Class 158 (Perkins) Enhancement Pack

Contents

How to Install 2
Liveries 3
Cab guide 8
Keyboard controls 10
Features 11
- Global System for Mobile Communication-Railway (GSM-R) 12
- Voith T211rz Hydraulic Transmission 14
- Adhesion 15
- Gradients 17
- Automatic Unit Numbering 17
- Dynamic Exhaust Effects 18
- Vultron Destination Indicator Controller 19
- AI Horns 22
- Cold Start 23
- Bits and Bobs 24

Setting Up the Driver's Cab 25
How to Use in the Scenario Editor 25
- Numbering 25

Scenarios 26
Credits 26

How to Install

1) Locate where you have downloaded this pack and unzip it. Information on how to do this can be found *here*.
2) Go to the location where you have extracted the files from the .zip file.
3) Now find the .exe file called 'Class 158 (Perkins) Enhancement Pack'. Double-click this file.
4) Follow the steps and by the end of the process, the main part of this pack will have installed.
5) If you intend to use any of the included scenarios, make sure you have the freely available extra stock pack and requirements installed, as listed on the product page.
6) To ensure the cab environment sounds as intended in this pack, please make sure that 'EFX' is ticked within your in-game Audio settings.

Liveries

Regional Railways:

with / without Regional Railways logo - *RR AP / Ex-RR AP*

with Central Trains / Wales & Borders / Wales & West logo - *Ex-RR (CT / WB / WW) AP*

Wales & Borders (with/without W&B logo) - *WB AP / Ex-WB AP*

Ex-Wales & Borders (with Arriva logo) - *Ex-WB (ATW) AP*

Wessex Trains - *WT AP*

Wessex Trains Revised:

with / without Wessex Trains logo - *WT2 AP / Ex-WT2 AP*

with East Midlands Trains / Northern Rail logo - *Ex-WT2 (EMT/ NR) AP*

Arriva Trains Wales - *ATW AP*

Arriva Trains Wales Revised - *ATW2 AP*

Northern Rail (with / without Northern Rail logo) - *NR AP / Ex-NR AP*

Central Trains:

with / without Central Trains logo - *CT AP / Ex-CT AP*

with Arriva / East Midlands Trains / Northern Rail logo - *Ex-CT (ATW/EMT/NR) AP*

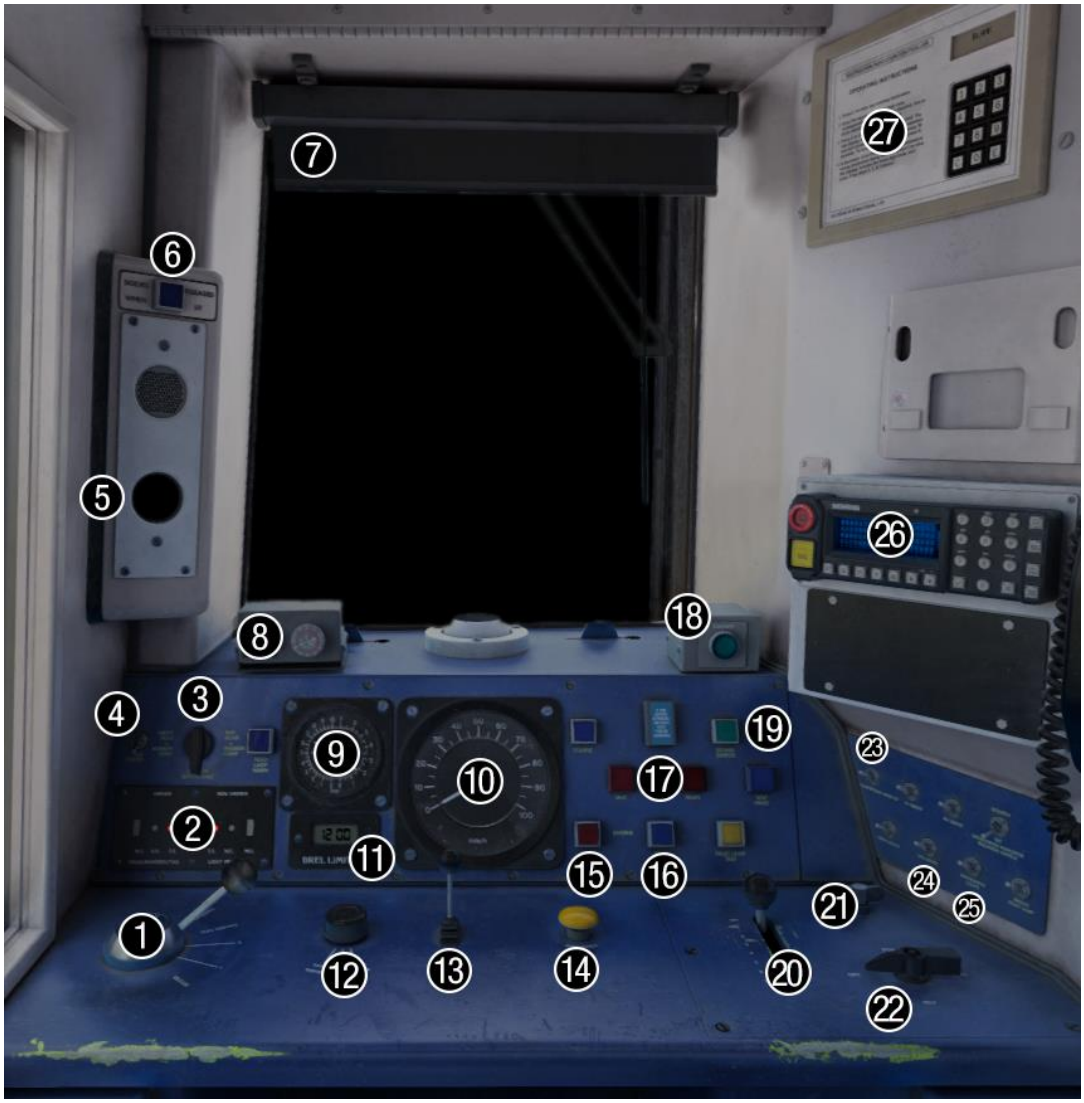
East Midlands Trains:

with East Midlands Trains logo - *EMT AP*

with East Midlands Railway logo - *Ex-EMT (EMR) AP*

Cab guide

Standard



1 - Brake handle (release/1/2/full service/emergency)
2 - Light proving indicator
3 - Head lights switch (off/day/markers/night)
4 - Tail lights switch (off/on)
5 - AWS sunflower
6 - Door interlock light
7 - Blind
8 - Driver Reminder Appliance (DRA)
9 - Main res. & brake cylinder gauge
10 - Speedometer
11 - Digital clock
12 - Windscreen wiper switch (fast/park/slow)
13 - Horn (high/low)
14 - AWS reset button
15 - Engine stop button
16 - Engine start button
17 - Transmission fault lights
18 - Sander button
19 - Driver to guard buzzer button
20 - Power handle (off to 7)
21 - Master key
22 - Reverser (off/reverse/neutral/forward)
23 - Compressor speed up switch (off/on)
24 - Cab lights switch (off/on)
25 - Instrument lights switch (off/on)
26 - GSM-R (post-2013 liveries only)
27 - Vultron destination controller

Refurbished

This refurbished cab has the same functionality as the standard one but with newer buttons, head lights switch, light proving indicator & DRA. In this pack, it is fitted to the Arriva Trains Wales Revised & East Midlands Trains liveries.

Keyboard controls

Non-standard keyboard controls are listed below:

L -	Cab light ON/OFF
E -	Deadman's pedal (DVD reset)
F7 -	Destination blind UP
F8 -	Destination blind DOWN
Y -	Driver reminder appliance (DRA) ON/OFF
C -	Driver to guard buzzer
Ctrl+D -	Driver vigilance device (DVD) ON/OFF
Z -	Engine start button
Ctrl+Z -	Engine stop button
H -	Headlight switch CLOCKWISE
Shift+H -	Headlight switch ANTI-CLOCKWISE
I -	Instrument lights switch ON/OFF
Shift+W -	Master key IN/OUT
K -	Tail lights switch ON/OFF
V -	Wiper switch ANTI-CLOCKWISE
Shift+V -	Wiper switch CLOCKWISE

Features

- Brand new cab (standard & refurbished variants)
- 10 liveries
- Detailed internal & external audio
- Accurate acceleration & braking physics
- Global System for Mobile Communication - Railway (GSM-R)
- Voith T211rz hydraulic transmission
- Adhesion
- Automatic unit numbering
- Dynamic exhaust effects
- Vultron destination indicator controller
- Driver vigilance device (DVD)
- Bits and Bobs

Global System for Mobile Communication-Railway (GSM-R)

Beginning in 2013 and completed by 2016, Global System for Mobile Communication - Railway, more commonly known as GSM-R, replaced the existing National Radio Network (NRN) & Cab Secure Radio (CSR) systems. This communication system and its accompanying unit has been simulated to the best of our ability within the simulator. Please see below for how to register & deregister your train:

Registering

1) Move the reverser away from 'Off' or hold down either the 'Registration' or 'Accept' button for 5 seconds. The GSM-R unit will begin a boot up sequence.
2) When 'GSM-R GB' appears, the unit has successfully booted.
3) Press the 'Registration' button in the top right-hand corner.
4) Using the numerical keys, insert your 4-character train reporting number (headcode), followed by the signal number you are standing at in a 3-digit format. For example, signal WH84 would require you to enter '084'. If you wish to delete a character, press the 'x' button.
5) Press the '✓' button.
6) Registration will take a moment. Once it has completed, you will hear a double beep and the train reporting number will appear in the top right-hand corner of the display.

Deregistering - Method 1

If you are closing down the driving desk, use this method.

1) Move the reverser to 'Off'.

2) Deregistration will automatically begin and you will be given the opportunity for a short moment to retain the registration by pressing the '✓' button. Simply do nothing if you would like to continue with the deregistration.

3) Deregistration will take a moment. Once it has completed, the train reporting number will no longer be displayed.

Deregistering - Method 2

If you wish to keep the driving desk active after deregistering, use this method.

1) Press the 'Registration' button in the top right-hand corner.

2) A prompt will appear on the unit saying 'Confirm deregister?'.

3) Press the '✓' button.

4) Deregistration will take a moment. Once it has completed, the train reporting number will no longer be displayed.

Please note that GSM-R is only included for liveries that are relevant for operations post-2013.

Voith T211rz Hydraulic Transmission

Great care has been taken in recreating the characteristics of the 2-stage hydraulic transmission used in this unit.

1st Stage - Torque Converter

When accelerating from a standing start, the engine revs up and oil fills the torque converter, which allows acceleration to take place. There is a 2 second or so delay between the engine revving up and the oil filling the converter, which is why these units don't accelerate as soon as powered is applied, and is what causes the distinctive, initial surge of rpm before the engine settles. This also explains why you don't get that same initial surge of rpm when powering up from 'Notch 1', instead of 'Off', as the converter is already filled with oil. During this 1st stage, engine rpm is directly controlled via the notch selected on the power handle.

2nd Stage - Fluid Coupling

At 57mph, the oil transfers from the torque converter to the fluid coupling which results in a reduction of engine rpm. During this stage, engine rpm is directly proportional to the speed of the train which means rpm will be the same regardless of which notch is selected on the power handle. All that varies is the load being placed on the engine. As speed increases then, you will gradually hear engine rpm rise in sync.

The unit will stay in this second stage until speed drops below 52mph. At this point, the transmission reverts to the first stage.

Adhesion

Adhesion between a train's wheels and the rails plays a big part in allowing a train to accelerate or brake. Too little of it and the train will slip or slide. There are a myriad of factors that control the level of adhesion and we have attempted to simulate the most important of these to give a varied and realistic driving experience:

Season

Adhesion is generally good in dry conditions during summer and spring. Slightly decreased adhesion during winter to take account of the increased amount of moisture and possible ice on the rails due to cooler temperatures. Much decreased adhesion during autumn due to leaf mulch.

Weather

Adhesion decreases in wet weather, especially so when rain first starts falling before it has had a chance to clean the railhead. If rain is light, it will take longer for the railhead to be cleaned whereas heavy rain will clean it quicker, resulting in adhesion recovering sooner.

When using the drizzle weather pattern in our Sky & Weather Enhancement Pack, adhesion is particularly poor as the rain hasn't enough force to clean the railhead but still makes it sufficiently wet to worsen adhesion.

Time of Day

Adhesion will decrease somewhat after dusk as the air cools and dew is more likely to form on the railhead. This persists throughout the night until around an hour after sunrise when higher temperatures or the sun dry it out. In our simulation, this factor is reduced during summer to account for warmer temperatures, which on average result in less dew.

Tunnels

When adhesion is poor due to external factors such as weather or season, adhesion will generally improve upon entering a tunnel, which is not as susceptible to these factors. When adhesion is good during dry weather and outside of autumn, adhesion may decrease a little upon entering a tunnel due to their damp nature.

Wheelslip

Wheelslip protection aids the driver when powering or braking during times of poor adhesion.

When wheelslip is encountered during acceleration, a two stage process takes place:

1) Power is automatically reduced and the two gearbox fault lights illuminate in the cab.
2) Once wheelslip stops, power is reapplied to the notch selected on the power handle and the two gearbox fault lights extinguish. If wheelslip reoccurs, the process starts again.

As a driver, you must assess which power notch is most suitable for the conditions and balance the occurrence of wheelslip with the maximum possible rate of acceleration.

Wheelslide

When wheelslide is encountered during braking, a two stage process takes place:

1) Brake pressure is automatically reduced and the two gearbox fault lights illuminate in the cab.
2) Once the wheelslide stops, brake pressure is returned to the notch selected on the brake handle and the two gearbox fault lights extinguish. If wheelslide reoccurs, the process starts again.

As a driver, you must resist the temptation to reduce the brake yourself as the wheelslip protection will offer the best braking performance.

Gradients

By default in Train Simulator Classic, only gradients of 1 in 185 or steeper have a gravitational effect on a train and this is only suitably realistic on gradients of approximately 1 in 125 of steeper. This means on gradients shallower than 1 in 125, the train does not experience the gravitational forces upon it than it should.

With this information in hand, we have managed to get rid of this limitation by making the train invisibly power or brake itself to simulate the effect that gravity has where Train Simulator Classic by default doesn't do so. This is all invisible to you as the player so you won't suddenly find the power or brake handles moving without your say so, but it does mean you have to drive to the gradients of the route a lot more than before, just like a real driver, especially on mainline routes where gradients rarely reach the severity where Train Simulator Classic has them behave realistically. You will also now find that if trying to recreate real timetabled runs, your timings will much more closely match reality.

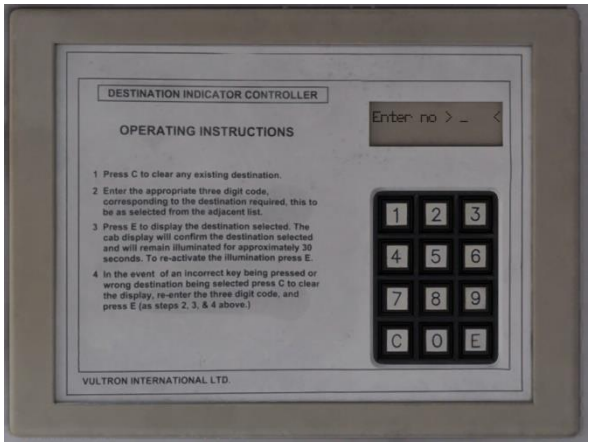
Automatic Unit Numbering

When placing a class 158 unit in the scenario editor or using one in Quick Drive, both the DMSL(A) & DMSL(B) will automatically be given correct unit and coach numbers, instead of you having to select each vehicle and changing their number manually so they match. The unit number is controlled via the DMSL(A) coach if you wish to change it. Please note that the destination display on both driving coaches is also controlled via the DMSL(A) coach. Finally, vehicle numbers might not be correct for units that don’t follow the standard numbering system.

Dynamic Exhaust Effects

Dynamic exhaust effects mean that the exhaust reacts to what the engine is doing. For example, when in notch 7, the engine will produce more exhaust than it would when idling. Also, when revving up, exhaust thickens before thinning out when rpm settles. Equally, when revving down, exhaust thins. On top of that, when starting up, exhaust rises in sync with the sound of the engine revving up. Finally, in reality, the smokiness of each vehicle varies depending on how well maintained it is, so to represent this in the simulator, a random 'clag' factor is allocated to each vehicle which ranges from 1 to 10; 1 being the cleanest and 10 being the dirtiest.

Vultron Destination Indicator Controller



A fully functioning electronic destination display is provided with both the old triangle-based and new dot matrix variants represented. Instructions on how to operate the display can be found on the 'Vultron' destination indicator controller in the cab (pictured left). For each livery, a set of relevant destinations are provided. Please see below for a list of the available destinations on each livery and their relevant code. The numerical code is what you need to input into the 'Vultron' and the letter is if you wish to control the destination via the unit's number on an AI service:

Regional Railways

000/a - Blank	**118/s - Holyhead**	**136/K - Norwich via Acle**
101/b - Birmingham International	**119/t - Huddersfield**	**137/L - Norwich via Reedham**
102/c - Birmingham New Street	**120/u - Hull**	**138/M - Nottingham**
103/d - Bristol Parkway	**121/v - Lancaster**	**139/N - Paignton**
104/e - Bristol Temple Meads	**122/w - Leeds**	**140/O - Pembroke Dock**
105/f - Cardiff Central	**123/x - Leicester**	**141/P - Penzance**
106/g - Carlisle	**124/y - Liverpool Lime Street**	**142/Q - Plymouth**
107/h - Carmarthen	**125/z - Llandudno**	**143/R - Preston**
108/i - Cheltenham Spa	**126/A - Lowestoft**	**144/S - Sheffield**
109/j - Chester	**127/B - Manchester Airport**	**145/T - Sunderland**
110/k - Cleethorpes	**128/C - Manchester Oxford Road**	**146/U - Taunton**
111/l - Crewe	**129/D - Manchester Piccadilly**	**147/V - Weston-Super-Mare**
112/m - Derby	**130/E - Manchester Victoria**	**148/W - York**
113/n - Exeter St Davids	**131/F - Middlesbrough**	**997/X - Depot**
114/o - Fishguard Harbour	**132/G - Milford Haven**	**998/Y - Not In Public Use**
115/p - Grimsby Town	**133/H - Newcastle**	**999/Z - Special**
116/q - Great Yarmouth via Acle	**134/I - Newquay**	
117/r - Great Yarmouth via Reedham	**135/J - Norwich**	

Ex-Regional Railways (WW / WB) / Wales & Borders / Ex-Wales & Borders (ATW) / Wessex Trains / Wessex Trains Revised / Ex-Central Trains (ATW) / Arriva Trains Wales / Arriva Trains Wales Revised

000/a - Blank	118/s - Gloucester	136/K - Penzance
101/b - Aberystwyth	119/t - Great Malvern	137/L - Plymouth
102/c - Bangor	120/u - Hereford	138/M - Portsmouth Harbour
103/d - Barnstaple	121/v - Holyhead	139/N - Pwllheli
104/e - Birmingham International	122/w - Llandudno	140/O - Shrewsbury
105/f - Birmingham New Street	123/x - Llandudno Junction	141/P - Southampton
106/g - Brighton	124/y - Llanelli	142/Q - Swansea
107/h - Bristol Parkway	125/z - London Waterloo	143/R - Taunton
108/i - Bristol Temple Meads	126/A - Machynlleth	144/S - Westbury
109/j - Cardiff Central	127/B - Maesteg	145/T - Weston-Super-Mare
110/k - Carmarthen	128/C - Manchester Piccadilly	146/U - Weymouth
111/l - Cheltenham Spa	129/D - Milford Haven	147/V - Worcester Shrub Hill
112/m - Chester	130/E - Newport	148/W - Wrexham Central
113/n - Crewe	131/F - Newquay	997/X - Depot
114/o - Exeter St Davids	132/G - Newton Abbot	998/Y - Not In Public Use
115/p - Exmouth	133/H - Paignton	999/Z - Special
116/q - Fishguard Harbour	134/I - Par	
117/r - Frome	135/J - Pembroke Dock	

Ex-Regional Railways (CT) / Central Trains

000/a - Blank	118/s - Great Yarmouth via Reedham	136/K - Peterborough
101/b - Birmingham International	119/t - Hereford	137/L - Sheffield
102/c - Birmingham Moor Street	120/u - Kidderminster	138/M - Shrewsbury
103/d - Birmingham New Street	121/v - Leamington Spa	139/N - Skegness
104/e - Birmingham Snow Hill	122/w - Leicester	140/O - Stafford
105/f - Cambridge	123/x - Lincoln	141/P - Stansted Airport
106/g - Cardiff Central	124/y - Liverpool Lime Street	142/Q - Stoke-on-Trent
107/h - Cheltenham Spa	125/z - Lowestoft	143/R - Stratford upon Avon
108/i - Cleethorpes	126/A - Manchester Oxford Road	144/S - Walsall
109/j - Crewe	127/B - Manchester Piccadilly	145/T - Wolverhampton
110/k - Derby	128/C - Mansfield Woodhouse	146/U - Worcester Foregate Street
111/l - Doncaster	129/D - Matlock	147/V - Worcester Shrub Hill
112/m - Ely	130/E - Newark Castle	148/W - Worksop
113/n - Gloucester	131/F - Newark North Gate	997/X - Depot
114/o - Grantham	132/G - Norwich	998/Y - Not In Public Use
115/p - Great Malvern	133/H - Norwich via Acle	999/Z - Special
116/q - Grimsby Town	134/I - Norwich via Reedham	
117/r - Great Yarmouth via Acle	135/J - Nottingham	

Ex-Wessex Trains Revised (EMT) / Ex-Central Trains (EMT) / East Midlands Trains

000/a - Blank	118/s - Kettering	136/K - Norwich
101/b - Alfreton & Mansfield Parkway	119/t - Leeds	137/L - Nottingham
102/c - Bingham	120/u - Leicester	138/M - Peterborough
103/d - Blythe Bridge	121/v - Lincoln	139/N - Scarborough
104/e - Boston	122/w - Liverpool Lime Street	140/O - Sheffield
105/f - Burton-on-Trent	123/x - London St Pancras	141/P - Skegness
106/g - Chesterfield	124/y - Long Eaton	142/Q - Sleaford
107/h - Cleethorpes	125/z - Longton	143/R - Spalding
108/i - Corby	126/A - Loughborough	144/S - Stockport
109/j - Crewe	127/B - Lowestoft	145/T - Stoke-on-Trent
110/k - Derby	128/C - Manchester Oxford Road	146/U - Warrington Central
111/l - Doncaster	129/D - Manchester Piccadilly	147/V - Worksop
112/m - Ely	130/E - Mansfield Woodhouse	148/W - York
113/n - Gainsborough	131/F - March	997/X - Depot
114/o - Grantham	132/G - Matlock	998/Y - Not In Public Use
115/p - Grimsby Town	133/H - Melton Mowbray	999/Z - Special
116/q - Hunts Cross	134/I - Newark Castle	
117/r - Irlam	135/J - Newark North Gate	

Ex-Central Trains (NR) / Ex-Wessex Trains Revised (NR) / Northern Rail

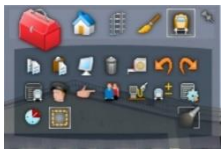
000/a - Blank	118/s - Lancaster	136/K - Selby
101/b - Barrow in Furness	119/t - Leeds	137/L - Sheffield
102/c - Bishop Auckland	120/u - Lincoln	138/M - Skipton
103/d - Blackpool North	121/v - Liverpool Lime Street	139/N - Southport
104/e - Blackpool South	122/w - Manchester Airport	140/O - Sunderland
105/f - Buxton	123/x - Manchester Oxford Road	141/P - Wakefield Kirkgate
106/g - Carlisle	124/y - Manchester Piccadilly	142/Q - Wakefield Westgate
107/h - Chester	125/z - Manchester Victoria	143/R - Warrington Central
108/i - Cleethorpes	126/A - Metrocentre	144/S - Whitby
109/j - Clitheroe	127/B - Middlesbrough	145/T - Whitehaven
110/k - Crewe	128/C - Morecambe	146/U - Wigan Wallgate
111/l - Doncaster	129/D - Newcastle	147/V - Windermere
112/m - Harrogate	130/E - Nottingham	148/W - York
113/n - Hexham	131/F - Preston	997/X - Depot
114/o - Heysham Port	132/G - Rose Hill	998/Y - Not In Public Use
115/p - Huddersfield	133/H - Saltburn	999/Z - Special
116/q - Hull	134/I - Scarborough	
117/r - Kirkby	135/J - Scunthorpe	

AI Horns

To blow an AI train's horn in a scenario, you must edit the speed limit properties of the section of the track at which you would like the AI train to sound its horn. Please see below for instructions:

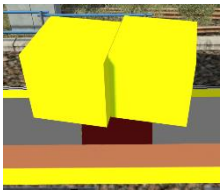
1) In the scenario editor, go to the location at which you would like the AI train's horn to sound, and press **Spacebar** 3 times. The track will now display a certain colour which represent its speed limit.

2) Go to the top-left-hand fly-out and click the 'Select' icon.



3) Hover your mouse over the piece of track where you like the AI horn to sound. A yellow border will appear around the track when it is selected.

4) Click and drag the yellow box in either direction until the measurement reading at the bottom of the screen says at least '1.0 metres'.



5) Go to the right-hand fly-out and change the two 'Speed Limit' values to '900'.

6) Click outside of any menus and the section of track you selected will now say 'Unspecified'. Any AI train which passes over this section of track will now blow its horn.

The manner in which the AI train blows its horn is randomly calculated each time, meaning no horn is ever the same. You may hear a single tone (any post-2007 liveries only), a two tone, a three tone, or now and then, even the infamous 'Ilkley Moor' sequence.

Cold Start

'Cold start' means the unit is in the following state when it loads:

- Main reservoir and brake cylinder pressures are 0
- The engine is shut down

To prepare a unit from cold, please follow the instructions below:

1) Insert the master key by pressing **Shift+W**.

2) Move the reverser to 'Neutral' by pressing **S**.

3) Reset the AWS self-test by pressing **Q**.

4) Start the engine by holding **Z** until the 'Engine Start' button illuminates.

5) You will now need to wait for the compressor to build the air in the main reservoir. You can speed up this process by turning on the 'Compressor Speed Up' switch which increases engine rpm. The compressor is directly linked to the engine so when the engine revs faster, the compressor also does so.

6) When the main reservoir reaches 4.5 bar, you have sufficient air to obtain a brake release and get on the move. Ideally though, you want to have between 6.5 & 7.5 bar as if it drops below 4.5 bar, an emergency brake application will occur.

After carrying out this procedure, your unit will be successfully prepared from cold.

Bits and Bobs

This section is dedicated to aspects of this pack that don't warrant a dedicated section but are still of note:

- The driver to guard buzzer is inactive when the doors are open. This is to prevent the driver incorrectly giving the right away buzzer.
- The reverser must be placed in 'Neutral' to start the engine.
- Power cannot be applied if the brake handle is in 'Step 2', 'Step 3' or 'Emergency'.
- If the emergency brake applies, power can only be regained if the power handle is returned to 'Off'.
- If the brake handle is placed in 'Step 2', 'Step 3' or 'Emergency' whilst powering, power will be lost and you must return the power handle to 'Off' before being able to regain power.
- 1 second delay between train passing over AWS magnet and AWS warning sound occurring. The F3/F4 HUD will show the warning immediately so you must wait 1 second before trying to cancel it.
- The headlights only provide illumination before sunrise and after sunset. This is to avoid the unrealistic appearance of projected light in broad daylight.
- Original bulb and new LED headlight variants for relevant liveries.

Setting Up the Driver's Cab

Please follow these steps to set up the cab so you are ready to move:

1) Turn the master key in by pressing **Shift+W**.
2) Move the reverser to the 'neutral' position by pressing **W**.
3) Cancel the Driver Vigilance Device self-test by pressing **E**.
4) Cancel the AWS self-test alarm by pressing **Q**.
5) Turn off the tail lights by pressing **K**.
6) Turn the headlights on by pressing **H**.
7) If GSM-R is present, register your train.
8) Set your destination on the 'Vultron' destination indicator controller.
9) Turn the Driver Reminder Appliance (DRA) off by pressing **Y**.

You should now be ready to move off.

How to Use in the Scenario Editor

Numbering

When placing a class 158 in the scenario editor, you are able to control the destination and cold start via the number. Please note that you need only change the DMSL(A) number to apply to the whole unit. The DMSL(B) number is simply a placeholder.

Example number

158815A;Cold=1;GSMR=1A22084

Key:
158815 - Unit number
A - Destination
;Cold=1 - Add this to the end of the number to activate cold start mode
;GSMR=1A22084 - Add this to the end of the number to restrict the train reporting number and signal number that the player can use to register with on the GSM-R. In this example, '1A22' is the train reporting number and '084' is the signal number.

Scenarios

APC158PEP: 07:10 Exeter St Davids - Cardiff Central
Route = South Wales Main Line
Track covered = Bristol Temple Meads - Cardiff Central
Traction = Wessex Trains 158815
Year = 2005
Duration = 55 minutes

APC158PEP: 09:30 Cardiff Central - Portsmouth Harbour
Route = South Wales Main Line
Track covered = Cardiff Central - Bristol Temple Meads
Traction = Ex-Regional Railways (Wales & West) 158822
Year = 1998
Duration = 1 hour

APC158PEP: 13:33 Manchester Piccadilly - Pembroke Dock
Route = South Wales Main Line
Track covered = Newport - Swansea
Traction = Wales & Borders 158835
Year = 2003
Duration = 1 hour 20 minutes

Credits

Nicolas Schichan - Advanced scripting

Arriva Trains Wales - Assistance in recording sounds

Ewan Rutledge - Assistance in gathering reference photographs