TRIDENT NOTES: NUMBER 6
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# KEEPING COMPRESSED AIR IN TRAINS CLEAN

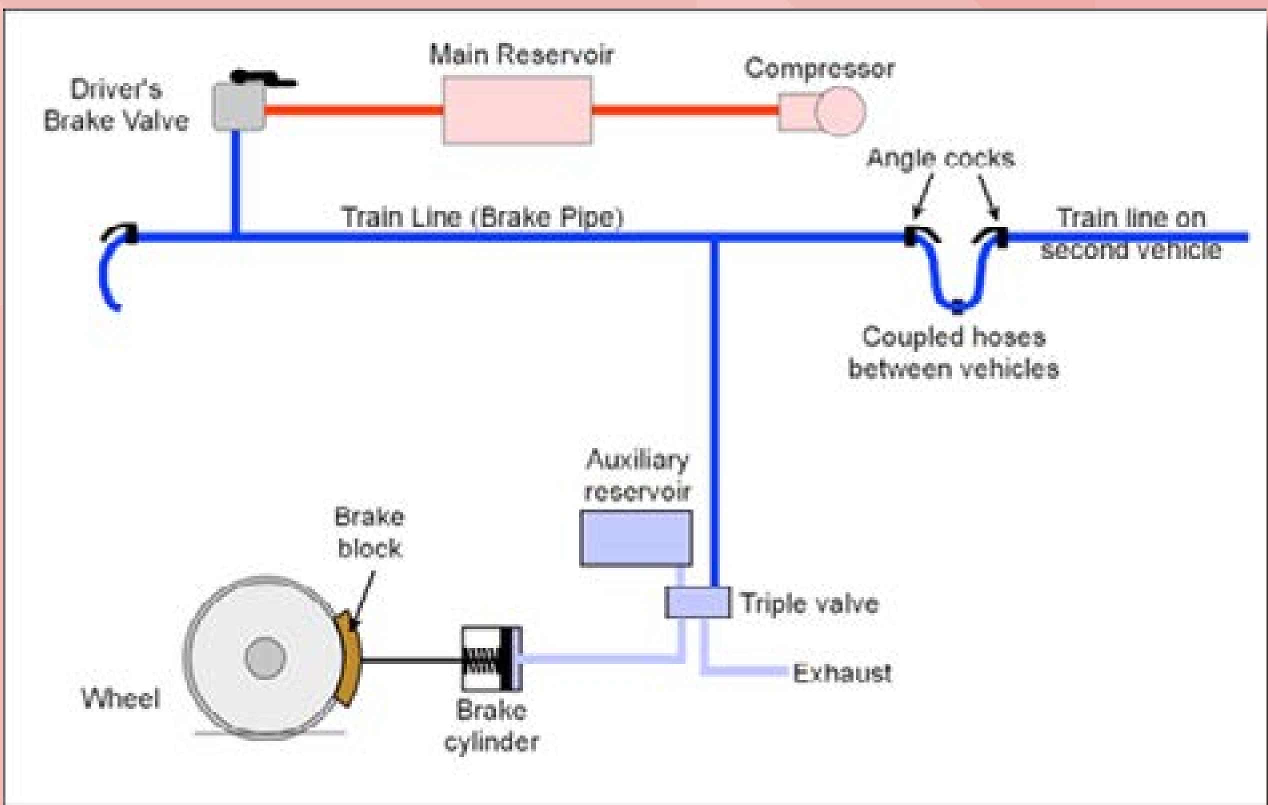
*Trains can't stop quickly or swerve. The average freight train is about 1 to 1¼ miles in length (90 to 120 rail cars). When it's moving at 55 miles an hour, it can take a mile or more to stop after the locomotive engineer fully applies the emergency brake. An 8-car passenger train moving at 80 miles an hour needs about a mile to stop.*

*—Minnesota Safety Council*

*(https://www.minnesotasafetycouncil.org/facts/factsheet.cfm?qs=858251BECECF1976F908D7D68B570E85)*

Passenger and freight trains, metros, trams—they all need to stop at stations and, when necessary, between stations; they also need to stop moving when there are emergencies. Having stopped, a train should not roll down a gradient. It is thanks to pneumatic braking systems that trains do all this, barring very exceptional circumstances. The reliability of the air brake system is testified to by the long usage it has enjoyed.

In the words of the Railway Technical Website, 'The air brake system is undoubtedly one of the most enduring features of railway technology. It has lasted from its initial introduction in 1869 to the present day and in some places, still hardly different from its Victorian origins. There have been many improvements over the years but the skill required to control any train fitted with pure pneumatic brake control is still only acquired with long hours of practice and care at every stage of the operation. It is often said that whilst it is easy to start a train, it can be very difficult to stop it.'




*Schematic of railway air brake system. [http://www.railway-technical.com/trains/rolling-stock-index-l/train-equipment/brakes/, The Railway Technical Website]*

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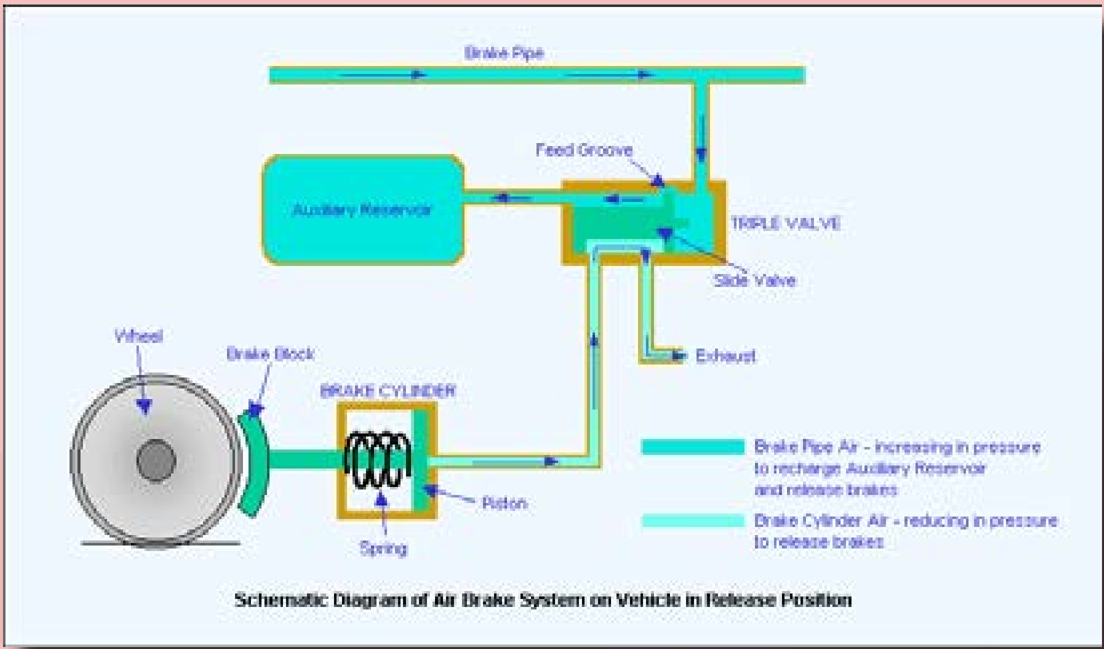
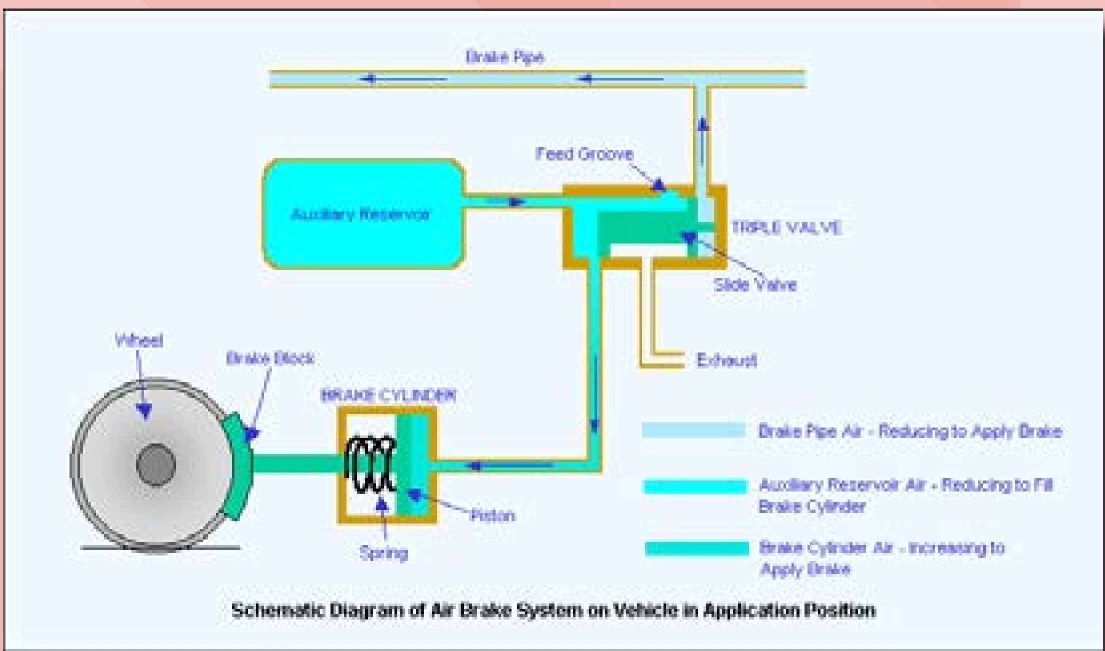
*engineering quality air and gas*

Today's typical railway brake system depends on air-released, spring-operated brakes. A compressor in a train produces compressed air that is stored in a main reservoir. The compressed air is distributed from the main reservoir to auxiliary reservoirs distributed along each rolling stock unit of the train through a pipe known as the main reservoir pipe. The air stored in these reservoirs is used to operate the brake system. A device known as a distributor or triple valve controls the air flow between an auxiliary reservoir and a brake cylinder. The distributor is controlled by the driver using a brake valve, which varies the pressure in a second pipe. This pipe is called the brake pipe. When the pressure in the brake pipe is increased, the brakes are released, and when the pressure is decreased, the brakes are applied.




*The brake system during a brake release: the positions of the brake cylinder and the triple valve and the flow of air when the brakes are being released. The triple valve directs compressed air from the brake pipe to the auxiliary reserve. The valve also exhausts compressed air from the brake cylinder, releasing the brake.*
*[http://www.railway-technical.com/trains/rolling-stock-index-l/train-equipment/brakes/, The Railway Technical Website]*

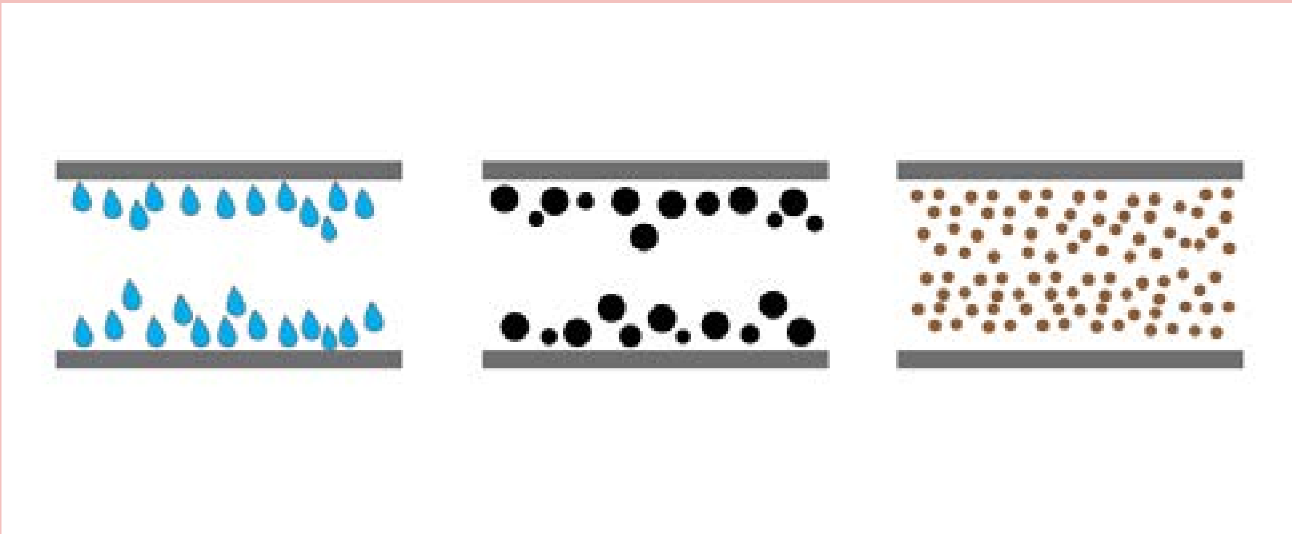



*The railway air brake system during application of brakes. Air flows from the auxiliary reservoir to the brake cylinder, compressing the spring and pressing the brake block on the wheel.*
*[http://www.railway-technical.com/trains/rolling-stock-index-l/train-equipment/brakes/, The Railway Technical Website]*

The critical components of the brake system are the brake cylinder and the valves. These components may malfunction in different ways. The moving seals of brake cylinders may get stuck or damaged. The valves may not function as they are expected to when they are clogged with oil, rust and metal particles and fragments from eroded welds. During cold weather, moisture will freeze, blocking valve orifices.
A malfunctioning brake system is a serious concern as it could lead to a runaway train, the image of which is conjured by the lyrics of a song sung by the rock group Soul Asylum:

*Runaway train never going back*
*Wrong way on a one way track*
and
*Runaway train never comin' back*
*Runaway train tearin' up the track*

If the components are vulnerable to these problems, how does the entire brake system remain fail-proof?
The causes of malfunctioning of the brake system components can be traced to components added to the air during the process of compression: (1) Water droplets condense out of air when its pressure is increased. In addition to blocking valves by itself, water promotes rust formation and accumulation of rust particles in the air lines and valves. (2) Oil particles from the compressor invariably enter the air stream. (3) And metal particles are eroded from the compressor by the relative movement of components in contact with each other.



*Water droplets, oil particles and metal particles*

The key to exorcising the image of the runaway train is therefore in removing the impurities in the compressed air. This can be achieved by installing appropriate equipment in the brake system. Oil droplets and rust and metal particles are removed by passing the compressed air through filtration systems. Water is removed using air dryers.

In practice, the water in the moist air and the oil in it are first made to coalesce in a pre-filter. A drain valve drains the resulting mixture of oil and water. A controller opens the drain valve periodically. Only a fixed volume of condensate must be discharged at a time so that compressed air is not lost through the valve.

The air may then be passed through a drying tower. The tower is packed with activated alumina, which adsorbs water vapour as the air passes through it. The air may carry some fine alumina powder, which must be removed using an after-filter.

The alumina powder can only adsorb a certain amount of water vapour. It can be reused only after it has been ‘regenerated’. A part of the dry air produced by the drying system is used to regenerate the alumina. To avoid interrupting the supply of air during regeneration, a second drying tower is used in tandem.

The clean air provided by the filtration and drying system ensures that each time the driver applies the brake, the train halts as desired.

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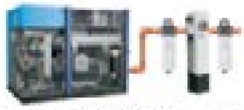
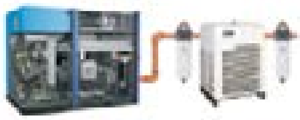
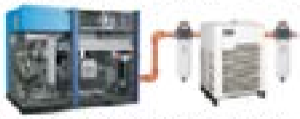
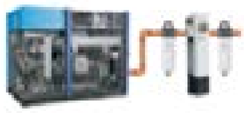
## Air Quality Class Recommendation for Textile, Engineering, Painting, Powder Coating and Chemical Industries as per Pneurop Standard

| Applications | Air Quality Class ISO | Recommended Layout |
|---|---|---|
| Blow Room, Carding, Lapping, Comber, Draw Frame, Speed & Ring Frames | ISO 4.3.3 |  |
| Auto Coner | ISO 2.2.2 | ISO 4.3.3 / ISO 2.2.2 / ISO 2.2.3 |
| Testing Lab | ISO 2.2.2 | |
| Cleaning of Machines | ISO 4.4.4 |  |
| Air Motors, Miniature | ISO 3.3(1).3 | |
| Construction Equipments | ISO 4.5.5 | ISO 4.4.4 / ISO 3.4.3 |
| Conveying granular products | ISO 3.4.3 |  |
| Conveying Powder products | ISO 2.3.2 | |
| Industrial Hand / Machine Tools | ISO 4.3.5 | ISO 3.3.3 / ISO 2.3.2 / ISO 3.2.3 |
| Foundry Machines | ISO 4.4.5 |  |
| Pneumatic Cylinders | ISO 3.3.5 | |
| Precision Pressure Regulators | ISO 3.2.3 | ISO 4.5.5 / ISO 4.4.5 / ISO 4.4.6 |
| Process Control Instruments | ISO 2.2.3 |  |
| Workshop air general | ISO 4.4.6 | |
| Painting & Powder Coating | ISO 3.3.3 | ISO 4.3.5 / ISO 3.3.5 |

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Trident Pneumatics manufactures a wide range of equipment to treat compressed air for every possible use, for pressures up to 16 bar and flow rates up to 2000 cfm.