trailing ends of 10011-11011 were mounted. [T. E. Dyckhoff

Close-up of cast Aluminium outer end bogie, later fitted to 3363. [T. E. Dyckhoff





Experimental 1960 tube stock unit with car 3910 coupled to the articulated unit on 8th December 1970, at South Ealing. The articulated unit was acting as pilot to the "Chopper" controlled 1960 tube stock during tests. [T. E. Dyckhoff

On 4th December 1970, a fault occurred in the power wiring of the articulated unit, which resulted in the unit becoming immobile. In this instance, instead of normal shunting, manpower was used — many hands make light work! [L.U.R.S. Collection





When the articulated train project was abandoned, the unit was transferred to the service stock fleet and was painted in service stock maroon in May 1972. It was then used as a shunting unit at Acton Works, being especially useful for bridging conductor rail gaps in the yard, and was numbered L14A and L14B (ex-10011 and 11011 respectively).

The cars which were awaiting scrapping were cut up at Ruislip depot (10009, 11009, 10010, 11010, 70510, 70511, 70512) by T. Collins of Stepney, the official scrapping date being 10th October 1971. Cars L14A and L14B were withdrawn in February 1974 and were stored in the Acton Works pending scrapping, latterly on accommodation bogies, as the experimental bogies on L14A and L14B at the driving ends were used on 1972 Mk.II stock D.M. car 3363 for further testing purposes. The car bodies of L14A and L14B were cut up at Acton in February 1975 by Ferro Recycling of Highgate.

With the last ex-streamlined converted Trailer running in service on the Northern Line (012489) being withdrawn in 1976, and finally being scrapped on 16th February 1977, this ends the story of the 1935 Experimental Tube Stock, which had a very interesting, if relatively short, operating life.

In conclusion, the authors would like to express their thanks to Mr J. G. Bruce O.B.E., especially with the early history of the stock.



The twin articulated unit seen in Acton Works in the summer of 1974, on accommodation bogies prior to the bodies being cut up early the following year, showing the service stock maroon livery applied in 1972. [B. R. Hardy

### 1935 EXPERIMENTAL TUBE STOCK

MOTORS: Two Crompton C200 168hp series wound.

COMPRESSORS: Bernard Holland KLL4 or EMB 36H4.

MOTOR GENERATORS: Metropolitan Vickers type 33.

Train	Unit	Car Nos.	Compressor	Gear Ratio	Interior Finish	Interior Paint	Equipment	Notes
1	A	10000	KLL4	22:73	Indian Greywood and Canadian Birch	Cerulean Blue	Crompton: Series-Parallel Crompton: Parallel G.E.C.: Camshaft	Stones Ventilation equipment. Crittals Ventilation equipment.
		11000	—	22:73				
	B	10001	EMB	22:73				
		11001	—	22:73				
	C	10002	EMB	18:59				
11002	—	18:59						
2	D	10006	EMB	21:68	Australian Silky Oak and Canadian Birch	Euphorbia Red	G.E.C.: Camshaft B.T.H.: P.C.M. Crompton: Camshaft	Originally Unit E.
		11006	—	22:73				
	G	10003	EMB	22:73				
		11003	—	22:73				
	F	10005	EMB	22:73				
11005	—	22:73						
3	E	10004	KLL4	22:73	Australian Silky Oak and Canadian Birch	Cerulean Blue	G.E.C.: Camshaft B.T.H.: P.C.M. B.T.H.: P.C.M.	Originally Unit G.
		11004	—	22:73				
	H	10007	KLL4	22:73				
		11007	—	22:73				
	J	10008	KLL4	22:73				
11008	—	22:73						
4	K	10009	KLL4	22:73	Indian Greywood and Canadian Birch	Euphorbia Red	Met. Vickers: Drum Met. Vickers: Drum Met. Vickers: Drum	Flat-ended.
		11009	—	22:73				
	L	10010	KLL4	22:73				
		11010	—	22:73				
	M	10011	KLL4	22:73				
11011	—	22:73						

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