Buying Guide to Vacuum Brakes

The guidance for passenger-carrying miniature railways is: Trains should have a braking system which is adequate for:

- Loaded train weight
- Normal speed of running
- Gradients
- Operating methods

The system is to be capable of bringing the train to a stop in a safe distance in normal and emergency conditions.

Based on these guidelines it is a must to fit an automatic (fail-safe) braking system on all your trains. Running without adequate braking could have serious consequences.

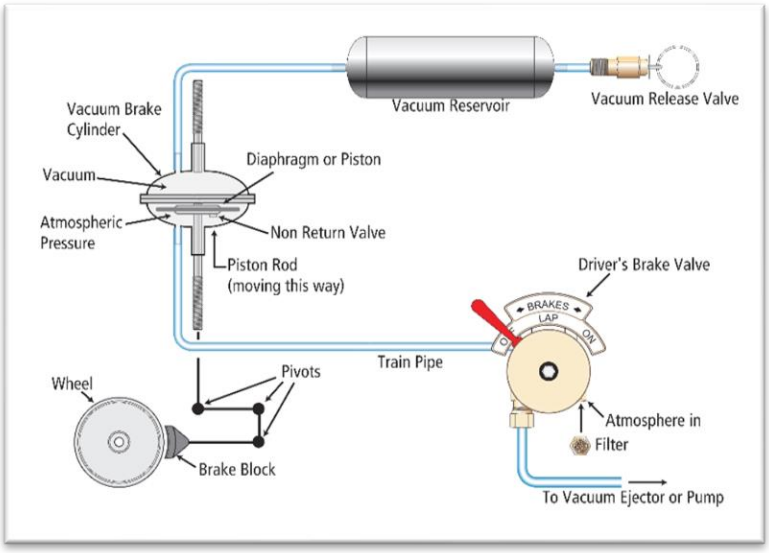
As per full size railways the two main choices for braking are vacuum and compressed air. The most popular choice for many miniature railways and model engineers is vacuum.

PNP Railways is the market leader in the model engineering world for vacuum brakes. We can supply the components and advice for fitting a fail-safe vacuum braking system. Our braking system is suitable for both standard and narrow gauge 5", 7¼ & 10¼" railways.

This guide will provide you with an overview of how vacuum brakes work and an overview of the components in the PNP Railways range. Included is an example of what you would require if you wished to fit vacuum brakes to a locomotive and two carriages.

How do Vacuum Brakes Work?

The ejector or vacuum pump draws the air from the train pipe, the brake cylinder and reservoir (via the non-return valve). The brakes will then be off, and the system will be in equilibrium. The brakes will stay off by being weight biased or lightly sprung. (See diagram).



Letting air back into the train pipe via the drivers brake valve or by a pipe disconnection, will apply the brakes. This is due to the air pressure acting on the underside of the piston or, in this case diaphragm,

The vacuum is trapped on the upper side of the diaphragm by the non-return value. The vacuum must be re-created in the train pipe to release the brakes.

When the loco's vacuum source is removed or the train has parted, the brakes need to be released to shunt the train. This trapped vacuum can be destroyed by opening the release valve.

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What do I use to create vacuum?

You will need either a vacuum pump or ejector. For electric or internal combustion powered locomotives, you will require a vacuum pump fitted to a train to evacuate the atmospheric pressure from the train pipe, reservoirs and brake cylinders to keep the brakes off. It is usually controlled from the driver's brake valve.

For creating vacuum on steam locomotives, you will need an ejector. The ejector consists of a series of cones inside a tube. Steam can pass through the cones so that a vacuum is created in the main body and thus in the brake pipe to which it is connected. A vacuum pump can also be used instead of the ejector.

How do I limit the amount of vacuum in the system?

If your steam locomotive has been fitted with an ejector, fitting a vacuum limiting valve will allow you to set the highest limit of vacuum used in the system. This is usually 12" -15" of mercury, shown as Hg units on the vacuum gauge. An electric pump has a vacuum switch which can be set to the required vacuum level.

Why is it important to limit the vacuum in the system?

If the reservoir vacuum is ever higher than the vacuum achievable by the pump or ejector, the brakes will stay on and not come off.

What do I use for the brake pipe?

The vacuum brake system is controlled through a brake pipe (The train pipe) connected to a brake valve in the driver's cab. Each vehicle in the train should have at least one brake cylinder and vacuum reservoir.

The train pipe can be a flexible PVC hose that runs the length of the train. It is connected between vehicles, which can be uncoupled when the locomotive and rolling stock separate. When separated the loss of vacuum will allow air at atmospheric pressure to apply the brakes, making the vehicles fail safe. Releasing the vacuum in the reservoir side of the actuator with the release valve allows atmospheric pressure on both sides of the diaphragm, thus releasing the brakes.

Overview of components in the PNP Railways vacuum brake range

Vacuum Pump

For electric or internal combustion locomotives, you will require a 12v Vacuum Pump. The PNP Railways Vacuum Pump has an on/off switch, adjustable vacuum level control, relay, non-return valve, thermal cut out and fuses. All mounted in a case, piped and ready to run. When installed, turn on and let the vacuum switch run the system.

The pump should hardly need to run. If it does, then check that all the vacuum connections are good, and the end tails are on their dollies. The vacuum high limit is set by a switch mounted within the pump.

Please note: When used on a different locomotive or vacuum generator on a fitted set, it is best to expose all vacuum reservoirs to atmospheric pressure and re-evacuate to the current vacuum limit in use.

No other limiter of electrical or mechanical type should be used in conjunction with the pump.

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Vacuum Ejector

There are two sizes of ejector in the range both by Bob Bransom, designed to create the most vacuum using the least amount of steam. Both provide a reliable and effective means of creating vacuum on steam locomotives for powering the brakes systems fitted to 5”, 7¼" & 10¼" gauge rolling stock.

Vacuum Limiting Valve

This is for use on steam locomotives fitted with an ejector. It is used to set the highest limit of vacuum used in the system. Limiting the amount of vacuum is important because if the reservoir vacuum is ever higher than the vacuum achievable by the pump or ejector, the brakes will stay on and not come off. PNP Railways limiting valves are easily adjustable and are small enough to be mounted discretely.

Vacuum Release Valve

The release value is employed to allow atmospheric pressure into the vacuum reservoir. To release a detached vehicle.

Brake Actuator

There are two types of brake actuation kit in the PNP Range, our standard kit and kit with trunnion mounting.

What is the difference between the standard brake kit and kit with trunnion mounting?

The only difference between the kits is the way that the actuators can be mounted. The standard kit has a stud extending from the rear cover and the other with two bearings mounted at its mid-point. If space is at a premium, then the trunnion version is the better option. The kits are very easy to assemble, no machining required.

Vacuum Reservoir

The reservoir is a necessary component when fitting vacuum brakes. The reserve of vacuum (if there is such a thing) makes it possible to create the differential between it and atmospheric pressure to apply a force on the diaphragm, thus applying the brakes.

Drivers Brake Valve

There are two types of drivers brake valves in the PNP Range. The 1/3rd scale progressive brake valve works with both electric and steam generated vacuum and is particularly good when used in conjunction with the vacuum pump. The combined vacuum and steam valve have been designed to allow the operation of a locomotive steam brake and application of the train vacuum brake with the same control handle.

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Gauges

Two gauges can be used, one to show the train pipe vacuum and the second to show the vacuum in the reservoir on the loco. We offer two types of gauge, one brass and one plastic. One only on the train pipe is enough.

Brake Blocks

There are five types of brake blocks in the PNP Railways range.

What are the brake blocks made from?

All brake blocks are plastic injection moulded in a grade of nylon which is filled with glass beads to a level of 40%. The beads are very small and provide the braking medium with the plastic acting as the carrier

The plastic brake blocks bed into the wheels and remove traces of dirt and aluminium. They will also not attach to the wheels with rust.

Standard Brake Blocks

There are two types of standard brake blocks.

The 1/3rd scale brake blocks are for use on 7¼" narrow gauge prototypes with wide wheel profiles (5" - 8" diameter).

The smaller 1/8th scale blocks are for standard scale 7¼" gauge rolling stock or locomotives with a 4" - 5"-wheel diameter. If required these blocks can be machined to fit larger scale 5"-gauge stock

Before use you will need to drill a hole for the brake hanger.

Link to video – How to drill brake blocks

RCH Brake Blocks

There are two sizes RCH brake blocks in the range. They have flange clasp detail as used on wagons without cross tie rods. Supplied in a set of 4 with three pre-drilled holes. No machining required; they can be used straight from the packet.

The 7¼" standard scale version are suitable for locomotives and rolling stock, with a wheel diameter of 4¼" (scaled from 3' 1" full size wagon wheel). This version is available in black or rust.

The 10¼" standard scale version is suitable for locomotives and rolling stock, with a wheel diameter of 7" (scaled from 3' 1" full size wagon wheel). This version is available in black only.

Handed Brake Blocks

The largest brake block in the range has been designed to fit the largest 7¼" narrow gauge and 10¼" standard scale models.

The brake blocks are left and right-handed. This is because the hanger position is below centre. Being handed allows room for sets of blocks to be fitted to close coupled wheel sets. This block is suitable for 10" diameter wheel but will suit a wheel from 8" to 12".

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Vacuum Hoses

We can supply a 1/3rd Scale vacuum hose with swan neck and coupling set. Suitable for 7¼", 10¼" narrow gauge stock.

A set of castings and ribbed hose suitable for 10¼" standard scale and smaller 7¼" narrow gauge types i.e. Romulus' etc.

Vacuum hoses only are also available in 5" gauge, 7 ¼" & 10 ¼". All are suitable for passenger carrying rolling stock.

Ancillary Equipment

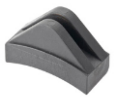
We can supply all the pipe and fittings to install the system.

What components do I need?

We are frequently asked what items are required to fit vacuum brakes.

There are of course many different types of locomotives and rolling stock so there is no generic answer. The solution shown below is based on a narrow-gauge Romulus hauling two eight wheeled wagons. On the loco, all wheels are braked whilst on the wagons just the rear four-wheel bogie is braked.

Product	Part No.	Description	Qty	Unit Cost	Total Cost
	PNR-4R	Vacuum Ejector Required to create the vacuum	1	£76.00	£76.00
	PNR-1H	Vacuum Limiting Valve Used to set the limit of vacuum in the system	1	£39.00	£39.00
	PNR-3P	7¼" Narrow Gauge Progressive Brake Valve with Lap	1	£188.00	£188.00
	PNR-2D	Vacuum Brake Kit with Trunnion. This version is to allow for fitting in carriages where space may be an issue.	3	£43.85	£131.55
	PNR-1C	Vacuum Reservoir To hold a reserve of vacuum without which the brakes would not be able to be applied	3	£16.50	£49.50

	PNR-1G	Vacuum Release Valve Employed to allow atmospheric air pressure into the vacuum reservoir	3	£12.00	£36.00
	PNR-3U	Vacuum Gauge – Brass Two are required, one to show the vacuum in the train pipe and the second to show what is in the reservoir on the loco.	2	£49.70	£99.40
	PNR-1E	1/3 Scale Brake Blocks (Set of 4)	3	£15.35	£46.05
	PNR-1J	T-Hose Connector	6	£1.40	£8.40
	PNR-1M	BSP Socket	3	£2.00	£6.00
	PNR-1L	Male Taper Hose	3	£1.75	£5.25
	PNR-1I	Clear PVC Tube 3 1/16th	4 m	£1.05	£4.20
				Total Including VAT	£689.35

The PNP Railways vacuum brake system will give you complete peace of mind knowing that you can stop the train.

Vacuum Brakes Price List

Vacuum Creators

Vacuum Pump

For electric or internal combustion locomotives

PNR-2E	12v Vacuum Pump Dimensions: (L) 200mm x (W)150mm x (H) 75mm	£413.00

Vacuum Ejectors

Reliable and effective way of creating vacuum on a steam locomotive

PNR-4R	Vacuum Ejector – No. 0 20 to 35 in^2 Grate Area	£76.00
PNR-12M	Vacuum Ejector No. 3 with extra cones 75 to 100 in2 Grate Area	£143.00

Vacuum Limit Valves

Used to set the limit of vacuum in the system.

PNR-1H	Vacuum Limiting Valve	£39.00

Vacuum Gauges

Two gauges are required one to show the vacuum in the train pipe and the second to show what is in the reservoir on the loco.

PNR-3U	Vacuum Gauge - Brass – 1 5/8" DIA. 0-30in.Hg. Includes back plate, nipple and nut	£49.70
PNR-3Y	Vacuum Gauge - Plastic - 50mm 1/8" BSPT - 1000mbar/-30 inHg-0	£12.80

Vacuum Brake Valves

Progressive brake valve particularly good for use with a vacuum pump

PNR-3P	7¼" 1/3rd Scale Narrow Gauge Progressive Brake Valve with Lap	£188.00
PNR-3Z	Brake Valve Handle	£3.20
PNR-4I	Brake Valve Legend Plate	£5.25

Will allow the operation of a locomotive steam brake and application of vacuum brake with the same control handle.

PNR-10K	Combined Vacuum and Steam Brake Valve Suitable for 5" Standard Scale – Small 7¼" Narrow Gauge	£177.65
PNR-10L	Combined Vacuum and Steam Brake Valve Suitable for 7¼" Narrow Gauge – Small 10¼" Standard Scale	£188.00

Brake Actuation Kits

The brake actuators transfer the force to the brake to achieve the braking effect.

PNR-1A	Vacuum Actuation Kit Dimensions: 110mm diameter x 210mm overall length Piston Rod Travel – 20.6mm Pulling Force – 30 Hg – 124lbs, 20 Hg – 83lbs, 15 Hg – 62lbs, 10 Hg – 41lbs, 5 Hg– 20lbs	£40.75
PNR-2D	Vacuum Actuation Kit with Trunnion Mounting Dimensions: 143 diameter x 142mm Overall length Piston Rod Travel – 20.6mm Pulling Force – 30 Hg – 124lbs, 20 Hg – 83lbs, 15 Hg – 62lbs, 10 Hg – 41lbs, 5 Hg – 20lbs	£43.85
PNR-12H	Refurbishment Kit for Vacuum Actuator For either PNR-1A or PNR-2D	£22.00

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Vacuum Reservoir		
A necessary component to hold the reserve of vacuum		
PNR-1C	Vacuum Reservoir Dimensions: Overall length 252mm x 68mm Volume – 573 – 575 cubic cm	£16.50
Vacuum Release Valve		
Used to allow atmospheric pressure into the vacuum reservoir to release a detached vehicle		
PNR-1G	Vacuum Release Valve	£12.00
Vacuum Hoses		
Used to connect vehicles by flexible hoses, which can be uncoupled to allow vehicles to be separated.		
PNR-10I	10¼" Vacuum Scaled Ribbed Hose	£10.45
50005	10¼" Vacuum Coupling Dummy Casting	£8.10
50027	10¼" Vacuum Coupling Casting	£8.10
50036	10¼" Vacuum Swan Neck Casting	£14.40
PNR-4K	7¼" 1/3rd Scale Vacuum Hose with Swan Neck and Coupling	£46.00
PNR030	7¼" 1/3rd Scale Vacuum Hose Dolly	£8.35
PNR031	7¼" 1/3rd Scale Vacuum Hose Coupling	£8.35
PNR-4A	Pipe Clamp – 12mm	£2.10
PNR-12P	7¼" Vacuum Hose (fits ¼ pipe) Suitable for standard and narrow-gauge rolling stock	£6.50
PNR-12N	5" Gauge Vacuum Hose (Fits 7/32 pipe) Suitable for standard and narrow-gauge rolling stock	£9.00
Brake Blocks		
30% glass filled Nylon Plastic injection moulded brake blocks		
PNR-1D	7¼" Standard Scale Brake Blocks - 1/8th Scale Suit 4" - 5" Wheel diameter	£12.50 Set of 4
PNR-1E	7¼" Narrow Gauge Brake Blocks - 1/3rd Scale Suit 5" - 8" Wheel diameter	£15.35 Set of 4
RCH Brake Blocks		
True Scale, flange clasp detail as used on wagons without cross tie rods.		
PNR-4Y	7¼" Standard Scale RCH Brake Blocks – Black Suit wheel diameter of 4¼" (scaled from 3' 1" full size wagon wheel)	£14.50 Set of 4
PNR-4Z	7¼" Standard Scale RCH Brake Blocks – Rust Suit wheel diameter of 4¼" (scaled from 3' 1" full size wagon wheel)	£14.50 Set of 4
PNR-10H	10¼" Standard Scale RCH Brake Blocks – Black Suit wheel diameter of 7" (scaled from 3' 1" full size wagon wheel	£25.00 Set of 4
Handed Brake Blocks		
Light and right-handed brake blocks for close coupled wheel sets.		
PNR-11G / PNR-11H	7¼" Narrow Gauge, 10¼" Standard Scale Brake Blocks	£25.00 Set of 4 (2 Left & 2 Right)

Ancillary Equipment		
All the ancillary equipment required to fit the braking system		
PNR-1J	T-Hose Connector	£1.40
PNR-1M	¼ BSP Socket	£2.00
PNR-1L	Male Taper Hose	£1.75
PNR-1I	Clear PVC Tube 3 1/16th	£1.05 p/m
PNR-4B	Clevis & Pin 6mm	£3.15

The prices quoted include VAT - Valid from October 2019

Carriage is extra and is calculated on weight and destination

Orders can be placed on-line at www.pnp-railways.co.uk or by telephone 01453 83 33 88