# Steam Simulation Data

Release version 1.0 (2008-01-25)

# 1 Introduction

All locomotives in Rail Simulator require engine simulation data to operate. This is effectively the virtual engine that runs the train.

The detail in this document relates to the Engine Simulation Blueprints created in the Asset Editor.

To begin creating Simulation Data, expand the Engine Simulation Component field, and then the Subsystem field, and click 'Insert First'. From here you can choose which type of Simulation blueprint you wish to create.

# 2 Browser Information

### 2.1.1 Display Name

This is the name of your engine as seen when using the World Editor in Scenario Tool mode. Localisation fields are available for multiple languages.

### 2.1.2 Other

This allows for other languages to be specified if they are not in the list provided.

### 2.1.3 Lang ID

A numeric identifier for the additional language, if more than one is implemented.

### 2.1.4 String

Specify the location of the language file here.

# 3 Sub System Setup

For setting up a steam simulation blueprint, click "Insert First" and select "Steam Sub System Blueprint" from the pop-up box.

### 3.1.1 Loco Brake Assembly

This defines the vehicle's locomotive brakes. See separate Brake Blueprint Documentation.

### 3.1.2 Train Brake Assembly

This defines the train brakes. See separate Brake Blueprint Documentation.

### 3.1.3 Max Power (KW 0-20000 (1kW = 1.341HP)

This is the maximum power output of the locomotive, in kilowatts. It is more important to performance when travelling at high speeds.
In Train Simulator terms this is MaxPower

### 3.1.4 Max Force (kN 0-10000 (1kN = 225lbf)

This is the maximum Tractive Effort of the locomotive, in kilowatts. This is more important for performance at low speeds. Tractive Effort is important when starting a train.
In Train Simulator terms this is MaxForce.

### 3.1.5 Max Speed (Mph 0-300)

This is the point at which the simulation will stop producing any driving force to the wheels It scales from 90% of this speed = Full simulation force & 100 % = 0 simulation force. This should ideally be set slightly higher than actual max speed of a given loco.
In Train Simulator terms this is MaxVelocity.

### 3.1.6 Has Third Rail Power Supply

Non Functional for Steam Locos

### 3.1.7 Startup Time

Non Functional for Steam Locos

### 3.1.8 Shutdown Time

Non Functional for Steam Locos

### 3.1.9 Tender Required (True/False)

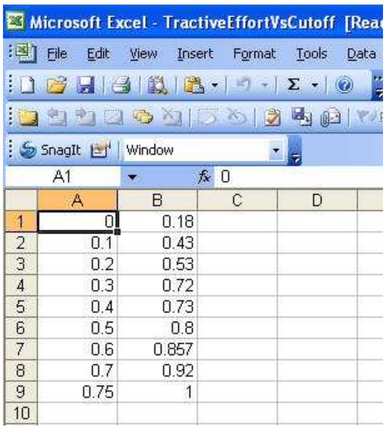
This defines if the locomotive has a traditional tender on its own wheels or if it is a Tank Engine style setup with a coal bunk on the back of the footplate.

'True' for Tender engines 'False' for Tank engines

### 3.1.10 Tractive Effort VS Cutoff CSV

In this field a custom 'Tractive Effort vs Cutoff curve' can be supplied in the form of a .csv (Comma Separated Variable) file. This maps the proportion of the Max Tractive Effort available at different settings of the Reverser (or "Cutoff").

The .csv must be in the format shown below with Reverser/Cutoff setting in Column 1 and Proportion of Max Tractive Effort in Column 2.

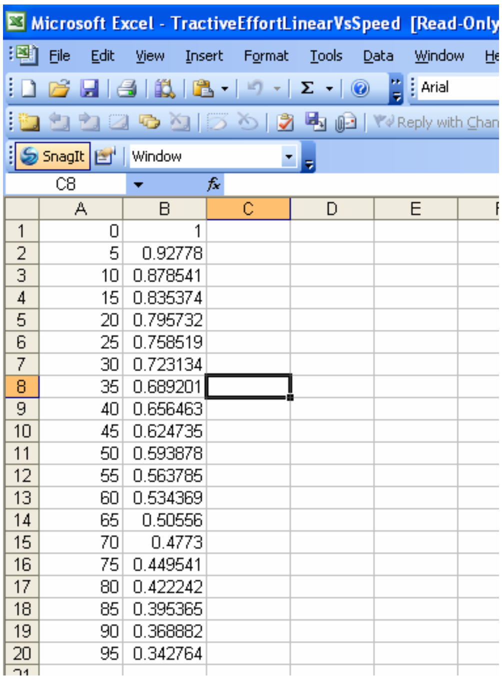


| | A | B | C | D |
|---|---|---|---|---|
| 1 | 0 | 0.18 | | |
| 2 | 0.1 | 0.43 | | |
| 3 | 0.2 | 0.53 | | |
| 4 | 0.3 | 0.72 | | |
| 5 | 0.4 | 0.73 | | |
| 6 | 0.5 | 0.8 | | |
| 7 | 0.6 | 0.857 | | |
| 8 | 0.7 | 0.92 | | |
| 9 | 0.75 | 1 | | |
| 10 | | | | |

### 3.1.11 Tractive Effort Linear VS Speed CSV

In this section a custom 'Tractive Effort Linear vs Speed' can be supplied in the form of a .csv (Comma Separated Variable) file. Generally this would be a linear relationship but the facility is there to use non-linear values.

The .csv must be in the format shown below with Speed in Column 1 and Proportion of Max Tractive Effort in Column 2



| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | 0 | 1 | | | |
| 2 | 5 | 0.92778 | | | |
| 3 | 10 | 0.878541 | | | |
| 4 | 15 | 0.835374 | | | |
| 5 | 20 | 0.795732 | | | |
| 6 | 25 | 0.758519 | | | |
| 7 | 30 | 0.723134 | | | |
| 8 | 35 | 0.689201 | | | |
| 9 | 40 | 0.656463 | | | |
| 10 | 45 | 0.624735 | | | |
| 11 | 50 | 0.593878 | | | |
| 12 | 55 | 0.563785 | | | |
| 13 | 60 | 0.534369 | | | |
| 14 | 65 | 0.50556 | | | |
| 15 | 70 | 0.4773 | | | |
| 16 | 75 | 0.449541 | | | |
| 17 | 80 | 0.422242 | | | |
| 18 | 85 | 0.395365 | | | |
| 19 | 90 | 0.368882 | | | |
| 20 | 95 | 0.342764 | | | |

### 3.1.12 Cutoff Steam usage scalar (No units (0 – 2.0)

Use this to increase / decrease the steam usage due to cut off.

### 3.1.13 Speed Steam usage scalar (No units (0 – 2.0)

This is a multiplier for steam usage due to speed.

### 3.1.14 Total Steam usage scalar (No units (0 – 2.0)

This is a multiplier for total steam usage.

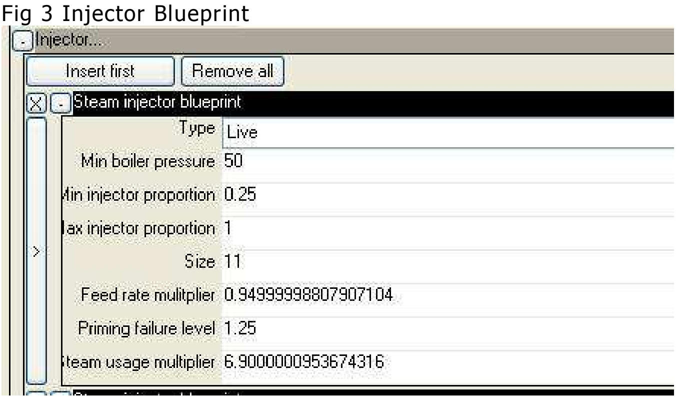
### 3.1.15 Basic Steam Usage (Lb/hour (200 – 2000)

This is the usage of steam for working the auxiliary units.
In Train Simulator terms this is BasicSteamUsage.

## 3.2 Injectors

The Injectors on a locomotive feed water to the boiler. Water in the boiler is consumed as steam is generated and it is essential that the water is replaced quickly to allow steam production to be maintained and to prevent a low water level. Injectors transfer water from the Tender to the Boiler.

Fig 3 Injector Blueprint




### 3.2.1 Type (Live Steam or Exhaust Steam)

Injectors either use Live Steam from the Boiler or Exhaust Steam from the Cylinders to combine with water from the tender.

### 3.2.2 Min Boiler Pressure (PSI (10 – 100)

This is the minimum boiler pressure for Injector1 to function

### 3.2.3 Min Injector Proportion (No units (0 – 1.0)

This is the minimum Water Valve Opening for Injector1 to function

### 3.2.4 Max Injector Proportion (No units (0 – 1.0)

This is the maximum Water Valve Opening for Injector1 to function
In Train Simulator terms these were all combined in the 'InjectorLimits1'

### 3.2.5 Size (Mm (1 – 16.9)

This is the size of one of the cones inside the injector. The larger it is the greater the capacity of the injectors.

### 3.2.6 Feed Rate Multiplier (No units (0 – 2)

This is the Steam Usage and Feeding Rate of the Injector, lower values use less steam

### 3.2.7 Priming Failure Level (No units (0 – 1.5)

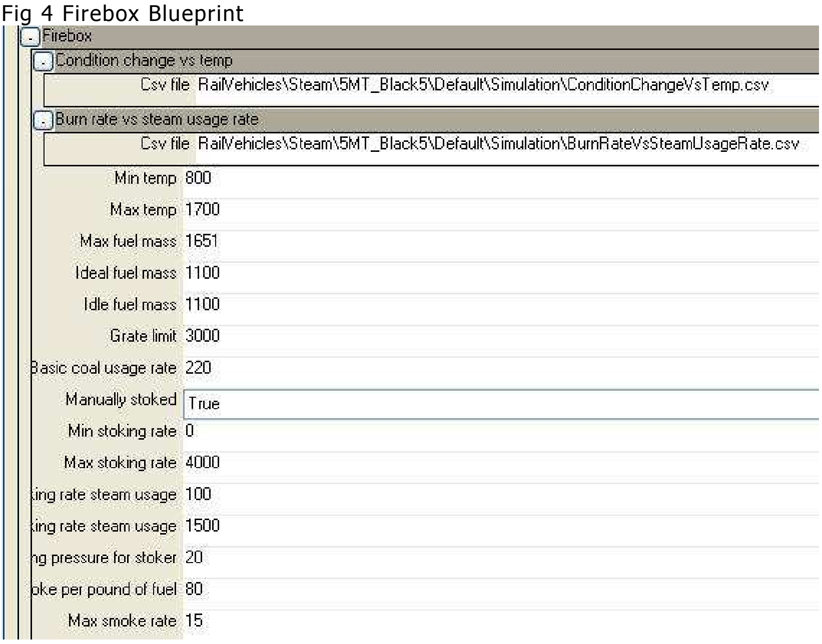
This is the level of Priming at which the Injectors will fail.

### 3.2.8 Steam Usage Multiplier

This is the amount of steam used by the Injectors

## 3.3 Firebox

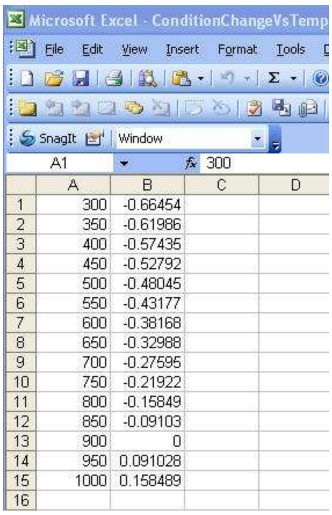
Fig 4 Firebox Blueprint




### 3.3.1 Condition Change VS Temperature CSV

Here a custom 'Condition Change vs Temperature' can be supplied in the form of a .csv (Comma Separated Variable) file. This controls how the effectivity of the Fire decreases as the Temperature tends away from the Ideal Temperature. In the example below the Ideal Temperature is 900.
N.B. The temperature values in this csv use arbitrary units and map on to the Min and Max Firebox Temperatures in Degrees Celsius supplied in the Firebox Blueprint

The .csv must be in the format shown below with Firebox Temperature in Column 1 and Condition Change in Column 2

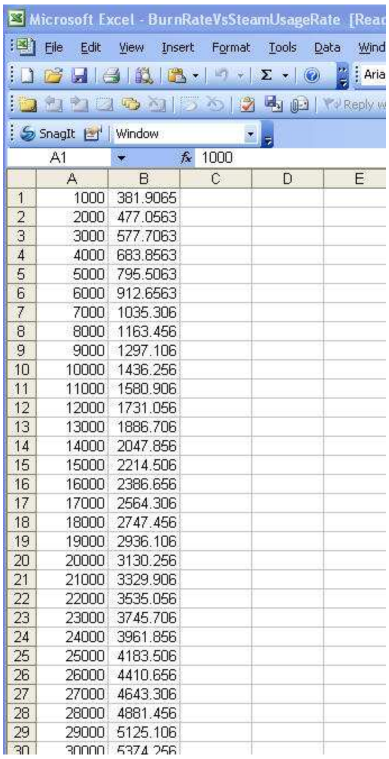


| | A | B | C | D |
|---|---|---|---|---|
| 1 | 300 | -0.66454 | | |
| 2 | 350 | -0.61986 | | |
| 3 | 400 | -0.57435 | | |
| 4 | 450 | -0.52792 | | |
| 5 | 500 | -0.48045 | | |
| 6 | 550 | -0.43177 | | |
| 7 | 600 | -0.38168 | | |
| 8 | 650 | -0.32988 | | |
| 9 | 700 | -0.27595 | | |
| 10 | 750 | -0.21922 | | |
| 11 | 800 | -0.15849 | | |
| 12 | 850 | -0.09103 | | |
| 13 | 900 | 0 | | |
| 14 | 950 | 0.091028 | | |
| 15 | 1000 | 0.158489 | | |
| 16 | | | | |

### 3.3.2 Burn Rate VS Steam Usage Rate CSV

In this section a custom 'Burn Rate vs Steam Usage Rate' can be supplied in the form of a .csv (Comma Separated Variable) file. This controls how the Fire condition and Steam Usage Rate interact.

The .csv must be in the format shown below with Steam Usage in Column 1 and Burn Rate in Column 2



| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | 1000 | 381.9065 | | | |
| 2 | 2000 | 477.0563 | | | |
| 3 | 3000 | 577.7063 | | | |
| 4 | 4000 | 683.8563 | | | |
| 5 | 5000 | 795.5063 | | | |
| 6 | 6000 | 912.6563 | | | |
| 7 | 7000 | 1035.306 | | | |
| 8 | 8000 | 1163.456 | | | |
| 9 | 9000 | 1297.106 | | | |
| 10 | 10000 | 1436.256 | | | |
| 11 | 11000 | 1580.906 | | | |
| 12 | 12000 | 1731.056 | | | |
| 13 | 13000 | 1886.706 | | | |
| 14 | 14000 | 2047.856 | | | |
| 15 | 15000 | 2214.506 | | | |
| 16 | 16000 | 2386.656 | | | |
| 17 | 17000 | 2564.306 | | | |
| 18 | 18000 | 2747.456 | | | |
| 19 | 19000 | 2936.106 | | | |
| 20 | 20000 | 3130.256 | | | |
| 21 | 21000 | 3329.906 | | | |
| 22 | 22000 | 3535.056 | | | |
| 23 | 23000 | 3745.706 | | | |
| 24 | 24000 | 3961.856 | | | |
| 25 | 25000 | 4183.506 | | | |
| 26 | 26000 | 4410.656 | | | |
| 27 | 27000 | 4643.306 | | | |
| 28 | 28000 | 4881.456 | | | |
| 29 | 29000 | 5125.106 | | | |
| 30 | 30000 | 5374.256 | | | |

### 3.3.3 Min Temperature (Celsius (100 – 2000)

This is the minimum temperature in the firebox to produce steam.

### 3.3.4 Max Temperature (Celsius (>=500)

This is the maximum temperature possible in the firebox.

### 3.3.5 Critical Temperature (Celsius (>=500)

The condition of the fire improves above this temperature

### 3.3.6 Max Fuel Mass (Lbs (>=1000)

This defines the maximum mass of firebox coal. In Train Simulator terms this is the MaxFireMass,

### 3.3.7 Ideal Fuel Mass (Lbs (>=1000)

This is the mass of firebox coal that will give the greatest steam production. The closer the actual fire mass gets to the ideal mass the better the steam production.
In Train Simulator terms this is the IdealFireMass.

**3.3.8 Grate limit** (Lbs/hour (>=1000)

This is the amount of coal burnt in an hour.
In Train Simulator terms this is CoalBurnage

**3.3.9 Basic Coal Usage Rate** (Lb/hour (100 – 1000)

This is how much coal is used for basic steam usage and maintaining the boiler temperature.
In Train Simulator terms this is BasicCoalUsage

**3.3.10 Min Stoking Rate** (Lb/hour (0 – 1000)

This is the minimum amount of coal the fireman will shovel in an hour.

**3.3.11 Max Stoking Rate** (Lb/hour (20 – 10000)

This is maximum amount of coal the fireman will shovel in an hour.
In Train Simulator terms this is the SteamFiremanMaxPossibleFiringRate

**3.3.12 Min Steam Usage** (Lb/hour (0– 1000)

This is the minimum amount of steam used per hour. For example, while it is idling.

**3.3.13 Max Steam Usage** (Lb/hour (1 – 10000)

This is the maximum amount of steam used per hour.

**3.3.14 Min Pressure for Stoker** (PSI (20 – 300)

This is the minimum boiler pressure at which the mechanical stoker can be used.

**3.3.15 Smoke per Pound of Fuel** (Units/pound. (50-1000)

This is the amount of Smoke produced per pound of fuel. This is a cosmetic feature that affects the amount of smoke coming out of the chimney, but has not yet been hooked up yet.

**3.3.16 Max Smoke Rate** (Smoke Units (1 – 20)

This is the amount of Smoke produced per second; which again affects the amount of smoke coming out of the chimney. As before, this is not hooked up yet.

## 3.4 Boiler

Fig 7 Boiler Blueprint

| Boiler | |
|---|---|
| Volume | 227.28999328613281 |
| Max pressure | 230 |
| Exhaust limit | 26750 |
| Blast exponent | 0.47499999403953552 |
| Max output | 26750 |
| Drafting effect | 1.3500000238418579 |
| Effectiveness | 1.2000000476837158 |
| water height multiple | 1.25 |
| Min priming level | 1.1000000238418579 |
| Priming factor | 1.0 |
| cylinder cocks open | 0.25 |
| power loss proportion | 0.20000000298023224 |
| Max water mass | 3900 |
| e increase proportion | 0.25 |
| Superheater | 1.2200000286102295 |
| Responsiveness | 1.0 |
| Length | 6.8000001907348633 |
| Gauge height | 0.10000000149011612 |
| Safety valve... | |

### 3.4.1 Volume (Cubic ft (50 – 10000)

This is the useable volume of the boiler. In Train Simulator terms this is the BoilerVolume.

### 3.4.2 Max Pressure (PSI (50 – 500)

This is the Boiler Pressure at which the Safety Valves lift.
In Train Simulator terms this is the MaxBoilerPressure

### 3.4.3 Exhaust Limit (Lb/hour)

This is the maximum mass of steam that can pass out the cylinders and chimney.

### 3.4.4 Blast Exponent (No units (0-1.0)

Exhaust steam is released from the cylinders, via the blast-pipe located inside the smoke-box. Aimed up the chimney, the jet of steam blasting up through the smoke-box draws air through the fire and along the boiler tubes and out the chimney. This parameter simulates the efficiency of the Blast Pipe and impacts the Firebox Temperature

### 3.4.5 Max Output (Lb/hour (1000-100000)

This is the maximum rate that the boiler can produce steam.

### 3.4.6 Drafting Effect (No units (0 - 1.5)

This is how well the fire produces energy. Lower values mean the fire is easier to burn.

### 3.4.7 Effectiveness (No units (1.0 - 2.0)

This is how effective the boiler is at producing steam.

### 3.4.8 Max Water Height Multiple (No units)

<Undefined>

**3.4.9 Min Priming Level** (No units (0.8 – 1.2)

Priming is when water from the boiler gets into the steam pipe, usually caused by too high water level. This can damage the engine and drastically reduce performance. This parameter is the lowest water level that Priming will occur at and how quickly it occurs

**3.4.10 Priming Factor** (No units (0.8 – 1.0)

This is how sensitive the locomotive is to priming.

**3.4.11 Reduction with Cocks Open** (No units (0 – 1.0)

This is how much priming is reduced by opening the Cylinder Cocks.

**3.4.12 Priming Power Loss Prop** (No units (0 – 1.0)

This is how much Priming affects Tractive Effort.

**3.4.13 Max Water Mass** (Lb)

This is the maximum amount of water that the Boiler can contain.

**3.4.14 Water Usage Increase Prop** (No units (0 – 10.0)

This is the rate of water loss from priming.

**3.4.15 Super Heater** (No units (1 – 1.4)

This is the efficiency of the super heater if present (1 means no Superheating). Higher values increase steam production and Tractive Effort

**3.4.16 Responsiveness** (No units (1.0 - 1.5)

This is how quickly the Boiler responds to firing changes.
In Train Simulator terms this is the BoilerResponsiveness

**3.4.17 Length** (Meters (1 – 20)

This is the length of the Boiler. It affects the boiler performance on steep gradients.
In Train Simulator terms this is the BoilerLength

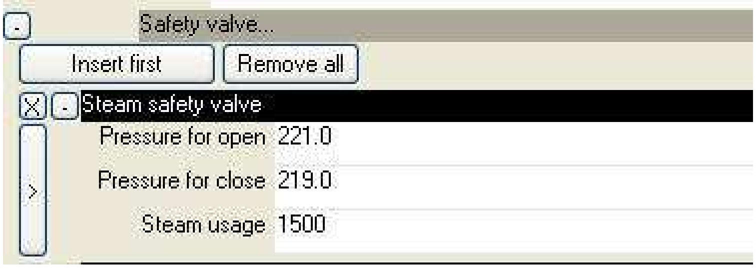
**3.4.18 Gauge Height** (Meters (0.01 -1)

<undefined>

### 3.4.19 Safety Valve

Fig 8 Safety Valve Blueprint




### 3.4.20 Pressure for Open (PSI)

This is the amount that the boiler pressure has to reach for the safety valves to open.

### 3.4.21 Pressure for Close (PSI)

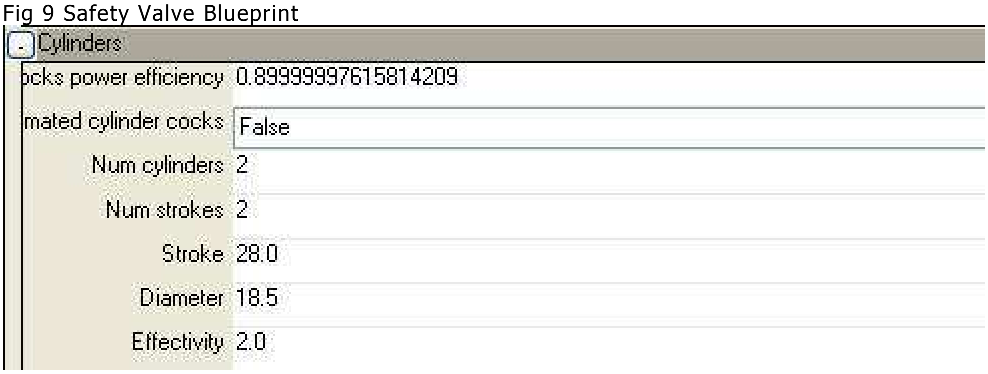
This is the amount that the boiler pressure has to fall below the maximum for the safety valves to close.

### 3.4.22 Steam Usage (Lb/hour (1000 – 20000)

This is how much steam the Safety Valves use when they lift in an emergency.

## 3.5 Cylinders

Fig 9 Safety Valve Blueprint




### 3.5.1 Cylinder Cocks Efficiency (No units (0 - 1.0)

This is how much steam the Cylinder Cocks use when they are open.

### 3.5.2 Automated Cylinder Cocks (0 or 1)

This turns on or off the automatic Cylinder Cocks. This is only active when Priming is on.
In Train Simulator terms this is the SteamCylinderCocksOperation.

### 3.5.3 No of Cylinders

This is the number of Cylinders that the locomotive has.

### 3.5.4 No of Strokes

This is the number of Strokes of Cylinder per one revolution of the Driving Wheels

### 3.5.5 Stroke

This is the length of Cylinder Stroke in inches

#### 3.5.6 Diameter
This is the diameter of Cylinder in inches

#### 3.5.7 Effectivity
<undefined>

### 3.6 Blower
The Blower is a means of providing a draught for the fire when no exhaust is available. It is used to maintain a draught on the fire. It is controlled by the driver, who will open a valve in the cab to allow live steam from the boiler to escape into the chimney whenever there is no exhaust steam from the cylinders to provide the draught.

The draught from the blower keeps the gases from the fire flowing through the tubes to the smoke box and prevents the possibility of a reversal of the flow with the resultant blow back of fire into the cab.

Fig 10 Blower Blueprint

| Blower | |
|---|---|
| Effect exponent | 0.89999997615814209 |
| Efficiency exponent | 1.1000000238418579 |
| lax steam usage rate | 1500 |
| portion of blast effect | 0.20000000298023224 |

#### 3.6.1 Effect Exponent (No units (0 - 2.0)
This defines how much the Blower affects the fire. Values less than 1 increase the blowers effect.

#### 3.6.2 Efficiency Exponent (No units (0 - 2.0)
<Undefined>

#### 3.6.3 Max Steam Usage Rate (Lb/hour (100-1500)
This is the maximum amount of steam used by the Blower.

#### 3.6.4 Proportion of Blast Effect (No units (0 - 1.0)
This is the effect of the Blower compared with the normal damping effect of the exhaust.

### 3.7 Regulator

Fig 11 Regulator Blueprint


#### 3.7.1 Type (Single or Twin Port)

Twin port was only used in the UK. A Twin Port Regulator has two valves (Main and Pilot) in the regulator controlled by the regulator handle. The Pilot Valve is smaller and lets a limited amount of steam to the cylinders. It's used for starting a light train, and maintaining a constant speed. The Main Valve is bigger, giving more steam pressure to the cylinders. The Main Valve is used when you need more power.

#### 3.7.2 Second Valve Start Pos (No units (0 - 1.0)

The rotation of the regulator needed to start the second valve operating.

#### 3.7.3 Pilot Valve Full Opening (No units (0 – 1.0)

This is the effect of the Pilot Valve being fully open

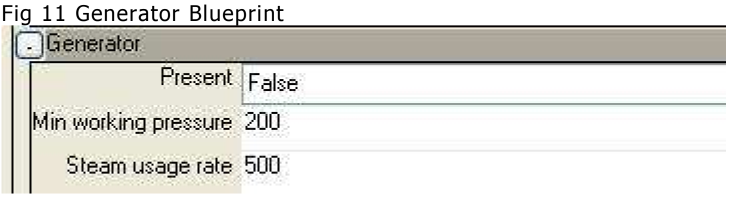
#### 3.7.4 Main Valve Initial Opening (No units (0 – 1.0)

This is the proportion of the maximum effect when the Main Valve is first opened

## 3.8 Generator

The generator provides electricity for carriage lighting and other systems not located on the locomotive.

Fig 11 Generator Blueprint




### 3.8.1 Present (True/False)

### 3.8.2 Min Working Pressure (PSI (100-300)

This is the minimum Pressure for the Generator to work.

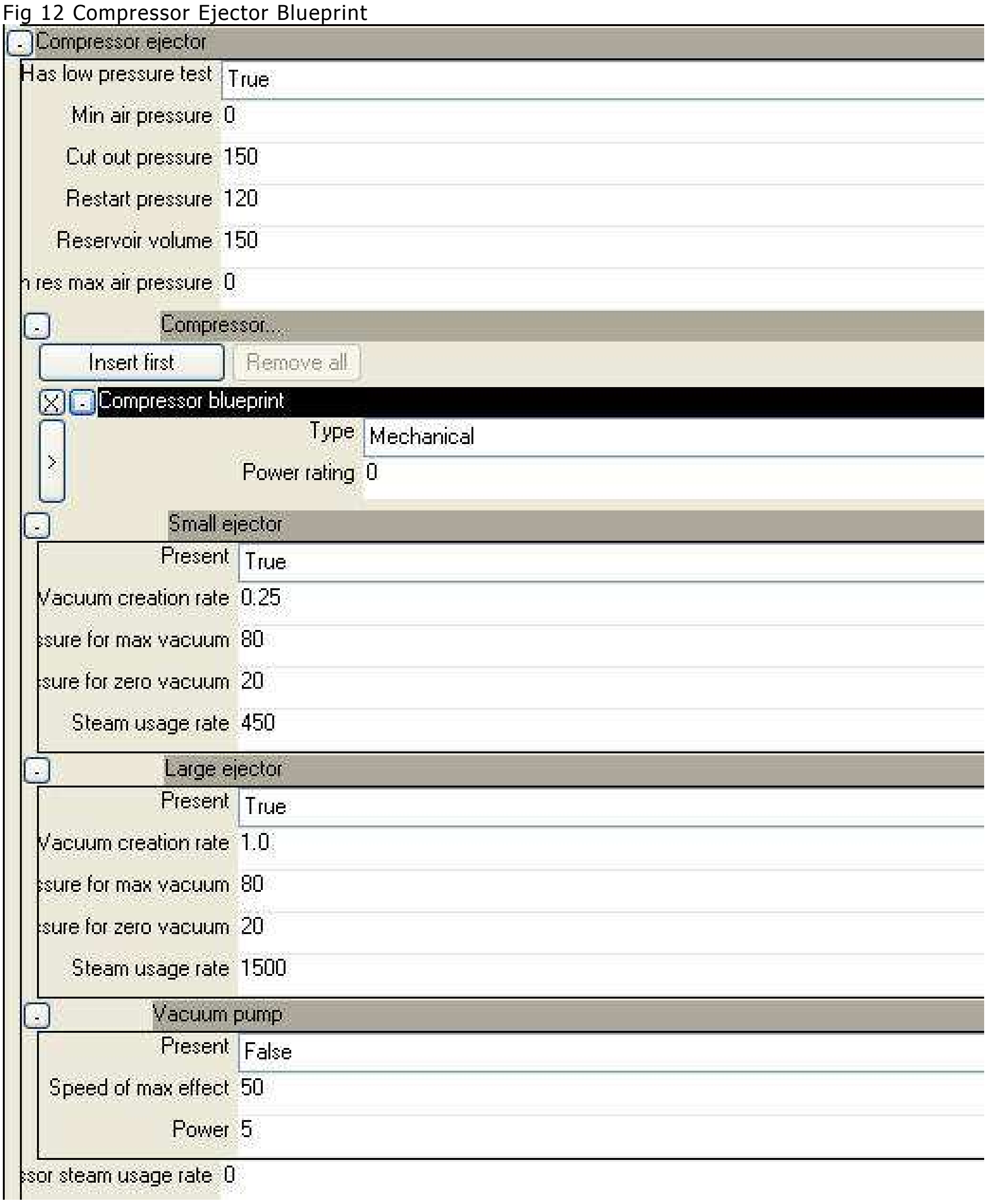
### 3.8.3 Steam Usage Rate (Lb/hour (100 – 500)

This is the amount of steam used by the Generator

### 3.9 Compressor Ejector

If the locomotive has Air Brakes it needs a Compressor to supply air
If the locomotive has Vacuum Brakes it needs an Ejector to create vacuum

Fig 12 Compressor Ejector Blueprint



### 3.9.1 Air System

**3.9.1.1 Has Low Pressure Test** (True/False)

When Brakes are released in an Air Brake System, the pressure in the Main Reservoir falls. If 'True' is selected here, once the pressure falls to a certain pressure Restart Pressure(1.4.4) then the Generator kicks in and restores Main Reservoir Pressure

**3.9.1.2 Min Air Pressure**

<undefined>

**3.9.1.3 Cut Out Pressure** (PSI)

This is the Main Reservoir Pressure at which the Generator cuts out.

**3.9.1.4 Restart Pressure** (PSI)

This is the Main Reservoir Pressure at which the Generator cuts in.

**3.9.1.5 Reservoir Volume (PSI)**

This is the Volume of the Main Reservoir. This affects how much the Main Reservoir Pressure falls when the Air Brakes are released.

**3.9.1.6 Main Res Max Air Pressure (PSI)**

This is the maximum pressure in Main Reservoir, and will normally be the same as 'Restart Pressure'

**3.9.1.7 Compressor**

**3.9.1.7.1 Type**

Non Functional for Steam Locos

**3.9.1.7.2 Power Rating**

Non Functional for Steam Locos

**3.9.1.8 Compressor Steam Usage Rate**

This is the amount of steam used by the Compressor in pounds per hour.

### 3.9.2 Small Ejector

The Small Ejector maintains the Vacuum against leakage.

**3.9.2.1 Present** (True / False)

**3.9.2.2 Vacuum Creation Rate**

The rate at which the vacuum is created in Inches Hg/Sec

**3.9.2.3 Boiler Pressure for Max Vacuum**

<undefined>

**3.9.2.4 Boiler Pressure for Zero Vacuum**

<undefined>

#### 3.9.3 Steam Usage Rate (Lb/hour (0 – 1000)

This is the amount of steam used by the Small Ejector.
In Train Simulator terms this is the VacuumBrakesSmallEjectorUsageRate

### 3.9.4 Large Ejector

The Large Ejector maintains the Vacuum against leakage

#### 3.9.4.1 Present (True / False)

#### 3.9.4.2 Vacuum Creation Rate (Inches Hg/Sec)

This is the rate at which the vacuum is created

#### 3.9.4.3 Boiler Pressure for Max Vacuum

<Undefined>

#### 3.9.4.4 Boiler Pressure for Zero Vacuum

<Undefined>

### 3.9.5 Steam Usage Rate (Lb/hour (0 – 1500)

This is the amount of steam used by the Large Ejector
In Train Simulator terms this is the VacuumBrakesLargeEjectorUsageRate

## 3.10 Vacuum Pump

### 3.10.1 Present (True/False)

<Undefined>

### 3.10.2 Speed of Max Effect

<Undefined>

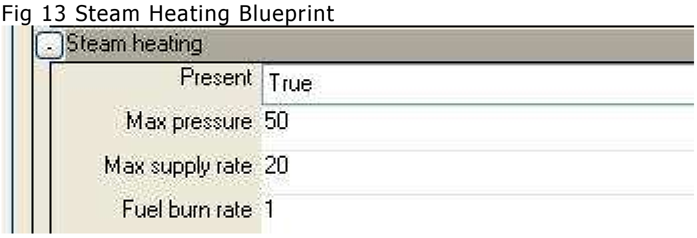
### 3.10.3 Power (PSI/Sec)

<Undefined>

### 3.11 Steam Heating

Steam from the locomotive can also be used to heat the carriages or vehicles it is hauling. In here you can define the details of this heating equipment.

Fig 13 Steam Heating Blueprint




#### 3.11.1 Present (True / False)

#### 3.11.2 Max Pressure

<undefined>

#### 3.11.3 Max Supply Rate (Lb/hour (0 – 1000)

This is the amount of steam used.

#### 3.11.4 Fuel Burn Rate (Lb/hour (0 – 1000)

This is the amount of fuel used.

## 3.12 Script Component

### 3.12.1 Name

This is where you specify the LUA Simulation Script created for this locomotive.