



**GREAT EASTERN MAIN LINE
LONDON TO IPSWICH**

1 ROUTE INFORMATION	4
1.1 History	4
<i>1.1.1 Liverpool Street Station</i>	5
<i>1.1.2 Electrification</i>	5
<i>1.1.3 Line Features</i>	5
1.2 Rolling Stock.....	6
1.3 Franchise History	6
2 CLASS 360 'DESIRO' ELECTRIC MULTIPLE UNIT	7
2.1 Class 360	7
2.2 Design & Specification	7
3 CREATING A CLASS 360 TRAIN SET	8
3.1 Scenario Editor (if creating new scenarios)	8
3.2 Assigning Destinations and Numbers	8
4 DRIVING THE CLASS 360	9
4.1 Cab Controls.....	9
5 SCENARIOS	11
5.1 Heading Out	11
5.2 Colchester Connection	11
5.3 Eastern Intercity.....	11
5.4 Its Snow Fun	11
5.5 Braintree Branch.....	11
5.6 Sunday Closures	11
5.7 1Y41 - 12:52 Ipswich to London Liverpool Street.....	11
5.8 Desiro Rescue	11
6 SIGNALS	12
6.1 Main Signal Head Aspects	12
6.2 Theatre Type Signals.....	12
6.3 Feather Type Signals.....	13
6.4 Ground Signals and Position Light Signals	14
6.5 Entering an Occupied Section of Track.....	15
6.6 Repeater Signals	15

7 SPEED SIGNS	16
7.1 Permissible Speed Indicators.....	16
7.2 Permissible Speed Warning Indicators.....	16
8 SAFETY SYSTEMS	17
8.1 AWS (Automatic Warning System)	17
9 CREDITS	18

1 Route Information

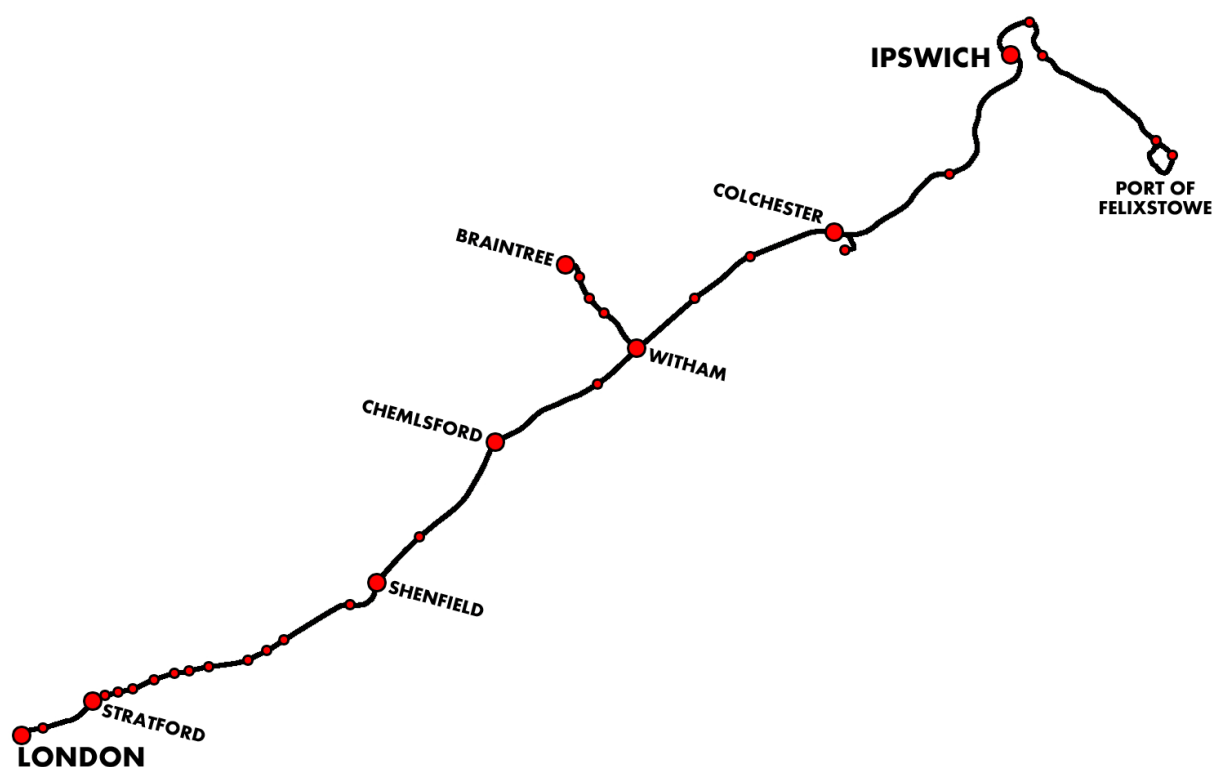
1.1 History

The Great Eastern Main Line is a 133 mile major railway line connecting Liverpool Street in the City of London with destinations in east London and the East of England, including Chelmsford, Colchester, Ipswich, Norwich and several coastal resorts such as Clacton-on-Sea and Walton-on-the-Naze. The main markets are commuter travel to London, particularly to the City of London and Docklands, and business and leisure travelers. The route also provides a main artery for freight traffic between the Port of Felixstowe, Harwich International Port and the rest of the country, via connections in London.

The earliest section of the line operated between Mile End and Romford from 1839 and was built by the Eastern Counties Railway (ECR). The London terminus was then moved to Bishopsgate railway station on 1 July 1840 and the line was extended out to Brentwood in the same year. A further 51 miles of route were added to link London with Colchester by 1843. The original gauge for the line was 5 feet, but this was converted to 1,435 mm (4 ft 8 1/2 in) standard gauge in 1844.

The section of line between Colchester and Ipswich was built by the Eastern Union Railway to standard gauge and opened for passenger traffic on 15 June 1846 and the route to Norwich opened in 1849.

Eastern Counties Railway and Eastern Union Railways and others were amalgamated to form the Great Eastern Railway in 1862. The London terminus was again moved, this time to Liverpool Street on 2 February 1872. The line was absorbed into the London and North Eastern Railway in 1923 and from 1948 formed part of the Eastern Region of British Railways.



1.1.1 Liverpool Street Station

Liverpool Street was designed by Great Eastern's chief engineer, Edward Wilson, and was built by John Mowlem & Co on a site which had been occupied by Bethlem Royal Hospital from the 13th to 17th centuries. A City of London Corporation plaque commemorating the station's construction hangs on the wall of the adjoining former Great Eastern Hotel. The station was named after the street on which it stands, which in turn was named in honour of Lord Liverpool, prime minister from 1812 to 1827, having been built as part of an extension of the City towards the end of his term in office.

The station was the first place in London to be hit by German bomber during the First World War. The bombing, killed 162 people. In 1922, the employees of G.E.R. who died during the War were honored on a large marble memorial on Liverpool Street's concourse.

By the 1970s the station had become dark, dilapidated and dank. As a result extensive modification was undertaken between 1985 and 1992, including bringing all the platforms in the main shed up to the same end point and constructing a new underground booking office. During this renovation, the stations facade, Victorian cast-iron pillars, and the GER memorial were retained. The redevelopment coincided with the closure and demolition of the neighboring Broad Street railway station and the construction of the Broadgate development in its place.

The current Liverpool Street station was officially re-opened by Queen Elizabeth II in 1991.

1.1.2 Electrification

Plans were drawn up in the 1930s to electrify the suburban lines from Liverpool Street to Shenfield at 1500 V DC and work was started on implementing this. However, the outbreak of the Second World War brought the project to a temporary halt and it was not until 1949 that the scheme was completed with electrification being extended to Chelmsford in 1956.

The British Railways 1955 Modernisation Plan called for overhead line systems in Great Britain to be standardized at 25 kV AC. However, due to low clearances under bridges the route was electrified at 6.25 kV AC. The section between Liverpool Street and Southend Victoria was completed in November 1960. Extensive testing showed that smaller electrical clearances could be tolerated for the 25 kV system than originally thought necessary. As a result it was now possible to increase the voltage without having to either raise bridges or lower the tracks along the route to obtain larger clearances. The route between Liverpool Street and Southend Victoria was converted to 25 kV AC between 1976 and 1980. Electrification was extended to Norwich by 1986.

1.1.3 Line Features

In the 1930s a flyover was constructed just west of Ilford to switch the main and electric lines over, to enable main line trains to utilise Liverpool St's longer west side platforms without having to cross east side suburban traffic in the station throat. The new arrangement also facilitated cross-platform interchange with the Central line at Stratford, services commencing in 1946. Either side of Ilford Flyover, there are single-track connections between the slow and fast pairs of lines, with the westbound track extending to Manor Park railway station and just beyond.

The only railway tunnel on the Great Eastern Main Line is just to the south of the current Ipswich railway station. The 361 yd (330 m) long tunnel was built by Peter Bruff as part of the Ipswich to Ely Line. It was completed in 1846 and it is thought to be the earliest driven on a sharp continuous curve. During the excavation of the tunnel many important fossils were uncovered, including rhinoceros, lion, and, mammoth; the site was known as the 'Stoke Bone Beds'. The finds are considered important in understanding climate change during the

Ice Age. This tunnel had the track bed lowered so the line could accommodate higher container trains.

1.2 Rolling Stock

Electric multiple units for inner and outer suburban passenger trains and diesel multiple units for non-electrified lines.

Class 315 four car units introduced by British Rail in 1980. It was the 5th and final design of 1972 multiple unit. Maximum speed 75 mph (121 km/h)

Class 321 four car units introduced by British Rail in 1988. These units came from the British Rail Mk3 body design, which bore many successful passenger train designs. Maximum speed 100 mph (161 km/h)

Intercity services are handled by electric locomotive hauled stock. Initially in the hands of Class 86 and Mk2 rolling stock with DBSO used to speed up turn around at terminal stations. With the introduction of the Class 390 Pendolino high speed trains on the West Coast Mainline, surplus class 90 and Mk3 rolling stock were introduced on the Great Eastern Mainline. These operate of speeds up to 105mph but are capable of up to 110mph.

In 2001 First Great Eastern ordered 21 4-car units to replace elderly Class 312 slam-door units. They entered service in 2003, and by mid-2004 had completely replaced the old trains. They are primarily used on London Liverpool Street to Clacton-on-Sea, Ipswich, and Colchester services and Manningtree to Harwich services, usually running as 4 carriages to Harwich and 8-12 carriages to Clacton-on-Sea and Ipswich. They also run to Walton on the Naze at peak times.

1.3 Franchise History

Just prior to Privatization, in 1986, the Great Eastern Mainline became part of Network SouthEast. With the introduction of the privatized railway companies, First Great eastern took control of suburban and medium distance services, while fast mainline services were operated by Anglia Railways. This lasted between January 1997 and March 2004.

All services are now operated by Greater Anglia.

In May 2015, Crossrail will take over the Shenfield metro service and (after 2018) take it via a tunnel through central London and link up with the Great Western Main Line as far as Maidenhead and Heathrow Airport. However, the Crossrail rolling stock is expected to enter service on the GEML in May 2017. The Crossrail service will interchange with remaining Great Eastern Main Line services at Liverpool Street (via new underground platforms), Stratford, Romford and Shenfield.

2 Class 360 ‘Desiro’ Electric Multiple Unit

2.1 Class 360

The Class 360 electric multiple units were built by Siemens in two sub-types from 2002–2003 and 2004–2005. These units are part of the Siemens Desiro family.

Siemens uses the name Desiro UK for the DMU and EMU trains operated by various train companies. These have come to form the basis on 1/3rd of passenger multiple units in the UK. The trains have modern equipment such as toilet waste retention tanks, ergonomic seats, and automated information displays and spoken announcements.

Unlike the South West Trains and West Coast Main Line Desiro units, the Class 360 lacks inter-unit gangways. This was a late design change in relation to feedback about the visibility from the cab with gangway present, during Driver Only operation.

All the units are owned by rolling stock operating companies (ROSCOs), apart from the 360/2s which are owned by BAA for the Heathrow Express and Heathrow Connect services.

All trains are adorned in blue that was initially applied in relation to First Group were the operators at the time of ordering. A white stripe was added in 2008 when the franchise was rebranded from "One" to National Express. 360115 was re-liveried into National Express colours by application of a vinyl wrap, this was removed by Greater Anglia in June 2012.

2.2 Design & Specification

TOPS Number	Class 360
Unit Numbering	360101 - 360121
Formation	DMCO(A)+TSO+PTSO+DMCO(B)
Unit Weight	170 tonnes (35-48t per vehicle)
Vehicle Length	66ft 11in (20.4m)
Vehicle Width	9ft 2in (2.8m)
Body Construction	Aluminium body with steel ends
Power Collection	25kV ACOverhead Line Electrification
Vehicle Power	2,080HP (1,550kW)
Design Speed	100 MPH (161km/h)
Coupling Type	Dellner
Brake Types	Air Regenerative
Seating	16 First & 264 Standard

3 Creating a Class 360 train set

3.1 Scenario Editor (if creating new scenarios)

To get the Class 360 ready for selection in a scenario that is not located on the Great Eastern Main Line, you will need to enable it in the object set filters, which will add it to the rolling stock browser list.

Follow these steps:

1. Enter the Scenario Editor. (Note: If a route is locked it will need to be unlocked first before you can enter the Scenario Editor. Unlock by clicking the padlock icon in the bottom right of the screen).
2. Click the Object Set Filter button (the small blue cube on the middle left panel).
3. In the new window which opens on the right hand side, select the following:
RSC / GEML
4. The Class 360 vehicles will now appear in the list of rolling stock.
5. You may need to repeat this process on other routes or scenarios where you wish the Class 360 to be available.

3.2 Assigning Destinations and Numbers

For developers wishing to make use of the units in their own scenarios and routes, it is possible to customise the Destination Display during creation of a scenario. This allows the train to correctly display an appropriate destination.

In order to display a specific destination, the correct value must be entered into the vehicle properties window. This number consists of a 12 digit value containing both a letter and numbers.

The 12 digit value is arranged like so: **dVVVVUUUUUU**

d = the Destination code (See the Destination List below)
VVVVV = the Vehicle number displayed on the side of the coach
UUUUUU = the Unit number displayed on the front of the driving vehicle

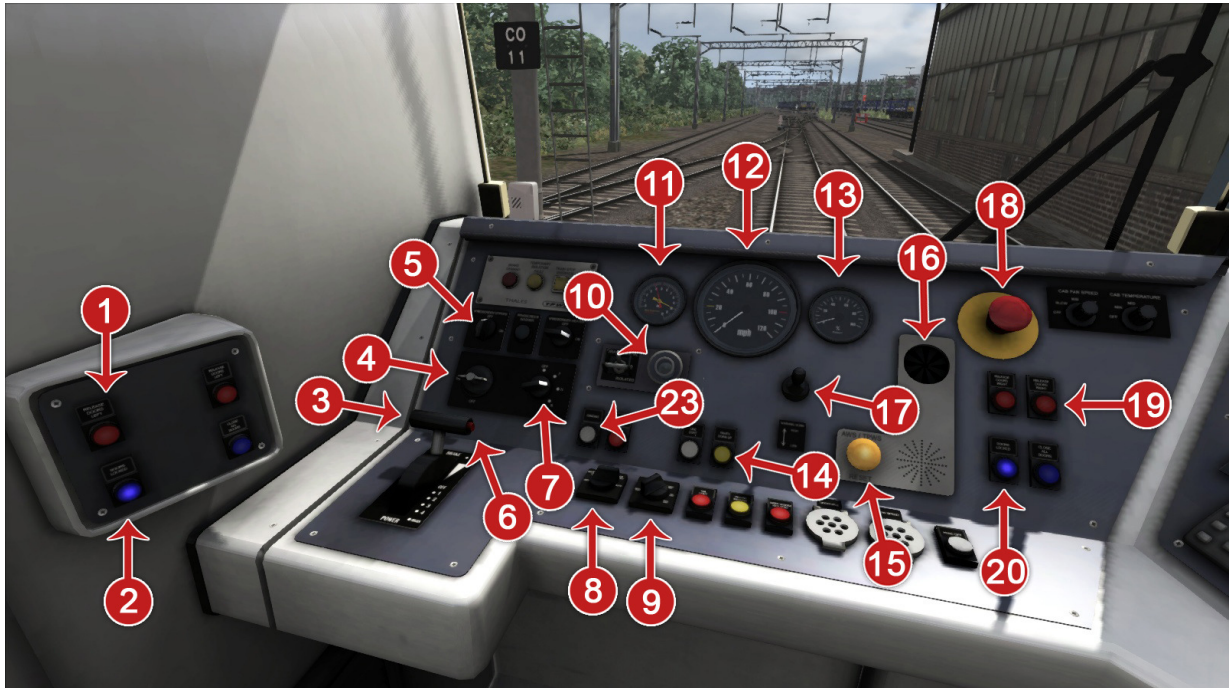
Example : d78580360101 (*where "d" is for Colchester Town*)

So the above value results in unit 360101, with vehicle number 78580, displaying "Colchester Town" as the destination

a	Shenfield	j	Heathrow Airport	s	Southminster
b	Braintree	k	Stansted Airport	t	Marks Tey
c	Colchester	l	London Liv St	u	Upminster
d	Colchester Town	m	Manningtree	v	Southend Victoria
e	Empty to Depot	n	Norwich	w	Walton-on-the-Naze
f	Chelmsford	o	Cambridge	x	Not in Service
g	Greater Anglia	p	London Paddington	y	Ilford
h	Harwich Town	q	Clacton	z	Special
i	Ipswich	r	Romford		

4 Driving the Class 360

4.1 Cab Controls



Train Simulator – GEML London Ipswich

Main console					
1	Door Release Left	8	Cab Light	16	AWS Sunflower
2	Door Locked Light	9	Head/Tail/Marker Lights	17	Horn
3	Combined throttle and brake	10	Driver Reminder Appliance (DRA)	18	Emergency Brake
4	Master Key	11	Brake Gauge	19	Door Release Right
5	Wiper Control	12	Speedometer	20	Door Locked Light
6	Brake Hold Button	13	Amp Meter	21	Information Screen
7	Reverser	14	Pantograph	22	Screen On/Off
		15	AWS Acknowledge		



5 Scenarios

5.1 Heading Out

An introduction to the Class 360 EMU, its control interface and driving technique.

- **Duration** **10 Minutes**
- **Start Location** **Ilford Depot**

5.2 Colchester Connection

Many services on the Great Eastern Main Line depend on services joining together in order to make the best available use of the paths provided by Network Rail. You are in charge of one such service today where you will take your 4 car Class 360 from Colchester Town as far as Colchester before coupling to another unit to form an 8 car service to Liverpool Street

- **Duration** **75 Minutes**
- **Start Location** **Colchester Town**

5.3 Eastern Intercity

Drive an 8 Car stopping train from Ipswich to London Liverpool Road.

- **Duration** **90 Minutes**
- **Start Location** **Ilford**

5.4 Its Snow Fun

After a heavy snowfall causing technical problems along the route, can you get to Shenfield without further incident?

- **Duration** **80 Minutes**
- **Start Location** **Ilford**

5.5 Braintree Branch

On a lovely spring evening in the capital, you will be driving a semi fast service to Braintree.

- **Duration** **70 Minutes**
- **Start Location** **London Liverpool Street**

5.6 Sunday Closures

On a lovely spring evening in the capital, you will be driving a semi fast service to Braintree.

- **Duration** **70 Minutes**
- **Start Location** **London Liverpool Street**

5.7 1Y41 - 12:52 Ipswich to London Liverpool Street

You're in charge of 360102 working 1Y41 1252 Ipswich to London Liverpool Street on a showery early afternoon, calling at Manningtree, Colchester, Marks Tey, Kelvedon, Witham, Hatfield Peverel, Chelmsford, Shenfield, Stratford and London Liverpool Street to arrive at 14:15. No problems have been reported so far but you should keep your wits about you....

- **Duration** **90 Minutes**
- **Start Location** **Ipswich**

5.8 Desiro Rescue

You're at Ilford depot and news has just come in of a failed 8-car Class 360 at Shenfield. You're tasked with taking a 4-car unit, that has just been washed, to rescue it and complete its journey to Liverpool Street. It is quite busy so the failed unit has already lost its booked path!

- **Duration** **50 Minutes**
- **Start Location** **Ilford Depot**

6 Signals

6.1 Main Signal Head Aspects



Colour light signals are used for controlling running movements. They display aspects by means of red, yellow and green coloured lights.

Signal Aspect	Description	Instruction to Driver
Red light	Danger	Stop.
Single yellow light	Caution	Proceed: be prepared to stop at the next signal.
Double yellow lights	Preliminary caution	Proceed: be prepared to find the next signal displaying one yellow light.
One flashing yellow light	Preliminary caution for a diverging route	Proceed: Be prepared to find the next signal displaying one yellow light with feather junction indicator for diverging route(s).
Double flashing yellow lights	Indication of diverging route ahead of the next but one signal	Proceed: Be prepared to find the next signal displaying one flashing yellow light.
Green light	Clear	Proceed: The next signal is displaying a proceed aspect.

6.2 Theatre Type Signals

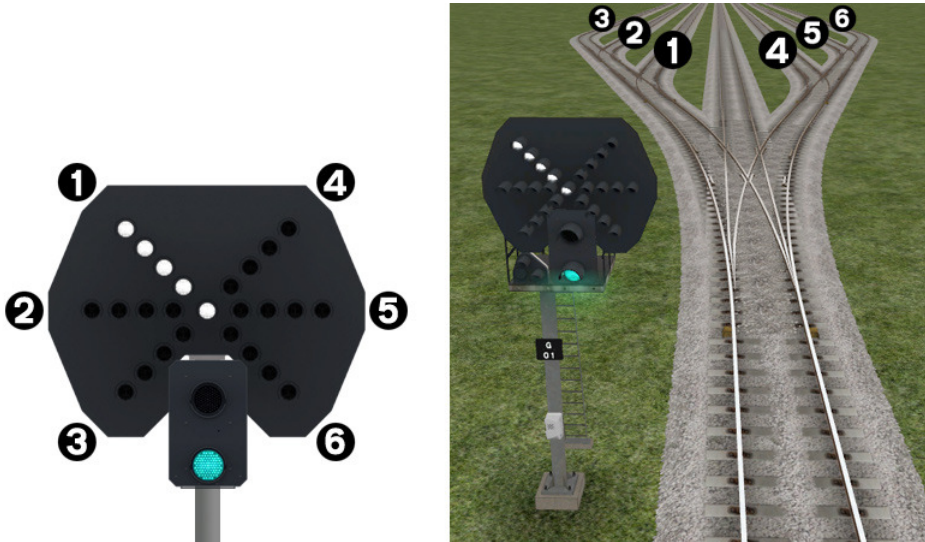


A Theatre alphanumeric route indicator indicates the route to be taken using numbers or letters (or a combination of numbers and letters).

A Theatre indicator is often used to show the arrival platform number.

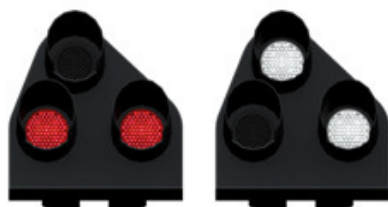
6.3 Feather Type Signals

A Feather junction indicator indicates a diverging route to be taken by the angle at which a line of five white lights is displayed. (*Position 1 shown*)



Feather Indication	Instruction to Driver
No Feather Indication	Obey main aspect, straight-ahead route is set
Position 1 indication	Obey main aspect, expect divergence to left
Position 2 indication	Obey main aspect, expect divergence to left more extreme than that for position 1
Position 3 indication	Obey main aspect, expect divergence to left more extreme than that for position 2
Position 4 indication	Obey main aspect, expect divergence to right
Position 5 indication	Obey main aspect, expect divergence to right more extreme than that for position 4
Position 6 indication	Obey main aspect, expect divergence to right more extreme than that for position 5

6.4 Ground Signals and Position Light Signals



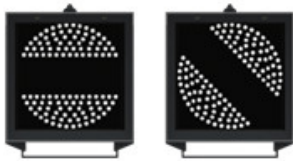
Ground Signals and Position Light Signals (PLS) display their aspects by means of the position and colour of lights. Ground Signals are always illuminated and can have miniature theatre indicators attached whereas PLS only illuminate to allow a train to pass in to an occupied section of line and are mounted as an addition to a main signal head.

Signal Aspect	Description	Instruction to Driver
Two red lights	Danger	Stop.
No aspect (located on a main aspect)		Obey main aspect.
Two white lights	Caution	The line ahead may be occupied. Proceed cautiously towards the next stop signal, stop board or buffer stops. Be prepared to stop short of any obstruction. The associated main aspect (where provided) may be passed at danger

6.5 Entering an Occupied Section of Track

During a scenario your train may be scheduled to enter a platform or section of track that is already occupied by another train or rolling stock. In this situation you should stop at the red signal protecting this section of track as normal. Once your train has stopped press the TAB key on your keyboard to request permission from the signalling centre to enter the occupied section of track. When your train movement is approved the signal will illuminate the two white lights on the position light signal if it has one.

6.6 Repeater Signals



A banner repeater signal indicates whether the signal ahead is displaying a proceed aspect or is at danger. Modern fibre optic banner repeating signals, as shown opposite, consist of a rectangular unlit black background displaying a white circle with a black bar.

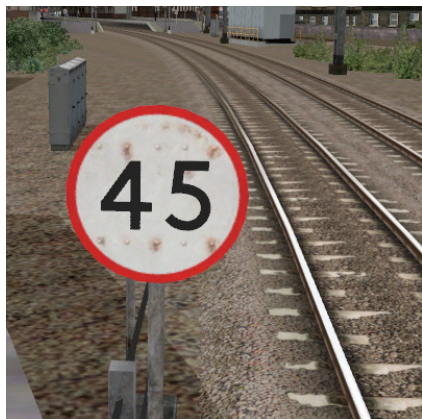
Signal Display	Instruction to Driver
Horizontal arm	Be prepared to find the related signal at danger
Arm at an upper quadrant angle of 45°	Related signal is exhibiting a proceed aspect

Repeater signals are intended to provide a driver with advance information of a signal that may be obscured on approach. A train does not need to stop at a repeater signal, only at the related signal if it is at danger.

Splitting banner signals provide two banner signal heads combined to form a splitting banner repeating signal. These are used to indicate the aspect of a signal with a feather junction indicator. If the related junction signal is displaying an illuminated feather then the lower banner head displays an arm at an upper quadrant angle of 45°. Alternatively, if the related junction signal is not displaying an illuminated feather and is indicating a straight ahead route then the higher “main” banner head displays an arm at an upper quadrant angle of 45°.

7 Speed Signs

7.1 Permissible Speed Indicators



These signs display the permissible speed in M.P.H. applicable to the section of line beyond the sign up to the commencement of any subsequent permissible speed section.

Remember to wait for the complete length of your train to pass these signs before accelerating if the permissible line speed is increasing. If the permissible line speed is decreasing then you must reduce your speed before passing these signs.

7.2 Permissible Speed Warning Indicators



These signs provide advance warning of a reduction in permissible speed ahead. Permanent AWS Ramps (Automatic Warning System) are often installed in conjunction with these signs. In these cases the driver must cancel the AWS warning when triggered on approach to these signs.

8 Safety Systems

8.1 AWS (Automatic Warning System)



AWS is provided to give train drivers in-cab warnings of the approach to signals, reductions in permissible speed and temporary/emergency speed restrictions, and to apply the brakes in the event that a driver does not acknowledge cautionary warnings given by the system.

As a train approaches a signal, it passes over AWS track equipment (magnets) which are fixed to the sleepers between the running rails. The magnets are sensed by a receiver mounted under the leading end of the train.

If the signal ahead is displaying a clear aspect (green), a bell (or an electronic ping) sounds in the driver's cab, and the AWS Sunflower indicator displays "all black". No action in respect of the AWS is required of the driver.

If the signal is displaying a caution or danger aspect (yellow, double yellow or red), a horn sounds in the driver's cab and the display shows "all black". The driver has to acknowledge the warning by pressing the "AWS Acknowledgement" push button. When the driver operates the push button, the horn is silenced and the AWS Sunflower changes to a segmented yellow and black circular display. If the driver fails to acknowledge the warning horn within a set time period, the brakes are applied automatically.

Where AWS equipment is provided on the approach to reductions in permissible speed and temporary/emergency speed restrictions, the cab equipment always operates in a manner equivalent to the approach to a signal displaying a caution or stop aspect. The driver receives a warning and has to respond to it accordingly; otherwise the brakes are applied automatically.

9 Credits

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