# WCML Over Shap

# 1 Route Information

## 1.1 History

The WCML is a trunk railway that was developed by a number of separate railway companies over a fifty year period in the 19th Century. The northern section beyond Preston towards Carlisle presented similar engineering challenges to those faced by the engineers of the Caledonian Railway when they tackled the Southern Uplands of Scotland and the notorious Beattock Bank. A name synonymous with the challenging terrain of the Northwest of England is Shap.

The construction of the line between Preston and Lancaster was undertaken by the Lancaster and Preston Junction Railway. The alignment via Garstang followed closely the line of the Lancaster Canal, through relatively gentle terrain. Engineer, Joseph Locke, would oversee this project with the 20 miles of double track completed just three years after the signing of an Act of Parliament approving its construction in 1837.

Locke would, however, have to contend with the Cumberland Hills if he was to successfully push the line north towards Carlisle and Scotland.

The Lancaster and Carlisle Railway began construction of the 70 mile route between the two cities in 1844, with the first sod being cut at Shap Summit, the highest point of the line (and that of the entire WCML in England) at 916 feet above sea level.
As with many new railway projects of the time, there had been fierce local debate with regard to the preferred route that should be adopted. George Stephenson, no less, had promoted a route that would have skirted the Cumberland coast in order to avoid the challenges of the fells and lakes. Locke would not shy away from such obstacles, instead his simple yet effective solution was to work with the landscape. The resulting alignment uses the contours to incredible effect, plotting a line through the hills that does not feature any tunnels. This is not to say that difficulties did not have to be overcome; several large viaducts and deep cuttings were necessary and this section of the WCML is perhaps the most curvaceous on the route.
In spite of the scale and difficulty of the project, completion would be achieved in just 30 months.

## 1.2 The Route

Preston is a railway town; since the coming of the railway in the 1830s the station has been a hub for the Northwest of England. Similar to York on the East Coast Mainline, Preston is roughly the half-way point on the mainline between London and Scotland. This has made it a logical point for crew changes and the station provides interchange with local lines radiating towards destinations such as Manchester, Bolton and Blackpool.
On our journey north, the complex throat beyond the station splits at the foot of the Church of St Walburge, a significant Preston landmark. Fylde Junction is where the line to the Fylde Peninsula and Blackpool diverges to the west and the mainline continues north through the northern industrial and suburban areas of Preston.

Beyond the loop at Oxheys and after passing beneath the M55 motorway the line leaves Preston and enters open countryside. The next loop, this time in the down direction, is Barton and Broughton and is located between the respective villages and was the site of a station in the steam era. Likewise, the next village of Brock lost its station in the 1960s. Beyond Brock, towards Garstang and Catterall, the railway remains level and straight as it runs parallel with the M6 motorway and close to the Lancaster Canal. At Scorton, the line crosses the River Wyre on a low stone viaduct. There was another local station at Bay Horse, all that remains is a substation and a pair of emergency crossings. As Lancaster draws closer the tracks fly over the village of Galgate on a high embankment and impressive viaduct before sweeping round the curves at Oubeck, the site of up and down passing loops.
The final approach to Lancaster cuts through the suburban area to the south of the city before curving sharply in advance of the station at Lancaster Castle.

On departure from the fine Lancaster and Carlisle Railway station, the line immediately crosses the River Lune at high level on a steel beam bridge, which replaced an earlier wooden structure in the 1960s. The bridge is known for emitting a low pitch hum when the wind blows in from Morecambe Bay. The Morecambe Branch diverges to the west as the northern suburbs of Lancaster are left behind. The twin track branch operates as two single lines, one line terminates at Morecambe, the other provides access to the Heysham Branch, Heysham Port station and Heysham Nuclear Power Station.

The triangular junction to the branch has Hest Bank level crossing at its northernmost point. Hest Bank, again the site of a former station, is located virtually on the sands of Morecambe Bay. This is the closest that the WCML gets to the western coastline of the UK along its 400 miles length.

Carnforth may not be the hive of activity that it has been in the past, however, it remains an important junction, with lines diverging to Barrow in Furness and the Cumbrian Coast and towards Hellifield and Leeds. The station itself no longer has platforms facing the mainline but the tightly curved platforms on the diverging route are still active. Carnforth Station was used as a location in the celebrated film of the 1940s, Brief Encounter. Today, many of the features of the period have been reinstated and the station building incorporates a visitor centre. The former steam shed on the down side was the home of the Steamtown Museum, now it provides a base for rail charter specialists West Coast Railway Company.

The relatively level running north of Carnforth soon gives way to a more curvaceous and graded railway as the line enters Cumbria at Milnthorpe, south of Oxenholme. Oxenholme (The Lake District) is a mainline station located in a village but it serves the larger settlement of Kendal in the valley below. The station is also the location where a single track branch diverges towards Windermere via Kendal. Immediately north of the station begins the first significant climb north of Preston, Grayrigg Bank.

Once over the Dockray Viaduct at Docker and the emergency crossings at Lambrigg the line levels out briefly at Grayrigg, the site of a former station and now the location of up and down passing loops. The M6 motorway rejoins us at the north end of the loops and it will follow the railway for much of the journey all the way to the Scottish border. After emerging from beneath the flyover the landscape changes yet again, this is the Lune Gorge where the railway, motorway and River Lune weave a path through the fells. The valley used to feature two junction stations, Low Gill to the south end - with the magnificent sandstone viaduct that used to carry the branch to Sedbergh still in situ - and Tebay at the north end which was a significant rural rail centre, a junction for the branch to Kirkby Lonsdale and the home to Shap banking engines.

Banking engines no longer reside at Tebay, as modern traction can take steep gradients like Shap in their stride. However, the five miles of 1 in 75 remains an obstacle for heavy freight trains and steam charters. The summit at Shap Quarry is 916 feet above sea level and is the highest point on the English WCML. Limestone and aggregates workings are aplenty on the hills around Shap; on the descent to Penrith the line serves facilities at Shap, Hardendale and Thrimby. The approach to Shap Summit from the north is less severe; trains making the journey north can cruise down the 1 in 125 for much of the way into Penrith as it follows the River Leith. In spite of the less dramatic landscape, the construction of significant structures was still necessary; Lowther and Eamont Viaducts, the work of Joseph Locke, and 2 concrete flyovers traversing the M6 motorway dating from the late 1960s.

Penrith (The North Lakes) was once a junction station for the branch to Keswick and provided a link to the Eden Valley branch to Stainmore. The town is now better known as a crossroads on the M6, where the motorway intersects the A66 trunk road linking west to east.

For much of the distance from Penrith to Carlisle, Locke's route follows the River Petteril. There are a number of villages along the way which have previously had their own station; Plumpton, Calthwaite, Southwaite, Wreay and Brisco. Some have retained the station buildings, now as private homes; Plumpton retains a goods loop on the up side and Southwaite retains emergency crossings.


The southern approaches to Carlisle take trains over Upperby Bridge Junction where the line opens up to main and goods lines. Once past the former depot and carriage sheds at Upperby, the goods lines dive below the mainline and bypass Carlisle Citadel Station to appear again at Caldew Junction between Citadel and Kingmoor. These avoiding lines were retained and electrified during the rationalisation of the area's railways in the 1970s but were closed in the mid 1980s following the derailment of a train of runaway Freightliner wagons which caused significant damage to infrastructure and bridges.

Carlisle is today what it has been for over 150 years, a major rail hub. Citadel Station is the busy interchange for services coming off the Settle and Carlisle line, The Cumbrian Coast, The Tyne Valley and the former Glasgow and South Western Railway route to Glasgow via Dumfries.

Upon departure from Carlisle on the WCML, the rivers Caldew and Eden are crossed in quick succession before the landscape opens up and one of British Railways' 1960's white elephant marshalling yards presents itself at Kingmoor (Carlisle New Yard). The extensive yards were never fully utilised and came under threat of complete closure during BR days. Today, a healthy flow of coal and timber from Scotland to the south means there is always some activity on the site. Direct Rail Services occupy the former Kingmoor TMD to the south of the yards.

Within 10 miles of Carlisle we cross the River Esk, where the Solway Firth reaches furthest inland, and then the Anglo Scottish border at Gretna. The mainline station at Gretna has long been closed, these days the twin village of Gretna Green benefits from the 1990's reopened station on the GSWR line which branches off the WCML at Gretna Junction. The former LMS mainline between Gretna Green and Annan was singled in the late 1960s and services were run down. Annan remains as the only intermediate station to Dumfries.

## 1.3 The Route in Train Simulator

The route depicted is broadly based on the layout as it exists today and has existed since electrification in the mid 1970s. The surrounding landscape and urban areas are also modelled on the present day with some stations and features represented as they existed during the 1980s in an effort to allow greater flexibility in recreating operations of that period.

The 90 route miles from Skew Bridge Junction (Preston) to Carlisle Upperby are included. The route continues north through Carlisle Citadel Station and via Bogg Junction and the goods/avoiding lines to Caldew Junction. The WCML extends past Kingmoor to Gretna Junction.

The Glasgow and Southwestern route from Gretna Junction is included as far as Dumfries, based on the 1980s layout.

The Morecambe and Heysham branch lines are included north of Lancaster.

The various quarry facilities in the Shap area are included.

The various lines converging on Carlisle are included in part to allow various depots and yards to be utilised in scenario creation.

The Ministry of Defence facilities at Longtown, Smalmstown and Eastriggs are included to offer further range in scenario creation.

The Maxwelltown branch west of Dumfries is also included.

The route also features Mk3 catenary assets individually placed to provide as accurate a representation as possible and UK Pro 4 aspect MAS signalling is also included across the route.

## 1.4 Rolling Stock

Rolling stock included in the pack includes:

- Class 87 BR Blue
- Class 47 BR Blue
- Class 47 BR Blue "Large Logo"
- Mark 2 Coaches in BR Blue Grey
- Mark 1 BG Coaches in various liveries
- Mark 1 RMB Coach in BR Blue Grey
- Mark 3 Coaches in BR Blue Grey
- Test Car 10 Coach
- FSA/FTA Container Freight Wagons
- HAA Hopper Wagon
- OAA Open Wagon
- PCA Tanker Wagon
- PGA Hopper Wagon
- TTA Liquid Tanks
- YGH Hopper Wagon

## 1.5 Focus Time Period

This Train Simulator simulation is early 1970s to 1980s.

# 2 Getting Started

## 2.1 Recommended Minimum Hardware Specification

The Western Lines of Scotland route is highly detailed and feature-rich and incorporates detailed night lighting and will benefit from a higher PC specification.

- Windows XP with latest service pack installed / Windows Vista / Windows 7 / Windows 8
- Processor: 2.8 GHz Core 2 Duo (3.2 GHz Core 2 Duo recommended), AMD Athlon MP
- RAM - 2.0GB
- GFX - 512 MB with Pixel Shader 3.0 (AGP PCIe only)
- SFX - Direct X 9.0c compatible

# 3 Driving

## 3.1 Brakes

Both Class 47 and Class 87 locomotives on this route are fitted with the modern standard BR air braking systems. The Class 47 is additionally dual fitted, allowing it to haul trains fitted with the older vacuum brakes. Operation is essentially identical in both cases.


The positions of the train brake handle, illustrated above, are as follows:

**EMERGENCY (100%)**
The brake pipe is completely vented, causing the brakes throughout the train to be applied as hard and as quickly as possible. Recharging the brake pipe from this condition can take a substantial amount of time on a long train.

**FULL SERVICE (70%)**
The brakes are applied fully and at a normal pace throughout the train. There is a detent to help avoid accidentally pushing the handle beyond this position and into EMERGENCY.

**SERVICE (30-70%)**
In this range, the train brakes can be controlled in intensity without restriction. Drivers are reminded that longer trains will respond more slowly to changes in brake pipe pressure, and will thus require earlier operation of the brakes.

**INITIAL (30%)**

This is the minimum setting before the train brakes must be completely released. Attempting to set the brake handle between RUNNING and INITIAL will result in the handle automatically settling to the nearer of the two.

**RUNNING (0%)**
In this position, the brakes throughout the train are fully released. The brake pipe gauge will settle on 5.0 bar (72.5 psi) under normal conditions.

**RELEASE (negative handle position)**
This is a spring-loaded position used for rapidly releasing the brakes, and for overcharging the brake pipe to calibrate the train's distributor valves. See the brake overcharge procedure laid out below for details. Unless the handle is held in this position, it will automatically return to the RUNNING position.

The loco brake handle can be continuously varied between 0-100% without restriction. It directly controls the brakes on the locomotive only. If both a train brake and a loco brake application are made at the same time, the locomotive's brakes will adopt the highest of the two resulting brake forces. Drivers are reminded NOT to use the locomotive brake alone to control the speed of a train.

The state of the train's brakes can readily be monitored on the gauges provided.

When fully released, the air brake pipe gauge will normally read 5.0 bar, while the vacuum brake pipe - which is only used when coupled to vacuum-fitted stock - will normally read 21 inches. The pipe pressure (or vacuum) is reduced to apply the brakes throughout the train. The power handle should always be moved to the OFF position when applying the train brake.

The duplex brake cylinder gauge indicates the brake pressure on the locomotive only. The friction brakes are fully released when this reads zero on both needles.

Drivers will note that the brake pipe will take some time to fully respond on long trains, and should think ahead accordingly. It is always better to brake too early or too much than to overrun a stopping point or the onset of a speed restriction. For small reductions in speed, a slight application of the brake is usually sufficient.

### 3.1.1 TRAIN DIVISION IN MOTION

If the train should divide while in motion, the brake pipe will part at that point, releasing all pressure (or vacuum) to atmosphere and thus automatically applying the brakes on both portions of the train. This automatic operation of the brakes has been mandatory on passenger trains since 1892, and is now standard practice on freight traffic as well.

Such an occurrence will be indicated on the brake gauges as for an emergency application, even though your brake handle may still be in RUNNING or even RELEASE. You should immediately move the power handle to OFF and the brake handle to FULL SERVICE, and wait for the train to come to a complete halt.

Your secondman will then examine the train, which may take several minutes, after which he will close the brake pipe at the far end of the train. With the brake handle in FULL SERVICE, you will notice the brake pipe pressure rise slowly as the brake system recharges. You may then proceed to cautiously recover your lost wagons and resume your journey.

### 3.1.2 OVERCHARGING THE BRAKE PIPE

Different locomotives charge their brake pipes to slightly different pressures. In order to avoid dragging brakes - which is dangerous as well as inefficient - drivers are required to perform a Brake Overcharge Cycle whenever taking over a prepared train, or when fresh vehicles are coupled to their locomotive. This automatically recalibrates the distributor valves throughout the train to conform to the brake pressure of your particular locomotive.

While some of the latest locomotives are fitted with automatic systems which perform a Brake Overcharge Cycle at the push of a button, the Class 47 and 87 are veteran stalwarts which require a little more attention from drivers:

1) If the train must be held stationary, apply the locomotive brake fully (‘]’ key).

2) Move and hold the train brake handle to the RELEASE position (hold ‘;’ key) for ONE MINUTE. The brake pipe pressure will be seen to climb appreciably above 5.0 bar.

3) Allow the brake handle to return to the RUNNING position. The brake pipe pressure will now slowly return to 5.0 bar over a period of several minutes. When this has completed, the overcharge cycle is complete.

4) If it is necessary to make a train brake application before the pressure has fully returned to 5.0 bar, then the Brake Overcharge Cycle procedure must be restarted from the beginning when next releasing the train brake.

Drivers please note that this procedure is NOT required on vacuum braked trains, on which an equivalent recalibration is performed by pulling the manual release valves on each vehicle. This task is performed by ground staff when required.

### 3.1.3 STARTING A TRAIN ON A RISING GRADIENT

1) Begin with the train held on the train brake and the power handle at OFF.

2) Apply the locomotive brake fully (100% - ‘]’ key).

3) Release the train brake fully (‘;’ key), and overcharge if required. If the train begins to roll backwards, hold the train using an INITIAL application only.

4) Apply power carefully until the train appears to strain forward against the brakes.

5) Ensure that the train brake is released, then release the locomotive brake fully (‘[‘ key).

6) Increase power as required.

IF AT ANY POINT the train begins to roll backwards, the power handle must IMMEDIATELY be moved to OFF, and the train brake applied to halt the unintended movement. If this continues to occur after repeated attempts of the above method, the train is too heavy for the gradient and the traction provided, and assistance will be required.

### 3.1.4 SPECIAL NOTE FOR CLASS 87 LOCOMOTIVES ONLY

Class 87 locomotives are fitted with a rheostatic brake, which automatically operates to relieve the friction brakes on the locomotive when a train brake application is made. The power handle must be at OFF and the tap-changer must have run back to zero before this will occur.

There is no change in brake force due to this, but you will notice the duplex brake cylinder gauges fall to near zero pressure, accompanied by the sound of the resistor bank fans, when the rheostatic brake is operating. Should any fault or interruption occur to the rheostatic brake, the friction brakes will take over again automatically.

## 3.2 CLASS 47


The Brush Type 4 locomotive, as the Class 47 was originally known, is a powerful mixed-traffic locomotive powered by the well-regarded Sulzer 8LDA12-B diesel engine. With a maximum permitted speed of 95 mph, over 2500 horsepower on tap and roughly 120 tons of adhesive weight on six axles, the class is highly versatile and was built in large numbers during the 1960s. Dozens of surviving examples are still used on the mainline network well into the 21st century.

As with all diesel-electric locomotives of this era, the diesel engine delivers power through a large electrical generator which is in turn connected to traction motors attached to each axle. There is no mechanical connection between the engine and the wheels. A smaller generator mounted alongside the main generator provides power for auxiliary systems, such as lights and compressors.


The power handle on this locomotive primarily controls the rotation speed of the diesel engine. An automatic load regulator controls the power delivery so as not to overload the engine. When the engine rotates faster, more electric power is delivered to the traction motors, and vice versa. Power delivery can be monitored on the main ammeter, pictured above.

There is also a special "shunting" notch at the low end which causes the load regulator to adopt a minimum position, delivering a small amount of power for slow, light-engine movements.

As the speed of the train increases, the voltage available from the generator becomes insufficient to maintain full power. The traction motors automatically transition into three successive stages of weak-field operation at 33, 45 and 61 mph. These weak-field stages slightly reduce the efficiency of the motors, but greatly reduce the voltage they need at high speeds. Drivers should expect tractive effort to fluctuate momentarily when weak-field stages are taken or removed, and will also notice the ammeter readings jump to a new level at the same time.

### 3.2.1 STARTING A TRAIN

When the power handle is opened beyond the SHUNT position, it takes several seconds for the load regulator to adjust to the optimal position for prevailing conditions. Drivers should resist the temptation to immediately throw the throttle wide open, as the machinery may then run away beyond his intentions after a delayed reaction.

To start a train gently on level track, it is appropriate to select the "ON 325rpm" position initially, then immediately release the brakes. When the ammeter reading begins to fall, the power handle can be opened further, keeping an eye on the main ammeter and, of course, the speedometer.

To start a heavy train on a rising gradient, please refer to the appropriate section of the Braking Instructions elsewhere in this manual. Maximum starting tractive effort is obtained at about 450rpm, and the ammeter should not be permitted to read over 3.5 KA (on ammeters calibrated to 5KA) or 7 KA (on ammeters calibrated to 10KA) for any significant period of time.

When shunting a loose-coupled train or operating in a yard with a low speed limit, use the SHUNT position initially, and open the throttle to the next position only if SHUNT provides insufficient power. There is a large difference in the power obtained by these two settings, so returning to the SHUNT position may soon be necessary. Note that the load regulator is just as slow to return to its minimum position as it is to rise.

## 3.3 CLASS 87


The Class 87 locomotive was purpose-built for hauling fast express trains on the West Coast Main Line, especially on the steep gradients of Shap and Beattock, as a straightforward development of the established Class 86. Nominally rated for a very impressive 5000 horsepower - and with even more available on a short-term basis - a Class 87 can cruise at 110 mph indefinitely if line conditions permit.

Operating a tap-changer locomotive such as this requires patience, good concentration and forethought. Learn how much power you need at each point on the route, and anticipate the changes in power you need to make, just as you anticipate the brake applications you need to stop the train in the correct place. The Class 87 will reward your efforts with seemingly limitless power.

There is no on-board diesel engine, and operation is therefore very different from a diesel locomotive. Instead, electric power is collected from the overhead wire, which is energised at 25kV 50Hz AC, via a Brecknell-Willis High Speed Pantograph. Drivers are reminded to stay well clear of the live wire, and NEVER to reach, with or without an implement, above the orange cant-rail stripe.

The power handle on this locomotive controls a tap-changer, which in turn controls the voltage applied to each of the four traction motors. Higher voltage results in greater current and tractive effort, while higher speeds require higher voltages to maintain the same current and effort.

There are six distinct positions of the handle:

**OFF**
Power is completely removed from the motors, and the tap-changer runs back towards zero.

**RUN DOWN**
The motors remain connected, and the tap-changer runs back towards zero.

**NOTCH DOWN** - briefly tap 'D' while in HOLD
The tap-changer steps down by one notch, and the handle springs back to the HOLD position.

**HOLD**
The tap-changer remains in its current position. While driving, this is the normal position.

**NOTCH UP** - briefly tap 'A' while in HOLD
The tap-changer steps up by one notch, and the handle springs back to the HOLD position.

**RUN UP**
The tap-changer runs up towards its maximum setting.

The tap-changer itself has 39 notches plus an Off position, known as Notch Zero. It can step or run in either direction at a maximum rate of one notch per second. The driver can make fine adjustments to the power setting using NOTCH UP/DOWN, and larger adjustments at the fastest rate available using RUN UP/DOWN. The first 38 notches incrementally select higher voltages, while the 39th notch engages a weak-field setting on the motors, maintaining the same voltage as Notch 38.

If an immediate cut of power is required, the OFF position may be used at any time, but the tap-changer must then completely run back to Notch Zero before power can be regained. This can take 30 seconds or more, depending on the original position.

Drivers are reminded that sudden changes in tractive effort tend to jolt the train, causing discomfort to passengers and potentially dangerous shockwaves in freight trains.

The present notch setting is displayed on the notch meters (on the right) as a percentage of maximum. Thus on this class of locomotive, Notch 39 appears at 100%. The left-hand of the two notch meters shows the notch setting on this locomotive, while the right-hand one is supposed to display the setting on the second locomotive of a pair - however, fitters are still tracing a persistent fault in this equipment, which disables the second meter.

The meters with coloured bands are the motor ammeters. The needles will normally remain in the green sector when cruising at constant speed, representing operation within the continuous rating of the locomotive.

For acceleration, however, it is accepted and normal practice to permit the needles to reach the very top of the yellow sector. At this optimal point, acceleration can be very rapid. Operation in the red sector is prohibited and may cause the overload relay to trip.

The three lamps in a vertical line are, from top to bottom, the LINE light (marked 'L'), the FAULT lamp (red), and the TRAIN HEAT lamp (train heat is locked u/s until further notice).

### 3.3.1 TROUBLESHOOTING – LACK OF POWER

1) Return the power handle to the OFF position.

2) Ensure that the notch meter indicates ZERO.

3) If LINE light is OUT, check for presence of NEUTRAL SECTION, then ensure pantograph RAISED.

4) If FAULT lamp is LIT, overload relay is tripped, press "PAN UP / RESET" button ('F' key).

5) Check air brake gauges in case of burst brake pipe or divided train.

6) Attempt to regain power.

7) If still unsuccessful, verify loco is on electrified track. If not, assistance will be required.

### 3.3.2 STARTING A TRAIN

On level track, start a train gently by selecting Notch 1 or 2, then release brakes completely. When the train begins to move, gradually notch up so that the ammeters enter the yellow sector. With a light train (up to 8 coaches), it may be possible to use RUN UP for acceleration once the train is moving. Otherwise, use NOTCH UP sufficiently to keep the ammeters in the upper part of the yellow sector for maximum performance.

On a rising gradient, follow the procedure given in the Braking Instructions elsewhere in this manual. Taking about 4-6 notches will usually be sufficient. Pay close attention to the ammeters and DO NOT use RUN UP until the train is moving well.

The first two or three notches are sufficiently gentle to permit fine control of light-engine shunting operations.

### 3.3.3 NEUTRAL SECTIONS

Roughly every 15 miles, it is necessary to switch the electric supply to a different phase of the National Grid, in order to balance the load of the railway network across the three phases. To avoid the possibility of bridging two phases, short Neutral Sections are used to separate electrified sections. Special driving techniques are required here for best results.

Neutral sections are marked for drivers with signs as shown above. A white-on-black sign marks the approach to the neutral section, giving drivers time to prepare the train to pass it. A black-on-white sign marks the beginning of the neutral section itself. Track magnets automatically open and close the locomotive's main circuit breaker either side of the neutral section.

Entering a neutral section under power is permitted but discouraged. Power will be instantly cut off (jolting your passengers) and you will then need to return the power handle to OFF and wait for the tap-changer to run back to ZERO before power can be regained. This may result in you coasting without power for as much as 40 seconds.

Correct neutral section driving technique is as follows:

1) Watch for white-on-black neutral section approach signs.

2) Use the RUN DOWN position to obtain a low or zero tap-changer notch at neutral section entry.

3) Move the power handle to OFF as you pass the black-on-white neutral section sign.

4) Observe the LINE light extinguishing, then relighting.

5) Check that tap-changer has reached ZERO.

6) Re-obtain power as required, using RUN UP immediately if appropriate.

Under braking, the rheostatic brake will be interrupted by neutral sections and will shut down, to be immediately replaced by the friction brakes. When power is restored and the tap-changer has run back to zero, the equipment will reset itself and re-engage if appropriate.

Do not stop your locomotive within a neutral section. If you inadvertently do so and cannot recover by rolling down a gradient, you may reset the circuit breakers using the PAN UP / RESET button ('F' key). You will need to do so twice - once within the neutral section, and again after leaving it. (In the real world, you would need to check where the pantograph physically was relative to the insulated phase gap, and proceed accordingly.)

### 3.3.4 POOR ADHESION & WHEELSLIP

The locomotive is equipped with automatic anti-slip systems which perform three distinct tasks when wheelslip is detected under power:

1) The locomotive friction brakes are applied slightly, to actively slow any spinning wheels.

2) Sand is applied to the rails to improve adhesion.

3) The tap-changer behaves as though RUN DOWN was selected, backing off power until a sustainable point is reached.

The brake and sand application can be manually applied by pressing the Anti-Slip button ('X' key). This also inhibits the automatic RUN DOWN behaviour, which may be useful in marginal conditions at low speeds. The Anti-Slip button MUST NOT be used above 60 mph.

# 4 The BR Class 87 Locomotive


## 4.1 BR Class 87 Electric Locomotive

The British Rail Class 87 is a type of electric locomotive built from 1973-75 by British Rail Engineering Limited. 36 of these locomotives were built to work passenger services over the West Coast Main Line and they were the flagships of British Rail's electric locomotive fleet until the late 1980s when the Class 90s started to roll off the production line. The privatisation of British Rail saw all but one of the fleet transferred to Virgin Trains where they continued their duties until the advent of the new Pendolino trains. The 87s were then transferred to other operators or withdrawn.

Specifications

| | |
|---|---|
| TOPS Number | Class 87 |
| Wheel Arrangement | Bo-Bo |
| Weight: | 84 tonnes |
| Height: | 12ft 2¼in (3.77m) with pantograph down |
| Length: | 58ft 6in (17.83m) |
| Width: | 8ft 8in (2.68m) |
| Electrical System: | 25kV AC Overhead Pantograph |
| Power Output: | 5,000hp (3,730kW) |
| Maximum Tractive Effort: | 58,000lb (258kN) |
| Brake Type: | Air |
| Axle Load Class: | RA 6 |

# The BR Class 47 Locomotive


## 4.2 BR Class 47 Diesel Locomotive

The British Rail Class 47 is a class of British railway diesel-electric locomotive that was developed in the 1960s by Brush Traction. A total of 512 Class 47s were built at Crewe Works and Brush's Falcon Works, Loughborough between 1962 and 1968, which made them the most numerous class of British mainline diesel locomotive.

## 4.3 Specifications

| | |
|---|---|
| TOPS Number | Class 47 |
| Wheel Arrangement | Co-Co |
| Weight: | 114 tonnes |
| Height: | 12 ft 9 1/2 in (3.90 m) |
| Length: | 63 ft 7 in (19.38 m) |
| Width: | 8 ft 10 in (2.69 m) |
| Power Output: | 2,750hp (2050kW) |
| Maximum Tractive Effort: | 55,000lb (245kN) |
| Brake Type: | Air |
| Axle Load Class: | RA 6 / 7 |

## 4.4 Keyboard Guide

| | |
|---|---|
| Increase / Decrease Throttle Notching Lever | A / D |
| Increase / Decrease Reverser | W / S |
| Increase / Decrease Train Brake | ` / ; |
| Increase / Decrease Locomotive Brake | [ / ] |
| Horn | Space |
| Open Passenger Doors | T |
| Request Permission to Pass Signal Ahead | Tab |
| Request Permission to Pass Signal Behind | Ctrl-Tab |
| Headlamps On / Headlamps Off | H / Shift + H |
| Change state of Junction Ahead / Behind | G / Shift + G |
| Couple Manually | Ctrl + Shift + C |
| Handbrake | / |
| Cab Light | L |
| Instrument Light | I |

# 5 Scenarios

## 5.1 Down Royal Scot

**Loco**: Class 87 BR Blue
**Description**: A straightforward northbound non-stop run between Preston and Carlisle

## 5.2 Icy Climb

**Loco**: Class 87 BR Blue
**Description**: Beginning at Oxenholme, take a passenger train up Grayrigg and Shap banks on a crisp winter afternoon. Your destination is Carlisle.

## 5.3 Long Haul Sleeper

**Loco**: Class 47 BR Large Logo
**Scripting**: Speed Limiter [80mph]
**Description**: A shortage of electric traction means that the Stranraer to Euston sleeper will be diesel hauled all the way to Crewe. Take the controls of a Class 47 for the long run between Dumfries and Preston.

## 5.4 Night Train to Scotland

**Loco**: Class 87 BR Blue
**Scripting**: Speed Limiter [80mph]
**Description**: Northbound Sleeper run through Preston and the Lakes to Carlisle.

## 5.5 North by Northwest

**Loco**: Class 47 BR Blue
**Description**: A local passenger service between Preston and Carnforth.

## 5.6 Northern Liner Part 1

**Loco**: Class 87 BR Blue
**Scripting**: Speed Limiter [75mph]
**Description**: A Freightliner trip bound for Glasgow starting at Preston.

## 5.7 Northern Liner Part 2

**Loco**: Class 87 BR Blue
**Scripting**: Speed Limiter [75mph]
**Description**: Continue a Freightliner trip bound for Glasgow as far as Carlisle.

## 5.8 Power Trip Part 1

**Loco**: Class 47 BR Blue
**Scripting:** Speed Limiter [75mph]
**Description**: This special freight service is carrying specialised equipment between Sellafield on the Cumbrian Coast and Heysham Power Station. Begin at Carnforth and take the load to the power station.

## 5.9 Power Trip Part 2

**Loco**: Class 47 BR Blue
**Scripting**: Speed Limiter [75mph]
**Description**: Following on from Part 1, pick up cargo from Heysham Power Station and take it as far as Preston.

## 5.10 Stone Cold

**Loco**: Class 47 BR Blue
**Scripting**: Speed Limiter [60mph]
**Description**: Collect a load of ballast from Shap Quarry and take it to Preston.

## 5.11 The Up Boat Train Part 1

**Loco**: Class 47 BR Large Logo
**Description**: Take charge of an ex-Stranraer Harbour boat train to London-Euston between Dumfries and Carlisle.

## 5.12 The Up Boat Train Part 2

**Loco**: Class 87 BR Blue
**Description**: Continue with the Stranraer Harbour to London Euston boat train from Carlisle to Preston behind a Class 87.

## 5.13 The Up Boat Train Part 3

**Loco**: Class 87 BR Blue
**Description**: Continue with the Stranraer Harbour to London Euston boat train from Oxenholme to Preston behind a Class 87.

## 5.14 A Tour of the WCML

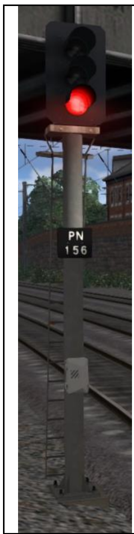
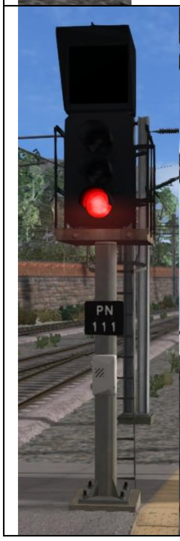
**Loco**: Class 87 BR Blue
**Description**: Drive between Preston and Carlisle and get an introduction to this part of the WCML.

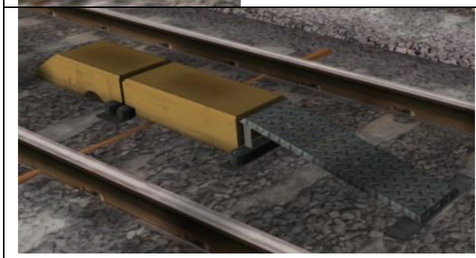
**Speed Limiter Scripting**
On a number of the scenarios included in this pack, it is important that you adhere to a lower train speed limit because of the nature of the consist that you are hauling. In order to provide an extra challenge to these scenarios, you will find that your assistant driver is particularly fussy about your adherence to these limits!

For example, in Stone Cold the maximum speed is 60mph. If you exceed 60mph then you get a warning in the top right corner from the assistant driver. While you are exceeding the speed, he will start keeping a kind of score - the more you are over the limit, the faster the score goes up. If you drop back under the limit, he resets the score to zero but remembers how many times he had to do that. If you remain over the speed limit and he reaches a certain "penalty score" then the assistant driver will pull on the emergencies and stop the train. Once it's stopped you receive a warning and can continue. You can only be warned a certain number of times before the scenario is ended and you can only be emergency stopped a certain number of times (usually 3) before the scenario is ended. At the end of the scenario, if successful in all other aspects, you should be given either a full congratulations (you didn't exceed the limit at all, no warnings given) - or a grumbly acceptance that you finished it, but badly, and some figures detailing some of your speeding violations.

**Tutorials**
There are two tutorials included in the pack that can be found under the Drive / Tutorials screen. The first will teach how you how to drive the Class 87 so you can learn how the unique tapping controls work and get the best out of the locomotive. The second will show you how to approach and drive successfully through Neutral Sections.

# 6 Colour Light Signalling

| | |
|---|---|
|   | **Signal Type: Three-aspect Stop Signal**<br><br>This signal shows the state of the next two blocks in front of you.<br><br>Green – The next two blocks are clear.  Your next signal will either be green or yellow.<br>Yellow – The next block in front of you is clear, your next signal is currently a red.<br>Red – Do not proceed. |
|     | **Signal Type: Stop Signal with Route Indicator**<br><br>This operates exactly like a standard stop signal however it has a route indicator on top which lets you know the route setting beyond the signal.  Experience will tell you what the displays mean but you can usually relate them as platform numbers, "D" for Down or "U" for up and so forth. |

| | |
|---|---|
|   | **Signal Type: Stop Signal with Feather**<br><br>Prior to the implementation of route indicators, signals came with an array of white lights called a "Feather".<br><br>This signal shows three right hand feathers indicating that from this point there are four possible routes – straight on (no feathers lit) or three possible right hand routes which would be indicated by each feather. Route knowledge would teach you what means what. |
|   | **Signal Type: Ground Frame**<br><br>This signal type is like a simple two-aspect signal. If it's showing two whites then you may proceed, if it's showing any reds then you may not proceed. |
|  | **AWS Ramp**<br><br>The route has been built with AWS ramps, if you are driving a locomotive fitted with AWS equipment then when you run over this ramp an alarm or bell will sound in the cab depending on the state of the next signal. If the next signal is green you will get a bell, if it is red or yellow then you will get an alarm. If you get an alarm you will have a limited time to acknowledge it by pressing Q or the emergency brakes will apply. |

| | |
|---|---|
|  | **Speed Limit**<br><br>This is a simple speed limit post indicating a 80mph speed limit from this point. |
|  | **Speed Limit via Route**<br><br>This sign indicates that if your train is heading to the left at the next junction then a 25mph speed limit applies. |

# 7 Acknowledgements

Thanks go to the following people for their contributions to this project:

- Keith Ross
- Jonathan Morton
- Darren Porter
- Chris Dewhurst
- Dave Dewhurst
- Paul Godber
- Stephen Menzies
- Chris Whiting
- Mervyn Deighton
- RailSimulator.com
- All the beta testers

We would also like to take this opportunity to thank the various online rail fan communities for their continued support and valued feedback.