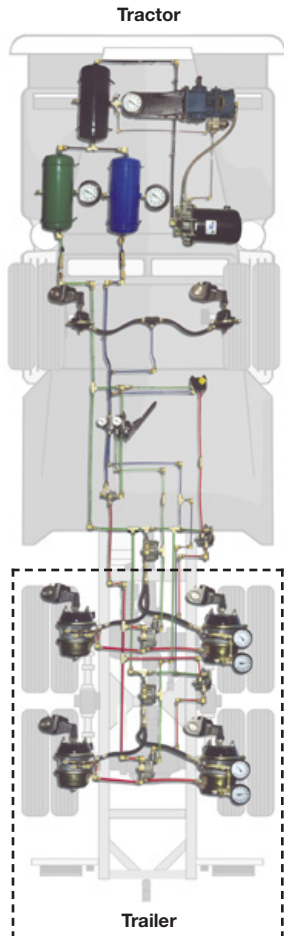


# Product Information Report

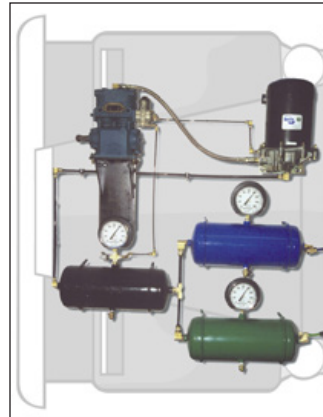
## Air Brake Hose, Tubing and Fittings



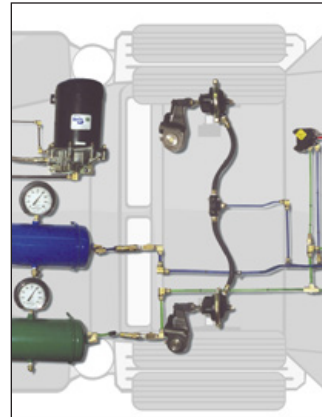
### Overview

Air brake systems are used on most large commercial vehicles and buses. This PIR can help 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.

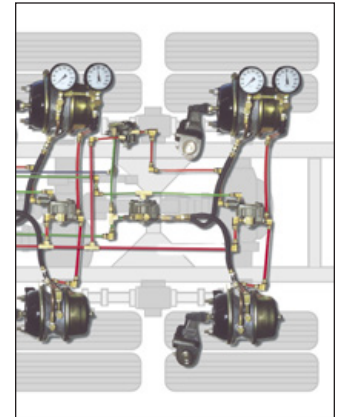
Air brake systems can be divided into five sub-systems.



Air Compressor to Tanks



Tanks to Manifold



Manifold to Wheels



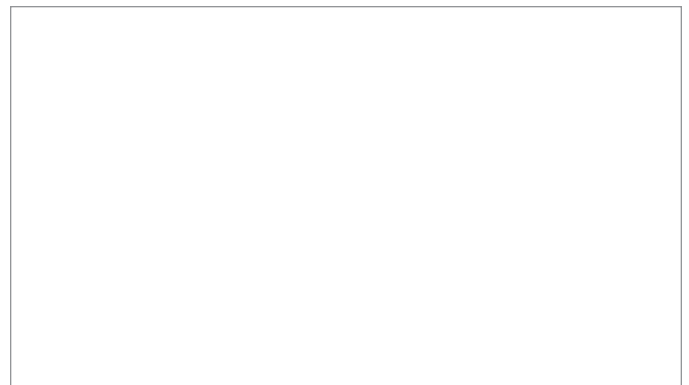
Tractor to Trailer



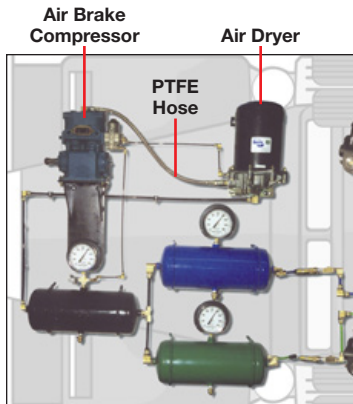
Transmission/Accessories

### 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 so a constant flow of air is available on demand. Air brake systems are divided into two sub-systems: service and emergency. The service system is used when the vehicle is in operation; the emergency system is used when the vehicle is parked or if the service system 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 falls to 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 can't be used until it is conditioned. There are two problems with the raw compressed air. First, air coming from the compressor is too hot for standard tubing. **PTFE hose** is used to connect the compressor to the dryer because it can handle temperatures up to 400°F. PTFE hose can be identified by the stainless steel braid that serves as both the cover and reinforcement.

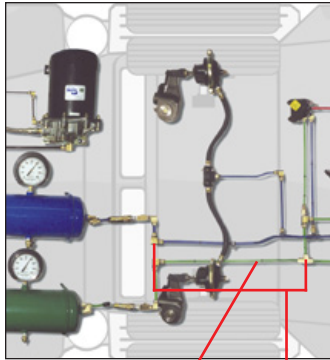
When there are longer runs of PTFE hose, such as on bus systems, there is the potential for static discharge to build up. This static can blow pin holes in the hose causing hose failure. Because of this, PTFE hose is available in two types, conductive and non-conductive. The most common is non-conductive and it can be identified by the white inner tube. Conductive PTFE hose has a black inner tube. The carbon in this liner conducts the static charges through the hose, preventing the concentration of static in one location. Steel tubing is used in place of the PTFE hose in some vehicles.

The second problem with the compressed air is that it holds too much moisture. If it doesn't pass through a dryer, the air from the compressor could cause problems with flow, as well as 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 by crimping, swaging, and with field-attachable fittings. Pre-made assemblies are preferred to avoid the challenges of dealing with the stainless steel braid and the need for assembly tooling. Bus garages are the most common type of customer making their own assemblies because of the lengths and diameters of hose involved. Making custom assemblies allows the flexibility of cutting hose to length and not having to inventory assemblies of specific lengths.

Once the conditioned air leaves the dryer it is delivered to the tank systems. There are three tanks in most systems: a main tank, a service tank and a reserve tank. The main tank receives the air directly from the compressor system. It acts as a reservoir for the service and emergency tanks. Even though the air is dried before it reaches the tanks it still contains some moisture. 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 moisture that has settled in the tank. Drivers are required to bleed the tanks on a regular basis. The valves have an attached **lanyard** to make it easier for the driver to activate the drain.

## Tanks to Manifold



Tubing Fittings



N2 Tubing



T-Hose



Compression



Brass Push-To-Connect



Composite Push-To-Connect

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. This tubing 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 SAE and the federal D.O.T. These regulations cover both the thermal stability and the pressure rating of the tubing. Nylon tubing used in air brake applications must be tested by D.O.T. 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**.

- **3A Tubing**, also known as **N2 Tubing**, is a single wall extruded tube. It is used in non-braking applications such as transmission shifters, seat and mirror controls, and windshield wiper and air horn lines. These tubes and fittings do not necessarily need to carry the D.O.T. 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" O.D. The 1/4" tube is the only 3A or N tube that is used for air brake circuits. Other sizes 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 D.O.T. markings. Other applications include gas and diesel.

Nylon has two major downsides. First, nylon is hydrophobic, giving off water as the temperature changes. This causes the tubing to become brittle resulting in flexing. The impact of road debris can cause the tubing to fracture or leak and can lead to system failure. Leaking tubing can also result in a fine by the D.O.T. and the vehicle may be removed from the road until repairs are made. The second major problem has been supply, which has resulted in shortages of nylon air brake tubing and forcing 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** is also used in air brake systems. It is a stronger than nylon and is not as susceptible to temperature issues. As a result, it is still used in place of nylon in cold temperatures. The downsides to copper are its cost and weight. This is why most systems today use nylon tubing.

### Fittings

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

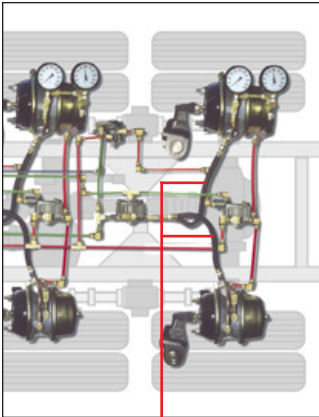
**Compression fittings** are made of brass and consist of three components: nut, sleeve (ferrule) and fitting. When assembling these fittings, the nut slides over the tube and then the sleeve is placed near the end of the tube. The tube is inserted into the body of the fitting and the nut is tightened.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

**Push-to-connect** fittings were designed to reduce installation time on OEM assembly lines. They are available in brass and nylon. The tube is simply pushed into the fitting until it is seated. While these fittings are easy to install, the quality of the seal depends on a clean, straight cut of the tube. If there are burrs or the cut is angled, 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 durability.

Regardless of the type of attachment, all fittings used on a braking system must be D.O.T. stamped.

The use of compression fittings or push-to-connect fittings 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 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 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.

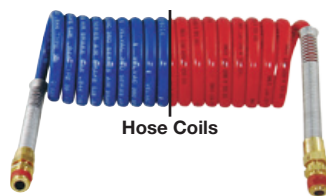
Hoses for this application are available in 3/8" I.D. and 1/2" I.D.

## Fittings

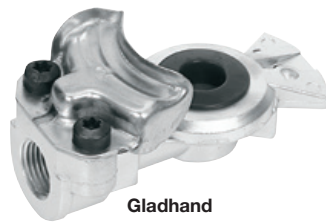
Traditionally brass fittings are used on Type A hose. These hoses are usually available as pre-made assemblies in graduated lengths and as bulk components. When assembling, end users can crimp the fitting on the hose or use a field-attachable fitting. If approved field-attachable fittings are used, they are acceptable to D.O.T. without further labeling. If the assembly is crimped, then the assembler is required to register with D.O.T. NHTSA and affix a Mylar® tag on the hose that carries the assembler registration number and date of assembly per **D.O.T. FMVSS S71.106**. These tags are commonly referred to as "turkey tags." See the **Crimped D.O.T. Hose Assemblies** PIR for an overview of the process.

Similar to the nylon and copper compression fittings, 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.

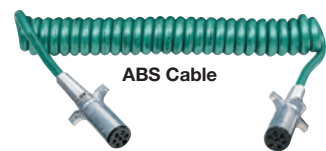
## Tractor to Trailer



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 connection between the tractor and the trailer is 1/2" dia. There are two different types of hose/tubing used for this application: nylon and rubber.

### Nylon Tubing

**SAE J844 3B Tubing** is the standard air brake tubing used to make this connection. The most common connection is a pair of coiled tubes (**red** and **blue**). However some fleets prefer to make their own assemblies using straight tubing, that they feel are more durable and less likely to snag. Color-coding is used to distinguish between the Service (**blue**) connection and the Emergency (**red**) connection. The assemblies are terminated with pipe thread and generally have round spring bend restrictors at both ends to reduce the chance of kinking. There is also a 1/4" dia. 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

Some fleets that prefer to use rubber hose for the assemblies connecting 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

Hoses are terminated with a pipe fitting, but the actual connection to the tractor and trailer is made through a gladhand fitting. This is covered by **SAE J318**. Gladhand are railroad-style connections that contain a rubber seal. The opposing sides are brought together and twisted 1/4 turn to make the connection, making it easy to connect and disconnect the air brake lines before disconnecting the trailer. There are also different suspension devices designed to prevent hoses from getting caught in the fifth wheel or dragging on the ground. These are springs and sticks called pogoes. A caddy is another accessory used in conjunction with the connection, allowing the driver to secure the hose to the tractor when the trailer is disconnected.

### Air Brake Electrical Connections

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

## Transmission/Accessories



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. Subsystems, 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 smaller diameter **SAE J844 Type 3A** tubing is used. There are smaller diameter compression fittings that are used for the shifter mechanism as well as in other locations. Since these circuits do not control the brakes, D.O.T. markings are not required. Standard compression and push-to-connect fittings are acceptable as long as they are not used for brake circuits.

