



Class 77 (EM2) Electric Locomotive



British Railsimulator Board

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INTRODUCTION:

The EM2, later Class 77 under TOPS, Co-Co electric locomotives were built at the Gorton Works in Manchester between 1953 and 1954. With their smoother ride and higher speed than the EM1, they were primarily designed and used for express passenger services between Manchester London Road and Sheffield Victoria on the Woodhead route.

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DESIGN:

The original electrification plan of 1936 for the Manchester, Sheffield and Wath lines included provision for nine express passenger locomotives. With the British Railways Executive ordering drastic savings, and not being able to justify that number of express locomotives for a 41 mile route, only seven locomotives were built. The final design for the EM2 emerged in 1953 from the Gorton Works in Manchester, with electrical equipment and traction motors being supplied by Metropolitan Vickers at Dukinfield.

Based upon the EM1 (Class 76) Bo+Bo mixed traffic locomotive, the EM2 was built with a similar, but stretched body, to accommodate the longer six wheeled Co-Co bogies. Unlike their sister class, the EM2 bogies were not coupled together, and the drawgear and buffers separated from the bogies back to the chassis, resulting in haulage forces being transmitted through the body giving a much smoother ride - a major fault of the EM1 series. Other changes included oval buffers, roller bearings and steam generators fitted to all of the locomotives. Each axle was driven by a 460hp, air cooled traction motor. For starting off, all six motors operated in series, then switched to two parallel circuits of three at intermediate speeds, and three parallel circuits of two for higher speeds. Locomotive air brakes and vacuum train brakes were fitted along with regenerative braking.

DEPOTS, NUMBERS AND LIVERIES:

Supplied in BR Black, Nos 27000 through 27002 were allocated to Wath depot, until 12th June 1954 when they transferred to Reddish upon its opening, with the remaining 27003 through 27006 being allocated to Reddish from new. In 1957 the class was renumbered, receiving a prefix of 'E' to the number. Throughout 1959 and 1960, following the naming of selected locomotives in the EM1 fleet, all 7 EM2s were given names from Greek mythology. In order of number they were Electra, Ariadne, Aurora, Diana, Juno, Minerva and Pandora. During the early 1960s, the entire class started to receive the standard BR green livery with E27002 receiving the same electric blue as the AC electric locomotives.

PERFORMANCE:

Performance tests of both the EM1s and EM2s were carried out between February and March of 1955. The EM2 suffered similar issues to the EM1 with weight transfer and traction problems under acceleration. While the EM1s were fitted with a weight transfer switch this was not deemed necessary for the EM2s so was not fitted.

The locomotives were recorded as being capable of hauling a 285 tons gross train at a steady 60-62mph up a 1 in 130 gradient between Sheffield and Penistone.

A working from Reddish Depot to Sheffield, pulling five coaches was given special authority to exceed the line speed on a number of sections. Speeds of 75mph were reached on three occasions and 80mph on the return.

In 1960, the line speed was dropped from 65mph down to 60mph. This coupled with the lack of performance advantages over their sister EM1s put into question the necessity for a separate express locomotive, resulting in all seven EM2 locomotives finally being removed from regular service on 2nd March 1968. By coincidence, the class was reallocated in the same month to TOPS Class 77.

POST WOODHEAD:

In September of 1969, all seven Class 77 locomotives were sold to Netherlands State Railways with an expected lifetime of ten years. 27005 was broken up and used for spares, while the remaining six locomotives entered service in 1970/71, after extensive modifications for NS operation and reclassification as NS 1500 Class.

Speeds of 86mph were recorded by scheduled trains in 1974. Mileages were much higher under NS service, with locomotives clocking up 2.5 million miles against 800,000 miles in England.

At their retirement, their lifetime far exceeded their original 10 year estimate, seeing service until June of 1986 when 27002, 27004 and 27006 were scrapped. 27000 and 27001 returned to England while 27003 remained in the Netherlands, all for preservation.

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PACKAGE CONTENT:

The Class 77 (EM2) Electric Locomotive package contains two locomotives in various liveries.

<i>Class 77 BR Black</i>	The original delivery colour.
<i>Class 77 Electric Blue</i>	Electric blue livery.
<i>Class 77 BR Green</i>	Post 1960 standard BR green livery.
<i>Class 76 BR Green</i>	EM1 in standard BR green livery.



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USING THE LOCOMOTIVES IN SCENARIOS:



Before you are able to use the Class 77 or BR Green Class 76 in your own scenarios you must enable it in the object set filters for that scenario.

When you make your own scenarios, or edit existing ones, only the default object sets are enabled for that route (for example the Kuju/RailSimulator assets for European routes and Kuju/RailSimulatorUS for North American routes). To enable additional object sets (which could be for any downloaded or freeware content) ready for use they must be checked in the object set filter list in the editors.

When editing the scenario you wish to add the Class 77 or BR Green Class 76 to, ensure you are in the **Scenario Editor** and click the small blue square on the middle left panel.

This opens a new panel on the right hand side of the screen (you may need to move your mouse over to the right hand side for the panel to fly out. You can pin it open if you wish).

This new panel has a drop down list of providers (usually the company name which produced the add-on) and a list of all products by that provider.

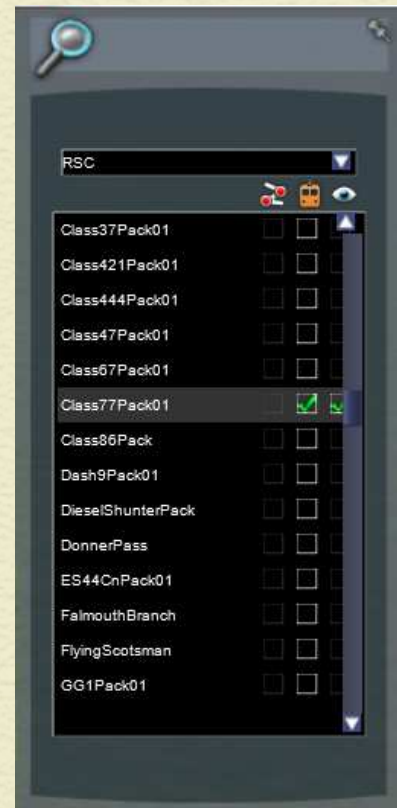
The Class 77 pack is produced by Railsimulator.com so RSC needs to be selected as the provider. The rest of the panel is then populated by all other RSC products you have purchased.

To enable the content of the pack for use in this scenario, check the box next to "Class77Pack".

Now the Class 77 and BR Green Class 76 electric locomotives will be available in the asset browser list for placement in the current scenario only.

If you want the locomotives to appear in the browser list for EVERY scenario on a route you must follow the same procedure but be in the **World Editor** and you can now check the first box.

The slight disadvantage of having content enabled for all scenarios on a route, even when that content may not be used, is increased loading times.



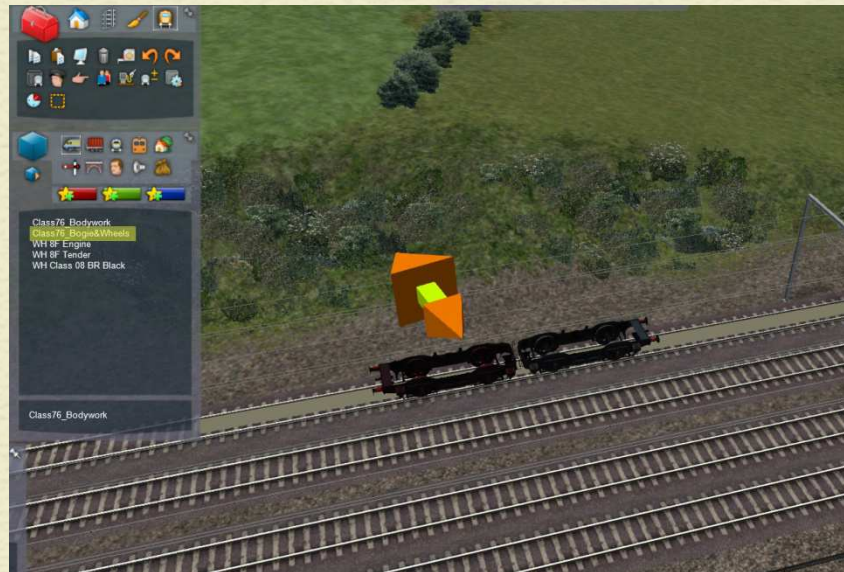
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CLASS 76 PLACEMENT:

In order to replicate the Bo+Bo bogie configuration of the EM1/Class 76, the TS2012 representation of the locomotive has been created as two distinct models; *Class76_Bogie&Wheels* and *Class76_Bodywork*.

To add a Class 76 into a scenario the following procedure may be used.

- Place two *Class76 Bogie BR Green* on the track, rotating one as required.



- Place a *Class76 Bodywork BR Green* into the route over the bogies. It will be 'attracted' to one set.



- Finally, tick the 'Consist Select' button, and click on your locomotive to check that it appears in the route as one unit.

If it is found that a bogie is not attached, it can simply be coupled to the rest of the loco as one would with an ordinary item of rolling stock.

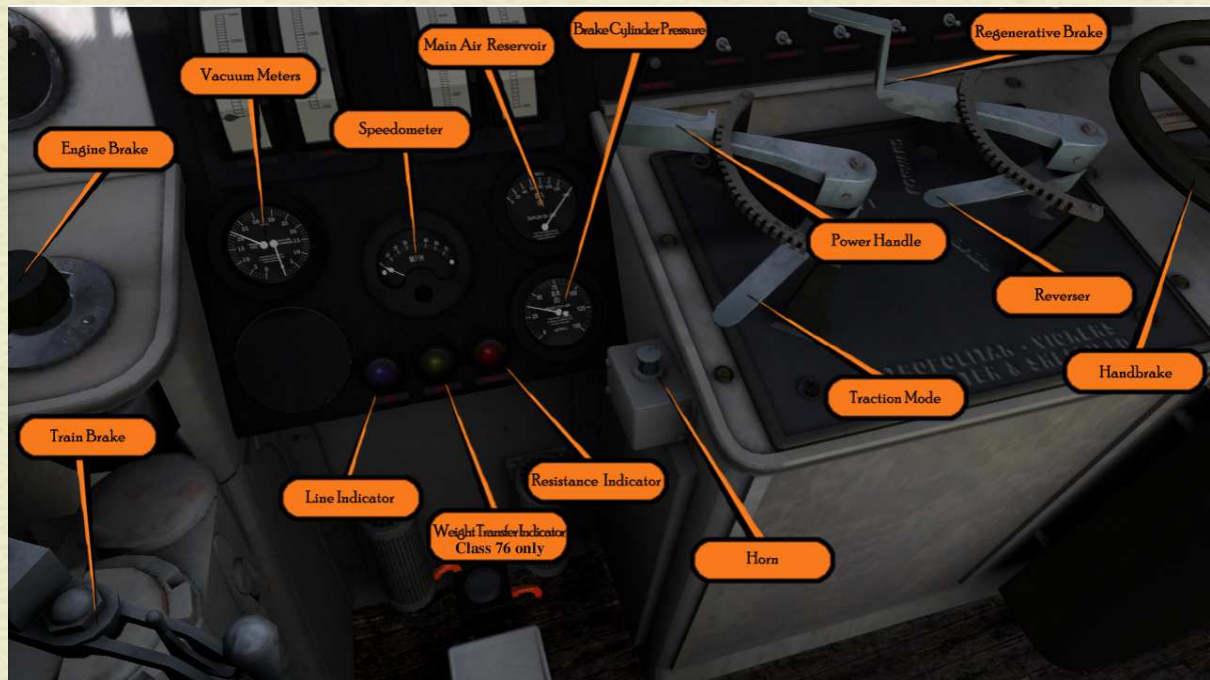


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DRIVING THE CLASS 76 AND 77:

CONTROLS & INSTRUMENTS:

Several of the controls of the Class 77 locomotive will not have been encountered previously in TS2012: these will be discussed in more detail, and a (hopefully) simple walkthrough is provided below.

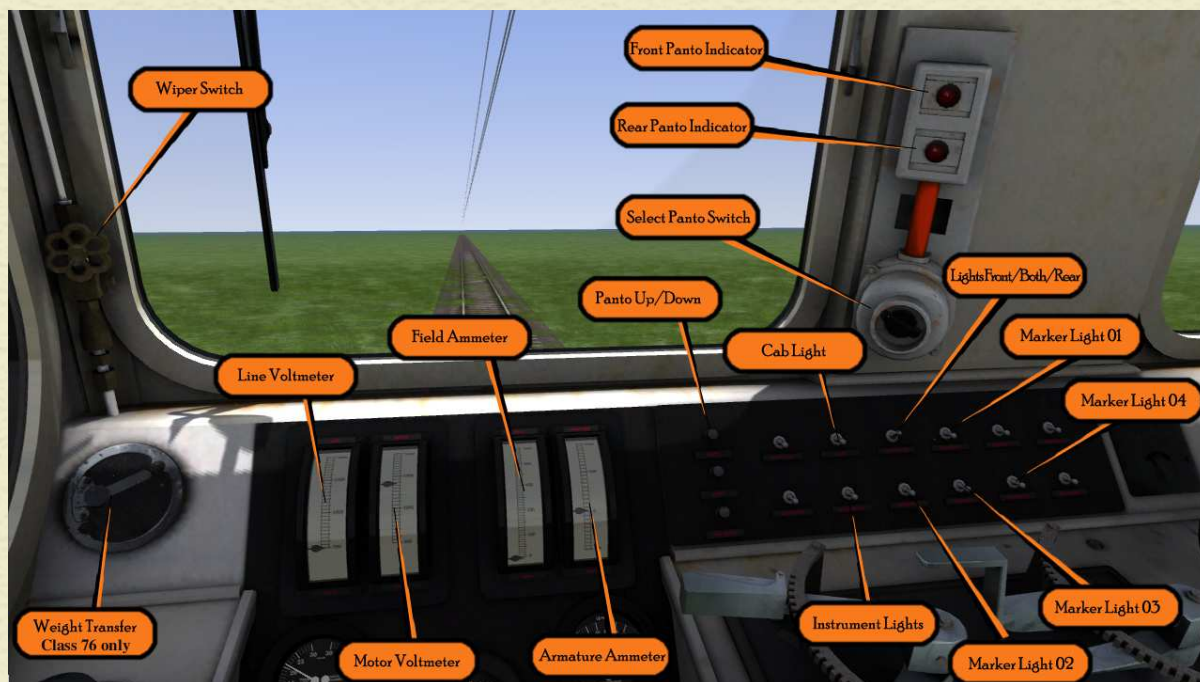


Line Indicator - Lit when pantograph(s) is raised under live catenary.

Resistance Indicator - Indicates a heavy load in the resistance banks. Generally to be avoided.

Traction Mode Lever - Switches the locomotive between Series and Parallel. As a guide, Series should be used up to around 30-35mph and Parallel for higher speeds. (Operated in-cab, via the Bell icon in the F4 display, or by pressing 'b')

Regenerative Brake Lever - At a crude level, this switches over the traction motors to become generators. Used for controlling heavy trains on long descents, careful adjustment of this lever enables the driver to maintain a desired speed. Electricity generated by the traction motors during this process is returned to the catenary via the pantograph(s). Please see the walkthrough.



Select Panto Switch - Enables either or both pantographs to be raised. For more information please see the walkthrough. (Only operable from the cab view)

Weight Transfer (Class 76 only) - This has the effect of reducing the torque supplied to the lead motor in each bogie which provides superior traction. However, this ceases to be effective at around 21mph, at which point switching off Weight Transfer will allow full power to be applied to both axles. (Only operable from the cab view)

Line Voltmeter - Indicates the catenary voltage.

Motor Voltmeter - Useful when initialising regenerative braking. For more information please see the walkthrough.

Field Ammeter - Indicates current usage of the motors.

Armature Ammeter - Gives an indication of the current being consumed or generated during regenerative braking operations. For more information please see the walkthrough.

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DRIVING WALKTHROUGH:

Before starting off a selection needs to be made for which pantographs are to be raised via the toggle switch, the positions of which are as follows.

Front Pantograph -



Both pantographs -



Rear Pantograph -



Once the required pantograph(s) have made contact with the catenary, the blue Line Indicator lamp will illuminate, and the Line Voltmeter will display 1500V.



With that done, the Class 77 can be driven very simply using the normal reverser, power handle and braking controls.

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Traction Mode Lever -



The locomotive will start in Series mode by default - this also allows finer power control - but by the time speeds of around 30mph are attained, performance will begin to deteriorate.

In order to change between Series and Parallel modes please follow these steps.

- Move the Power Handle to off
- Wait for the Field Amps reading to drop to zero
- Move the Traction Mode Lever to Parallel
- Re-apply current with the Power Handle

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Weight Transfer (Class 76 only) -

When full power is applied too early or when hauling heavy trains, under normal circumstances the following situation will occur.



With Weight Transfer switched on traction is maintained. Should this be insufficient the locomotive sanders may be used in addition.



Regenerative Braking -

Extremely useful for the long descents encountered in the route, Regenerative Braking provides braking by turning the locomotive into a mini-generator; returning the electricity generated back into the system via the pantograph.

To begin regenerative braking.

- Move the Power Handle to the off position
- Slowly pull the Regenerative Braking Lever towards you (cab view control only)
- Stop when the display on the Motor Voltmeter (2nd left gauge) matches that shown on the Line Voltmeter gauge



You will notice that the Armature Ammeter still displays zero at this stage.

- Move the Power Handle to its maximum travel

Train speed may now be controlled via the Regenerative Brake lever.

To slow, pull the lever towards you. The Armature Ammeter will display a reading of the current being generated.



The Regenerative Brake lever may also be used to increase speed (although it should not be used as an alternative Power Handle)

To increase speed, push the lever away towards the cab window. The Armature Ammeter will display a reading of the current now being consumed.



Note also that the reading on the Motor Voltmeter has dropped below parity with the Line Voltmeter.

To switch off regenerative braking the following steps should be followed.

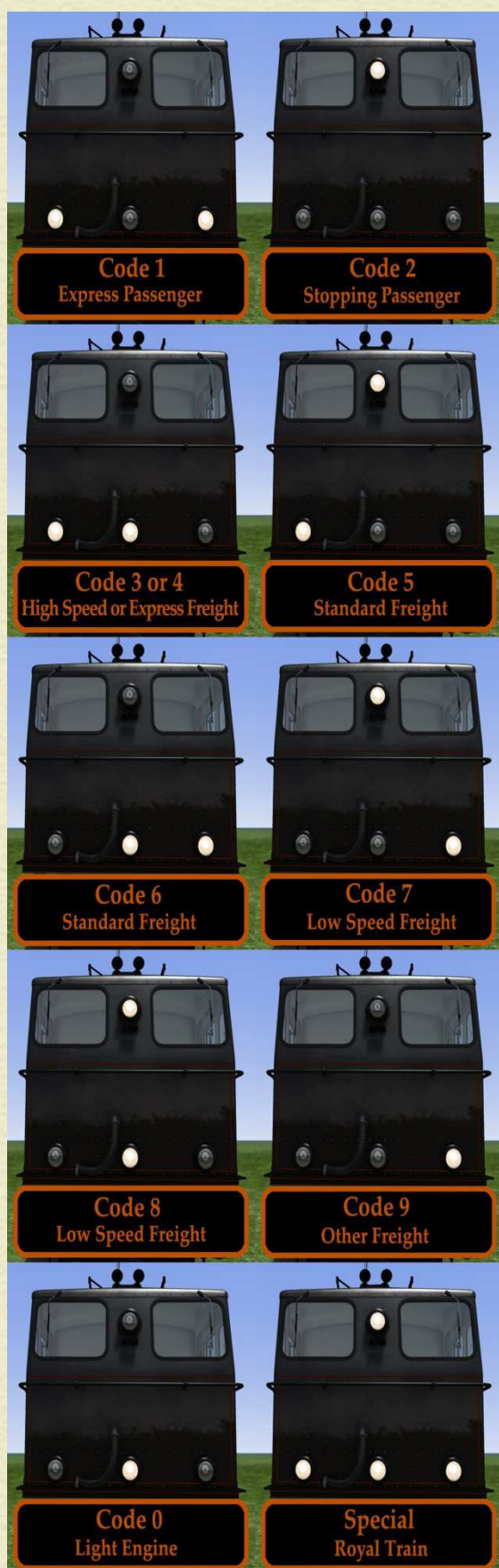
- Gently return the Power Handle to the off position
- Return the Regenerative Braking lever to its off position.
- The Armature Ammeter will display zero, and normal driving may be resumed.



KEYBOARD CONTROLS:

HANDBRAKE	O	
CABLIGHT	C	
INSTRUMENT LIGHTS	F	
HEADLIGHT / MARKER LIGHT 01	H	
MARKER LIGHT 02	J	
MARKER LIGHT 03	K	
MARKER LIGHT 04	L	
PANTO SELECTION 3 STATES		
FRONT/BOTH/REAR	F7	F8
SHIFT LIGHTS 3 STATES		
FRONT/BOTH/REAR	N	M

LOCOMOTIVE HEAD CODES:



Class/Code 1 -

Express Passenger train, news-paper train, or breakdown van train; snow plough on duty; light engine proceeding to assist disabled train.

Class/Code 2 -

Ordinary passenger, branch passenger or 'mixed train'; breakdown van train not on duty.

Class/Code 3 -

Parcels, fish, fruit, livestock, milk or other perishable train composed entirely of vehicles conforming to coaching stock requirements; empty coaching stock (not specially authorised to carry Class 1).

Class/Code 4 -

Express freight train pipe-fitted throughout with the automatic vacuum brake operative on not less than 90% of the vehicles.

Class/Code 5 -

Express freight train with the automatic brake operative on not fewer than half of the vehicles.

Class/Code 6 -

Express freight train partly fitted with the automatic brake operative on not fewer than 20% of the vehicles.

Class/Code 7 -

Express freight train not fitted with continuous brake.

Class/Code 8 -

Through freight train not fitted with the automatic brake.

Class/Code 9 -

Pick-up branch freight, officer's special train or ballast train requiring to stop in section.

Class/Code 0 -

Light engine with no more than 2 brake vans.

SCENARIO INFORMATION:

1 7.32 from Leicester (Standard)

Relieving the steam hauled express at Sheffield, you look forward to driving your EM2 hauled express at top speed to Manchester. But signalmen have their own idea of what takes priority...

Date July 1956
Rating Hard
Duration 73 minutes
Start Time 9.47am
Season Summer
Start Location Sheffield
Class 77 Black

2 From Coast to Coast (Standard)

Drive the electrically hauled express Guide Bridge to Sheffield in the dead of winter with the EM2 Locomotive.

Date December 1958
Rating Medium
Duration 55 minutes
Start Time 10.55
Season Winter
Start Location Guide Bridge
Class 77 Black

3 The Stand in (Standard)

Due to a temporary mechanical problem, the entire fleet of London Road EMUs has been temporarily withdrawn. Can the EM2 stand up to the task and fulfil the role of hauling the stopping train from Manchester to Hadfield?

Date July 1962
Rating Easy
Duration 36 minutes
Start Time 9.15am
Season Summer
Start Location Manchester London Road
Class 77 Green

4 Arc Under The Pennines (Standard and Career)

Take the drivers seat of 27000 and drive this special, inagural non-stop run from Sheffield to Manchester. Top railway brass are aboard so there should be no delays for you. Keep it smooth. All of your passengers are due at a meal in Manchester at 13:00 so you need to have them there by 12:25.

Date September 1954

Rating Medium

Duration 55 minutes

Season Autumn

Start Location Sheffield

Class 77 Black

5 Sheffield Express (Standard and Career)

Today you will be driving the service from Manchester Piccadilly to Sheffield, you will call at Guide Bridge, Godley Junction, Hadfield, Dunford Bridge, Penistone and Sheffield. Please note that you will need to pick up passengers at Manchester Piccadilly.

Date October 1967

Rating Easy

Duration 60 minutes

Season Autumn

Start Location Manchester

Class 77 Blue

6 Class 77s @ Manchester (Free Roam)

Drive an EM2 / Class 77 Locomotive from Manchester

Date August 1960

Duration Freeplay

Season Summer

Start Location Manchester

6 Class 77s @ Sheffield (Free Roam)

Drive a Class 77 from Sheffield

Date October 1960

Duration Freeplay

Season Autumn

Start Location Sheffield

6 Class 77s @ Wath (Free Roam)

Drive an EM2 / Class 77 Locomotive from Wath

Date March 1963

Duration Freeplay

Season Spring

Start Location Wath

6 Class 77s @ Penistone (Free Roam)

Drive an EM2 / Class 77 Locomotive from Penistone

Date January 1964

Duration Freeplay

Season Winter

Start Location Penistone