Brake Simulation Data

Release version 1.0 (2007-12-20)

1 Introduction

Brake Simulation blueprints can be attached to both Engine and Wagon simulation blueprints.

Mainly on Diesel or Electric Locomotives (although they can be found on some Steam Locomotives), there are **Train Brakes** which apply on the Locomotive and any other braked vehicles in the consist as well as **Loco Brakes** which apply the Brakes on the Locomotive only.

A vehicle would also have a manual mechanical **Handbrake** which would be applied when the vehicle is parked up out of use because Air Brakes tend to leak off over a period of time.

2 Brake Simulation Data

2.1 Loco Only Brake Blueprint

There are three **Loco Only Brake Blueprints**: Steam Brake / Air Brake / Vacuum Brake

There are three **Loco Only Brake Data Blueprints**: Steam Brake Data / Air Brake Data Vacuum Brake Data

They can be combined as follows:

Loco Only Steam Brake Blueprint can only have:	Loco Only Steam Brake Data Blueprint.
Loco Only Air Brake Blueprint can only have:	Loco Only Air Brake Data Blueprint
Loco Only Vacuum Brake Blueprint can have:	Loco Only Vacuum Brake Data Blueprint or Loco Only Steam Brake Data Blueprint

2.1.1 Loco Only Steam Brake Data Blueprint

These are only used on steam locomotives

2.1.1.1 Equipment Type

Air
Steam
Air Single Pipe
Air Twin Pipe
Vacuum Single Pipe
Vacuum Twin Pipe
Electro Pneumatic
Electrically Controlled Pneumatic
Air Piped
Vacuum Piped

2.1.1.2 Max Force Percent of Vehicle Weight

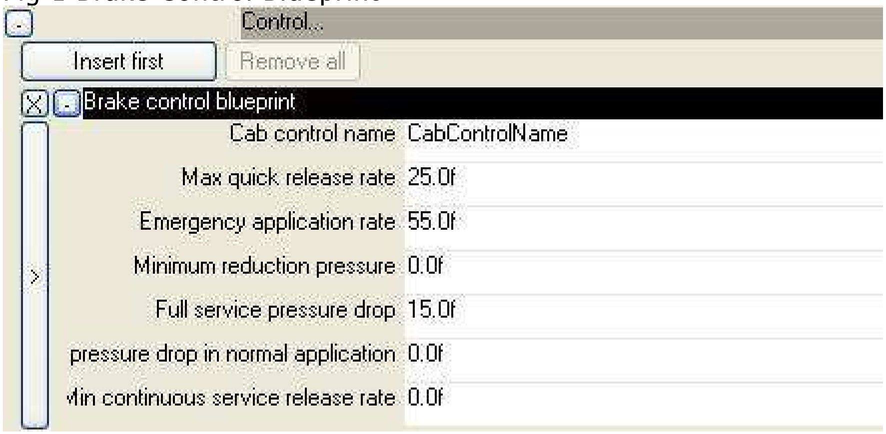
On disc brake vehicles, Brake Force in kN is usually roughly equivalent to the vehicle weight in Tons. So for example a 100 ton loco would be expected to have around 100kN Maximum Brake Force. Altering this figure is the easiest way of adjusting the maximum brake force of the locomotive. So, for example if your locomotive weighs 100 tons and you want a maximum Brake Force of 80kN, set this parameter to 80%.

For tread brake vehicles, the braking force is slightly less than the weight and thus a figure of 60-70% is more accurate.

2.1.1.3 Control

This is where the Loco Brake Cab Control characteristics are defined

Fig 1 Brake Control Blueprint



Note – The f found after certain numbers above serves no purpose and is not required.

2.1.1.3.1 Cab Control Name

Very important, this is what maps the Brake on to the Cab Control defined in the Engine Blueprint, Controls section. NB It is case sensitive.

2.1.1.3.2 Max Quick Release Rate

For MaxQuickReleaseRate Brake position only. Determines how quickly the brake is released

2.1.1.3.3 Emergency Application Rate

The rate of application of Emergency Brakes, either when a specific Emergency Brake control is activated or the Brake Control is moved to an 'Emergency' position. In psi/Sec

2.1.1.3.4 Minimum Reduction Pressure

For MinimumReduction position only. Pressure is set to system pressure minus Minimum Reduction Pressure

2.1.1.3.5 Full Service Pressure Drop

The amount the Brake Pipe Pressure falls during a Full Service (non-Emergency) brake application. For example on a typical UK Air Brake System with Pipe Pressure 72.5psi if this parameter is set to 17 the Pipe pressure will drop to about 55psi.

2.1.1.3.6 Pressure Drop in Normal Application

<undefined>

2.1.1.3.7 Min Continuous Service Release Rate

For ContinuousService position only. The Application rate is proportional to Control position * Max Application Rate + Min Continuous Service Release Rate

2.1.1.4 Handbrake

This is where the Handbrake is defined

Fig 2 Handbrake Blueprint

2.1.1.4.1 Max Force

The Maximum Brake Force of the Handbrake in kN

2.1.1.5 Max Release Rate

The maximum rate that the Loco Brake can be released in Inches Hg/sec

2.1.1.6 Max Application Rate

The maximum rate (non-Emergency) that the loco brake can be applied in Inches Hg/sec

2.1.1.7 Max Cylinder Pressure

The maximum pressure possible in the Brake Cylinder in Inches Hg/sec

2.1.1.8 Pressure for Max Force

The pressure in the Brake Cylinder at which the most Brake Force is available in Inches Hg/sec

2.1.1.9 Max System Pressure

The maximum pressure in the Vacuum Brake System in Inches Hg/sec when brakes are released*

2.1.1.10 Min System Pressure

The minimum pressure in the Vacuum Brake System in Inches Hg/sec when brakes are released*

* in a Vacuum System these figures are actually entered what may seem to be the wrong way around because a Vacuum is measured in relation to Atmospheric Pressure. A perfect Vacuum is a 30inchesHg (0psi), the vacuum used on most UK Vacuum systems is 21inchesHg (10.3psi) and Atmospheric Pressure is 0inchesHg (14.7psi). Max System Pressure would be set to 21 and Min System Pressure to 0 although in reality 21 represents a lower pressure in the brake pipe than 0.

2.1.2 Loco Only Air Brake Data Blueprint

2.1.2.1 Equipment Type

Air
Steam
Air Single Pipe
Air Twin Pipe
Vacuum Single Pipe
Vacuum Twin Pipe
Electro Pneumatic
Electrically Controlled Pneumatic
Air Piped
Vacuum Piped

2.1.2.2 Max Force Percent of Vehicle Weight

On disc brake vehicles, Brake Force in kN is usually roughly equivalent to the vehicle weight in Tons. So for example a 100 ton loco would be expected to have around 100kN Maximum Brake Force. Altering this figure is the easiest way of adjusting the maximum brake force of the locomotive. So, for example if your locomotive weighs 100 tons and you want a maximum Brake Force of 80kN, set this parameter to 80%.

For tread brake vehicles, the braking force is slightly less than the weight and thus a figure of 60-70% is more accurate.

2.1.2.3 Control

This is where the Loco Brake Cab Control characteristics are defined
Section above

2.1.2.4 Handbrake

This is where the Handbrake is defined
Section above

2.1.2.5 Max Release Rate

The maximum rate that the Loco Brake can be released in psi

2.1.2.6 Max Application

The maximum rate (non-Emergency) that the loco brake can be applied in psi

2.1.2.7 Max Cylinder Pressure

The maximum pressure possible in the Brake Cylinder in psi

2.1.2.8 Pressure for Max Force

The pressure in the Brake Cylinder at which the most Brake Force is available in psi

2.1.2.9 Max System Pressure

The maximum pressure in the Air Brake System in psi.

2.1.2.10 Min System Pressure

The minimum pressure in the Air Brake System in psi.

2.1.3 Loco Only Vacuum Brake Data Blueprint

In a Vacuum Brake System the Brakes are held off by a Vacuum in the Brake system created by a Exhauster/Ejector. When the Brakes are applied, the Vacuum is destroyed by letting air in to the System. When the Brakes are released, the Vacuum is recreated by the Exhauster/Ejector.

2.1.3.1 Equipment Type

Air
Steam
Air Single Pipe
Air Twin Pipe
Vacuum Single Pipe
Vacuum Twin Pipe
Electro Pneumatic
Electrically Controlled Pneumatic
Air Piped
Vacuum Piped

2.1.3.2 Max Force Percent of Vehicle Weight

By a happy coincidence Brake Force in kN is usually roughly equivalent to the vehicle weight in Tons. So for example a 100 ton loco would be expected to have around 100kN Maximum Brake Force. Altering this figure is the easiest way of adjusting the maximum brake force of the locomotive can be adjusted. So, for example if your locomotive weighs 100 tons and you want a maximum Brake Force of 80kN, set this parameter to 80%.

2.1.3.3 Control

This is where the Loco Brake Cab Control characteristics are defined
Section above

2.1.3.4 Handbrake

This is where the Handbrake is defined
Section above

2.1.3.5 Proportional Brake

<undefined>

2.1.3.6 Max Release Rate

The maximum rate that the Loco Brake can be released in Inches Hg/sec

2.1.3.7 Max Application Rate

The maximum rate (non-Emergency) that the loco brake can be applied in Inches Hg/sec

2.1.3.8 Max Cylinder Pressure

The maximum pressure possible in the Brake Cylinder in Inches Hg/sec

2.1.3.9 Pressure for Max Force

The pressure in the Brake Cylinder at which the most Brake Force is available in Inches Hg/sec

2.1.3.10 Max System Pressure

The maximum pressure in the Vacuum Brake System in Inches Hg/sec when brakes are released*

2.1.3.11 Min System Pressure

The minimum pressure in the Vacuum Brake System in Inches Hg/sec when brakes are released*

* in a Vacuum System these figures are actually entered in what may seem to be the wrong way around because a Vacuum is measured in relation to Atmospheric Pressure. A perfect Vacuum is a 30inchesHg (0psi), the vacuum used on most UK Vacuum systems is 21inchesHg (10.3psi) and Atmospheric Pressure is 0inchesHg (14.7psi). Max System Pressure would be set to 21 and Min System Pressure to 0 although in reality 21 represents a lower pressure in the brake pipe than 0.

3 Train Brake Simulation Blueprint

3.1 Train Brake Blueprint

There are 5 **Train Brake Blueprints**:
Air Brake, Dual Brake, EPB Brake, ECPB Brake and Vacuum Brake

There are 5 **Train Brake Data Blueprints**:
Air Brake Data, Dual Brake Data, EPB Brake Data, ECPB Brake Data and Vacuum Brake Data

They can be combined as follows:

Train Air Brake Blueprint can have:	Air Brake Data Blueprint or EPB Brake Data Blueprint or ECB Brake Data Blueprint
Train Dual Brake Blueprint must have:	Air Brake Data and Vacuum Brake Data Blueprints
Train ECPB Brake Blueprint can only have:	ECPB Brake Data Blueprint
Train EPB Brake Blueprint can only have:	EPB Brake Data Blueprint
Train Vacuum Brake Blueprint can only have:	Vacuum Brake Data Blueprint

3.1.1 Train Air Brake Data Blueprint

In an Air Brake System the Brakes are held off by compressed air, at a higher pressure than Atmospheric Pressure, in the Brake system created by a Compressor. When the Brakes are applied, the System is opened to the atmosphere, releasing air and reducing pressure. When the Brakes are released, the high pressure in the system is recreated by the Compressor.

3.1.1.1 Equipment Type

Air
Steam
Air Single Pipe
Air Twin Pipe
Vacuum Single Pipe
Vacuum Twin Pipe
Electro Pneumatic
Electrically Controlled Pneumatic
Air Piped
Vacuum Piped

3.1.1.2 Max Force Percent of Vehicle Weight

On disc brake vehicles, Brake Force in kN is usually roughly equivalent to the vehicle weight in Tons. So for example a 100 ton loco would be expected to have around 100kN Maximum Brake Force. Altering this figure is the easiest way of adjusting the maximum brake force of the locomotive. So, for example if your locomotive weighs 100 tons and you want a maximum Brake Force of 80kN, set this parameter to 80%.

For tread brake vehicles, the braking force is slightly less than the weight and thus a figure of 60-70% is more accurate.

3.1.1.3 Control

This is where the Train Brake Cab Control characteristics are defined
See Section 2

3.1.1.4 Handbrake

This is where the Handbrake is defined
See Section 2

3.1.1.5 Max Release Rate

The maximum rate that the Train Brake can be released in psi

3.1.1.6 Max Application Rate

The maximum rate (non-Emergency) that the Train brake can be applied in psi

3.1.1.7 Max Cylinder Pressure

The maximum pressure possible in the Brake Cylinder in psi

3.1.1.8 Pressure for Max Force

The pressure in the Brake Cylinder at which the most Brake Force is available in psi

3.1.1.9 Max System Pressure

The maximum pressure in the Air Brake System in psi.

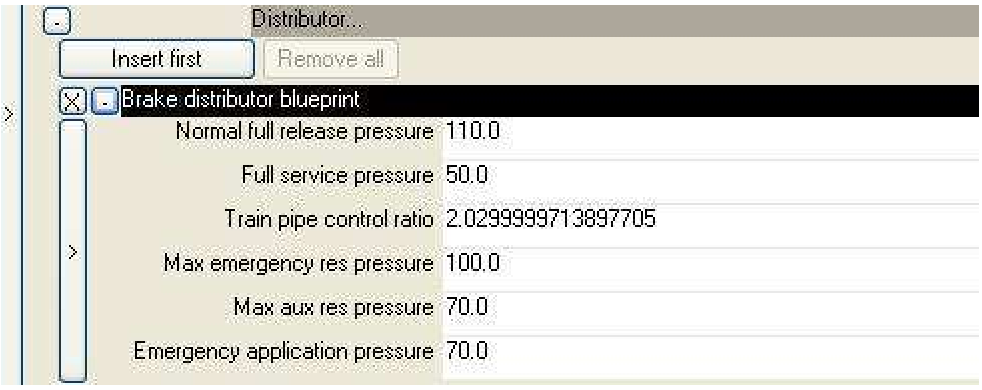
3.1.1.10 Min System Pressure

The minimum pressure in the Air Brake System in psi.

3.1.1.11 Distributor

Air brake control valve (derived from and known as a Triple Valve on older systems) mounted on each vehicle which controls the passage of air between the auxiliary reservoir and the brake cylinder and between the brake cylinder and atmosphere. The operation of the valve is controlled by changes of pressure in the brake pipe.

Fig 3 Distributor Blueprint



3.1.1.11.1 Normal Full Release Pressure

The pressure in the Auxiliary Reservoir when the brakes are fully Released in psi

3.1.1.11.2 Full Service Pressure

The pressure in the Auxiliary Reservoir After a Full Service Brake application in psi

3.1.1.11.3 Train Pipe Control Ratio

<undefined>

3.1.1.11.4 Max Emergency Res Pressure

The maximum pressure in the Emergency Reservoir in psi

3.1.1.11.5 Max Aux Res Pressure

The maximum pressure in the Auxiliary Reservoir in psi

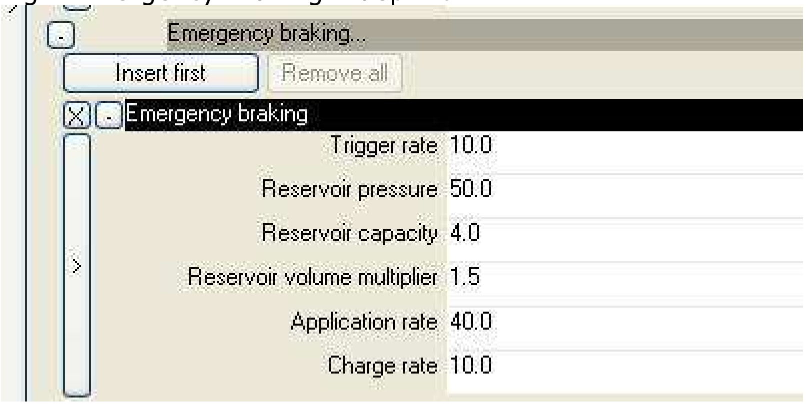
3.1.1.11.6 Emergency Application Pressure

<undefined>

3.1.1.12 Emergency Braking

Use only if the vehicle has an Emergency Braking Reservoir.

Fig 4 Emergency Braking Blueprint



3.1.1.12.1 Trigger Rate

<undefined>

3.1.1.12.2 Reservoir Pressure

The Max Pressure in the Emergency Braking Reservoir in psi.

3.1.1.12.3 Reservoir Capacity

The Volume of the Emergency Reservoir in cubic feet

3.1.1.12.4 Reservoir Volume Multiplier

<undefined>

3.1.1.12.5 Application Rate

The maximum rate (Emergency) that the Train Brake can be applied in psi/sec

3.1.1.12.6 Charge Rate

The maximum rate that the Emergency Reservoir can be recharged in psi/sec

3.1.1.13 Auxiliary Braking

The Auxiliary Reservoir is an air tank provided on each vehicle of a train equipped with air brakes to supply air for brake applications. More recently known as the brake reservoir.

Fig 5 Auxiliary Braking Blueprint

3.1.1.13.1 Max Charging Rate

The maximum rate that the Auxiliary Reservoir can be recharged in psi/sec

3.1.1.13.2 Max Reservoir Pressure

The maximum pressure in the Auxiliary Reservoir in psi

3.1.1.14 Pressure Used From Pipe Per Pound Gained

<undefined>

3.1.1.15 Pressure Gained From One Pipe Pound

<undefined>

3.1.1.15.1 Retainer Type

Options: No Retainer / 3 Position Retainer / 4 Position Retainer

A Retainer is manually operated valve mounted on many US freight cars to provide a constant minimum application even though the brake has been released from the driver's brake valve in the cab. Normally, when brakes are released, all of the air in the brake cylinders is discharged to the atmosphere. By setting retainer valves, when the brakes are released, some of the air pressure is "retained", hence the name. Typically, a certain number of cars on the rear of the train would have their retainers set by the conductor.

There are 2 types of retainer valves, a 3 position type and a 4 position type. The operating positions are:
EX- Exhaust, normal will not retain air
HP-High Pressure, will retain 20psi
SD-Slow Direct Exhaust, will not retain air but will exhaust the air more slowly then normal
LP-Low Pressure, will retain 10psi, only available on the 4 position retainer valve.

3.1.1.15.2 Triple Valve

Options: True / False
The principal control valve mounted on a vehicle fitted with air braking. So-called because it has three functions - to apply the brake, to hold the application at a constant level and to release and recharge the brake system. It also has three connections - to the brake pipe, to the brake cylinder and to the auxiliary reservoir.

Although newer vehicles have a ‘Distributor’ instead of a Triple Valve, this is not yet supported, and thus you must select Triple Value in the Asset Editor

3.1.1.15.3 Triple Valve Ratio

This is the ratio between the change in Brake Pipe Pressure and Brake Cylinder Pressure. Normally 2.5, so that a 1psi change in Pipe Pressure produces a 2.5psi change in the Brake Cylinder.

3.1.1.15.4 Retainer Slow Release

The Release Rate of air from the Retainer in psi/sec

3.1.2 Train Vacuum Brake Data Blueprint

In a Vacuum Brake System the Brakes are held off by a Vacuum in the Brake System created by a Exhauster/Ejector. When the Brakes are applied, the Vacuum is destroyed by letting air in to the System. When the Brakes are released, the Vacuum is recreated by the Exhauster/Ejector.

3.1.2.1 Equipment Type

Air
Steam
Air Single Pipe
Air Twin Pipe
Vacuum Single Pipe
Vacuum Twin Pipe
Electro Pneumatic
Electrically Controlled Pneumatic
Air Piped
Vacuum Piped

3.1.2.2 Max Force Percent of Vehicle Weight

On disc brake vehicles, Brake Force in kN is usually roughly equivalent to the vehicle weight in Tons. So for example a 100 ton loco would be expected to have around 100kN Maximum Brake Force. Altering this figure is the easiest way of adjusting the maximum brake force of the locomotive. So, for example if your locomotive weighs 100 tons and you want a maximum Brake Force of 80kN, set this parameter to 80%.

For tread brake vehicles, the braking force is slightly less than the weight and thus a figure of 60-70% is more accurate.

3.1.2.3 Control

This is where the Train Brake Cab Control characteristics are defined
See Section 2

3.1.2.4 Handbrake

This is where the Handbrake is defined
See Section 2

3.1.2.5 Max Release Rate

The maximum rate that the train brake can be released in Inches Hg/sec

3.1.2.6 Max Application Rate

The maximum rate (non-Emergency) that the train brake can be applied in Inches Hg/sec

3.1.2.7 Max Cylinder Pressure

The maximum pressure possible in the Brake Cylinder in Inches Hg/sec

3.1.2.8 Pressure for Max Force

The pressure in the Brake Cylinder at which the most Brake Force is available in Inches Hg/sec

3.1.2.9 Max System Pressure

The maximum pressure in the Vacuum Brake System in Inches Hg/sec when brakes are released*

3.1.2.10 Min System Pressure

The minimum pressure in the Vacuum Brake System in Inches Hg/sec when brakes are released*

* In a Vacuum System these figures are actually entered in what may seem to be the wrong way around because a Vacuum is measured in relation to Atmospheric Pressure. A perfect Vacuum is a 30inchesHg (0psi), the vacuum used on most UK Vacuum systems is 21inchesHg (10.3psi) and Atmospheric Pressure is 0inchesHg (14.7psi). Max System Pressure would be set to 21 and Min System Pressure to 0 although in reality 21 represents a lower pressure in the brake pipe than 0.

3.1.2.11 Proportional Brake

<undefined>

3.1.2.12 Pressure Used From Pipe Per Pound Gained

<undefined>

3.1.3 Train Dual Brake Data Blueprint

A dual Braked vehicle has both Air and Vacuum Brakes

3.1.3.1 Train Dual Brake Air Brake

See Train Air Brake Data Blueprint

3.1.3.2 Train Dual Brake Vacuum Brake

See Train Vacuum Brake Data Blueprint

3.1.4 Train EPB Brake Data Blueprint

Electro Pneumatic Brakes (EPB) are a variation on Air Brakes used almost exclusively on Multiple Units trains. When Air is used to propagate the braking signal along a train, there is inevitably some lag while the change in pressure travels down the length of the train. EPB braking gets around this by transmitting an electric signal down the train to activate the brakes on each vehicle.

Standard air brake equipment is normally also provided as the safety system for back-up purposes.

3.1.4.1 Train EPB Brake Air Brake Data

See Train Air Brake Data Blueprint

3.1.5 Train ECP Brake Data Blueprint

Electronically Controlled Pneumatic (ECP) Braking is a new form of electrical control of air braking being pioneered US. It uses modern electronic techniques to overcome the problems of air braking on long freight trains.
The difference is the word "Electronically" as opposed to "electrically". EPB Brakes use several train wires to control the brakes. Most of these systems use a second train line for main reservoir air supplies. ECP systems have built-in two-way communications and don't require wires. A vehicle in an ECP brake train can do a self-diagnosis and report the information to the driver and it only requires the standard train line pipe.

3.1.5.1 Train ECP Brake Air Brake Data

See Train Air Brake Data Blueprint

Users interested in learning more about braking systems are advised to study the excellent and informative Braking articles at the "**Railway Technical Web Pages**" website; http://www.railway-technical.com/brake1.shtml

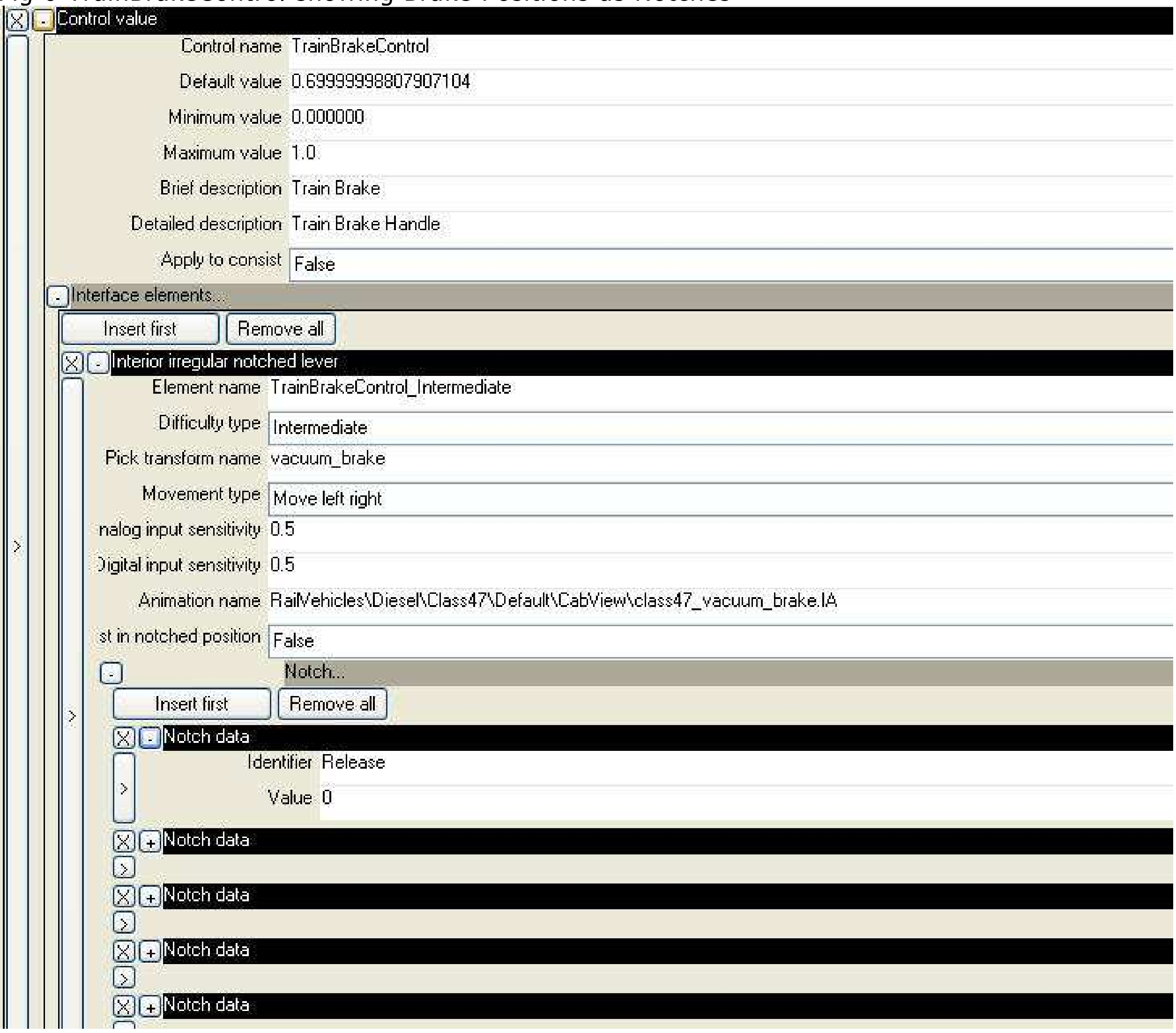
4 Brake Positions

4.1 Brake Control Positions

This section now refers to the **Engine Blueprint** and not the previous Engine Simulation Blueprint

The following Brake Control Positions are available. They should be used as 'Notches' on a Notched Lever TrainBrakeControl or EngineBrakeControl.

Fig 6 TrainBrakeControl showing Brake Positions as Notches



The following sections refer to fields inserted into the Notched Data Identifiers. Values in these fields are a decimal fraction of the full action of the notch (1).

4.1.1 Direct
Just 0-1 full release to full application

4.1.2 MaxQuickRelease
Air Brakes only, release at Max Quick Release Rate parameter.

4.1.3 SelfLapped
The train pipe maintained at current pressure

4.1.4 Hold / HoldLapped
Non Functional – Isolates the controller from the train pipe.

4.1.5 NeutralHandleOff
Non Functional – Isolates the controller from the train pipe.

4.1.6 MinimalReduction
Pressure is set to system pressure minus Minimum Reduction Pressure

4.1.7 FullService
Pressure is set to Max Pressure minus Full Service Pressure Drop

4.1.8 Suppression
Pressure set to Max Pressure – Minimum Reduction Pressure

4.1.9 Emergency
Full on Application. Control Value is set to 1.0.

4.1.10 GraduatedQuickRelease
Air only – release rate prop to max quick release rate and Control position.

4.1.11 Release or ReleaseLapped
The release rate is proportional to 'Max Release Rate' and the Control position.

4.1.12 EPApply or EPHold
Electro Pneumatic Brakes only. Apply / Hold the EP Brake.

4.1.13 Running
The controller closes all variable methods of train pipe control off.
Note that maintaining devices such as small ejector, compressors, exhausters on idle all still operate.
On vacuum brakes you should get a slow release in 'Running' - but only if there is a source working to restore the pressure.

4.1.14 GraduatedSelfLap
The Train Pipe is maintained at pressure proportional to Control position.

4.1.15 Apply

The Application rate is proportional to Control position

4.1.16 ContinuousService

The Application rate is proportional to Control position * Max Application Rate + Min Continuous Service Release Rate

4.1.17 GraduatedSelfLapLimited

This is the same as GraduatedSelfLap but proportional to Full Service Pressure Drop.

4.1.18 GraduatedSelfLapLimitedHolding

The Train Pipe Pressure is proportional to Control position and the difference between Full Service Pressure Drop and Minimum Reduction Pressure

4.1.19 GraduatedSelfLapLimitedKeepPressure

The Train Pipe Pressure is proportional to Control position and the difference between Full Service Pressure Drop and Minimum Reduction Pressure.