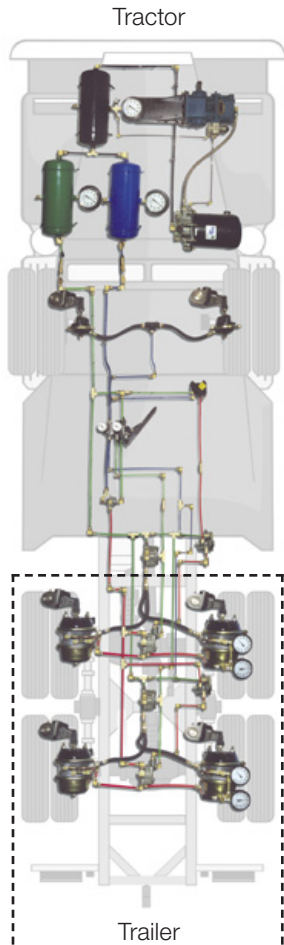


Product Information Report

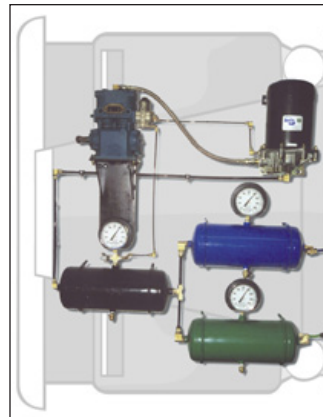
Air Brake Hose, Tubing, and Fittings



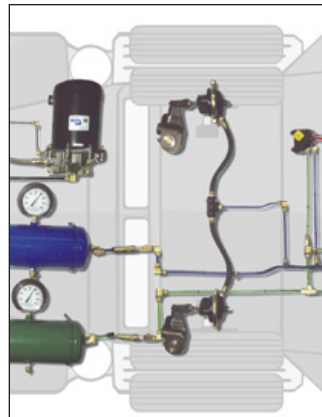
Overview

Air Brake systems are used on most large commercial vehicles and buses. The intent of this PIR is to identify the air brake systems that are found on these vehicles and describe their functions and the related products that support them. First, let's review how an air brake system functions.

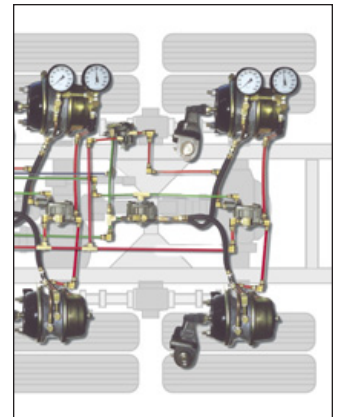
Air brake systems can be broken down into five sub-systems that will be discussed in further detail:



Air Compressor to Tanks



Tanks to Manifold



Manifold to Wheels



Tractor to Trailer

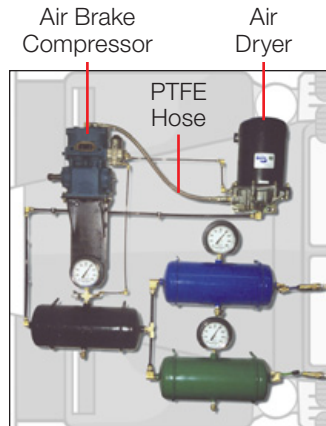


Transmission/Accessories

Air Brake System Operations

The air used in an air brake system is generated by a belt driven compressor, located in the engine compartment. Air brakes must function whether the engine is running or off. This means that a constant flow of air must be available, upon demand. Air brake systems are broken down into two sub-systems; service and emergency. The service side is used when the vehicle is in operation and the emergency side is used when the vehicle is parked or if the service side fails. As a result, the air from the compressor is stored in a series of tanks and is replenished by the compressor when the pressure in the tanks reaches a designated level.

Compressor to Tanks



PTFE Hose



Drain Valve and Lanyard

The compressor system consists of three components; the compressor, the air dryer, and the connecting hose (or tubing). Air flow generated by the compressor is not suitable for use, until it is conditioned. There are two issues with the raw compressed air. First, air coming from the compressor is too hot for standard tubing. As a result, **Teflon or PTFE hose** is used to connect the compressor to the dryer. This hose can handle temperatures up to 400F. PTFE hose can be identified by the stainless steel braid that serves as both the cover and reinforcement.

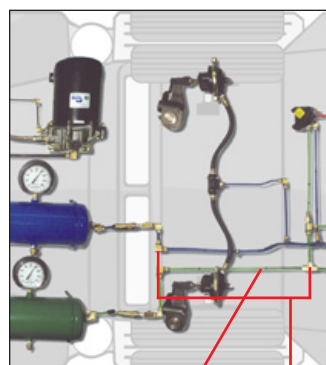
When there are longer runs of PTFE hose, such as on bus systems, there is the potential for static discharge to build up. This static can blow pin holes in the hose, causing the hose to fail. As a result, the PTFE hose is available in two forms, conductive and non-conductive. The most common form of PTFE hose is the non-conductive. It can be identified by the white inner tube. The inner tube on a conductive PTFE hose is black. The carbon in this liner conducts the static charges through the hose, preventing the concentration of static in one location. There are some vehicles where steel tubing is used in place of the PTFE hose.

The second problem with the compressed air is that there is too much moisture in the air. Without going through a dryer, the air from the compressor could cause problems with flow, as well as the corrosion of downstream components.

PTFE hoses are sold as complete assemblies, in graduated lengths or as bulk components. Fittings can be attached to the hose via crimping, swaging, and with field attachable fittings. Most fleets prefer the pre-made assemblies because of the challenge of dealing with the stainless steel braid and the need for assembly tooling. Bus garages are the most common type of customer that makes their own assemblies, due to the length and diameters that are involved. Making their own assemblies gives the garage the flexibility of being able to cut hose to length and not having to inventory specific length assemblies.

Once the conditioned air leaves the dryer, it is delivered to the tank systems. There are three tanks in most systems; a main, a service, and a reserve tank. The main tank receives the air directly from the compressor system. This tank serves as a reservoir for the service and emergency tanks. Even though the air is dried before it reaches the tanks, there is still a level of moisture in the air. As it cools, the moisture condenses and collects in the bottom of the tanks. Each tank has a **drain valve** that is used to bleed the air and the moisture that has settled in the tank. Drivers are required to bleed the tanks on a regular basis. The valves have a **lanyard** attached to them to make it easier for the driver to activate the drain.

Tanks to Manifold



Tubing Fittings

Air leaving the tanks is conveyed by **tubing or hose** that runs along the frame of the tractor to a distribution manifold. Air Brake tubing is also used from the front of the trailer to the back of the trailer. The tubing today is typically a nylon-based material, but older systems and some vehicles in colder climates use copper tubing. Each material has its own strengths and weaknesses.

Tubing

Nylon is the most commonly used material. It is light weight and relatively inexpensive. It is also available in a wide range of colors, enabling installers to color code branches of the system to avoid crossed lines. **Nylon air brake tubing** is regulated by both SAE and the federal DOT. The regulations cover both the thermal stability and the pressure rating of the tubing. Nylon tubing used in air brake applications must be tested by DOT and carry the appropriate SAE rating on the tubing. There are two major types of "air brake" tubing, SAE J844 3A and SAE J844 3B.



N2 Tubing



T-Hose

Tubing (cont.)

- 3A tubing, also known as **N2 Tubing**, is a single wall extruded tube. It is used in non-braking applications, such as transmission shifter, seat and mirror controls, windshield wiper and air horn lines. These tubes and fittings do not necessarily need to carry the DOT imprints required for lines used to operate the brakes. 3A tubing is available in 1/8", 5/32", 3/16", 1/4", and 5/16" ODs. The 1/4" tube is the only 3A or N tube that is used for air brake circuits. The rest of the diameters are used for control lines.
- 3B tubing, also known as **T-Hose**, contains two layers of tubing with an internal layer of reinforcement. Since this tubing is primarily used to control the brakes, the tube and the fittings must carry DOT markings. Other applications for this tube include gas and diesel

Nylon has some down-sides. Nylon itself is hydro-phobic, giving off water as the temperature changes. This causes the tubing to become brittle. As a result, flexing and the impact of road debris can cause the tubing to fracture or leak. In addition to potentially leading to system failure, leaking tubing can result in a fine by the DOT as well as having the vehicle removed from the road until repairs are made. Nylon's second major problem has been the issue of supply. These issues have resulted in supply shortages of nylon air brake tubing, leading suppliers to strictly allocate tubing to their customers. There has been a drive to overcome the problems with nylon. Some suppliers have developed materials that are less dependent on nylon

Copper tubing has also been used in air brake systems. Copper's advantage is that it is a stronger material than nylon and it is not as susceptible to temperature issues. As a result, it is still used in cold temperature areas, in place of nylon. The downside to copper is its cost and weight. This is why most systems today use nylon tubing.



Compression



Brass Push-To-Connect



Composite Push-To-Connect

Fittings

There are two styles of fittings used with tubing; compression and push-to-connect.

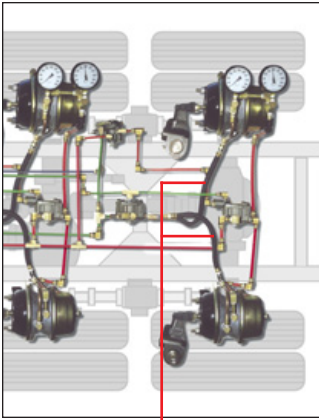
The original types of fittings used were the **compression fittings**. These fittings are made of **brass** and consist of three components; nut, sleeve (ferrule), and fitting. When assembling these fittings, the nut is slid over the tube and then the sleeve is placed near the end of the tube. The tube is inserted into the body of the fitting and the nut is tightened. The body of the fitting has an internal flare that stops the sleeve. As the nut is tightened, the sleeve is compressed, preventing the tubing from pulling out of the fitting. The advantages of this style of fitting are that it gives a reliable seal and most mechanics are familiar with assembling compression fittings. The disadvantages of this style of fitting are that it takes time to make a proper assembly and if the sleeve is not properly aligned, the tube will not be retained. Compression fittings are available for both nylon and copper tubing. You can identify the copper tubing fittings by the longer taper on the nuts as well as the difference in the sleeve. The sleeve for the nylon fitting is tapered with a ridge in the middle while the sleeve for the copper fitting is rounded.

The **push-to-connect** fitting was designed to reduce installation time on the OEM assembly lines. They are available in **brass and nylon**. The tube is simply pushed into the fitting until it is seated. While it is easy to install, the quality of the seal depends on a clean straight cut of the tube. If there are burrs or an angle, the tube will not be retained or will leak. Nylon fittings are used to reduce weight (there may be up to 80 fittings on a trailer), while brass is used for its durability.

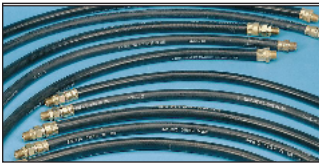
Regardless of the type of attachment, fittings used on a braking system must have the DOT stamp on it.

From a popularity standpoint, the market for compression vs. push-to-connect is split almost equally and is driven by customer preference.

Manifold to Wheels



Jumper Hoses



Jumper Hoses



Field Attachable Fittings



Crimp Fittings

Hoses

The brakes on every wheel in an air brake system are operated by a vacuum chamber that connects the distribution manifold on the vehicle and/or trailer to the wheel. These are often referred to as **jumper hoses**. While the nylon tubing is usually secured to the frame, the hose that goes from the manifold to the wheel is free floating and has to flex with the vehicle's suspension. As a result, a more durable hose is required. The most common hose used is defined by the **SAE J1402 Type A Specification**. This is a rubber hose with a fabric reinforcement that is more flexible and durable than nylon tubing.

Other hoses approved for this application are the **SAE 100R5** series of hoses which include the low pressure SAE J1402 Type A1 and the medium pressure SAE J1402 Type 3. These hoses are dual rated for air brake and hydraulic applications. While the SAE 100R5 hoses are more durable and handle higher pressure, they are heavier, less flexible, and more expensive.

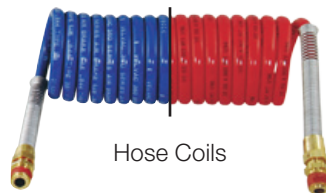
Hoses for this application are available in 3/8" and 1/2" IDs.

Fittings

Traditionally the fittings used on the Type A hose are brass. These hoses are usually available as pre-made assemblies, in **graduated lengths, and as bulk components**. When assembling, end users have the the choice of **crimping** the fitting on the hose or using a **field attachable** fitting. If the assembly is made with approved field attachable fittings, they are acceptable to DOT without further labeling. If the assembly is crimped, then the assembler is required to register with DOT's NHTSA and affix a Mylar tag on the hose that carries the assembler's registration number and date of assembly per DOT FMVSS S71.106. These tags are commonly referred to as "Turkey Tags". PIR 209 – Crimped DOT Hose Assemblies, gives a complete overview of the process and includes the registration form.

Similar to the nylon and copper compression fittings, the field attachable fittings for this hose consist of a nut, a sleeve, and a fitting body. The majority of the pre-made assemblies have a crimped, 2-piece brass fitting.

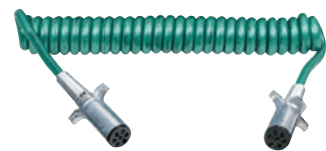
Tractor to Trailer



Hose Coils



Gladhand



ABS Cable

Since the compressor is located in the tractor, a flexible connection is needed to operate the brakes on the trailer. The diameter of the connection between the tractor and the trailer is 1/2". There are two different types of hose/tubing used for this application; Nylon and Rubber.

Nylon Tubing

The **SAE J844 3B tube** is the standard air brake tubing used to make this connection. While the most frequently seen connection is a pair of **coiled tubes (red and blue)** some fleets prefer to make their own assemblies, using straight tubing, believing that it is more durable and less likely to snag. The color coding is used to distinguish between the Service (blue) connection and the Emergency (red) connection. The assemblies are terminated with pipe thread and there are generally round spring bend restrictors at both ends to reduce the chance of kinking. In addition to the tractor to trailer coils there is a 1/4" diameter coil that is used to automatically disengage the fifth wheel slider. While this is not a braking application, it is another part of the hook-up process.

Rubber Hose

There are a number of fleets that prefer the rubber hose used for the assemblies that go from the manifold to the wheel. The SAE J1402 Type A hose used in **jumper hoses** is approved for use in this application. The downsides of using this hose are that the rubber hose is heavier and is less abrasion resistant.

Fittings

While the hoses are terminated with a pipe fitting, the actual connection to the tractor and trailer is made through a fitting called a **gladhand**. These are covered by SAE J318. The gladhand is a railroad style connection that contains a rubber seal. The opposing sides are brought together and twisted a quarter turn to make the connection. This makes it easy to connect and disconnect the air brake lines, before disconnecting the trailer. There is also a number of different suspension devices designed to prevent the hoses from getting caught in the fifth wheel or drag on the ground. These come in the form of springs and sticks (called pogoes). Another accessory that is used in conjunction with the connection is a caddy. This allows the driver to secure the hose to the tractor when the trailer is disconnected.

Air Brake Electrical Connection

Many air brake systems have an electrically operated ABS (Anti-skid Brake System) to reduce the chance of skidding. This is a seven conductor cable assembly with moisture resistant connectors. **The ABS cable** is color coded green to identify it as an ABS assembly and not a standard 7 pin power cord. These are available in coiled or straight assemblies. They are typically run parallel to the air brake air lines.

Transmission/Accessories



(5 of 5)

Auxiliary power is a major concern on heavy duty vehicles. Since lighting and engine controls place high demands on the charging and starting system, the availability of pneumatic flow from the air brake compressor supplements the electrical system. Sub-systems, like the transmission shifter, air ride seat, air suspension, remote mirrors, and wipers take advantage of the available pneumatic flow from the compressor. This is where the smaller diameter **SAE J844 Type 3A tubing** is used. There are also **smaller diameter compression fittings** that are used for the shifter mechanism as well as the other locations. Since these circuits do not control the brakes, DOT markings are not required. Standard compression and push-to-connect fittings are acceptable; again, as long as they are not used for the brake circuits.

