AIR BRAKE MANUAL

Alberta
INFRASTRUCTURE

This manual has been prepared as a guide only. For official purposes, please refer to the Highway Traffic Act, Motor Transport Act, and regulations, etc.

This manual should not be used as a guide for repairs, which should be carried out by a qualified mechanic.

Date Revised: December (99)

MESSAGE FROM THE ALBERTA INFRASTRUCTURE

Alberta Infrastructure, in cooperation with other government agencies and the private sector, provides leadership and coordination of driver education activities in Alberta. The Department has a strong commitment to increasing the level of safe driving behaviour practised by the motoring public.

The Department strives to establish and maintain high standards of driver education in order to increase roadway safety. This is accomplished through the training and development of drivers who are knowledgeable and skilled.

With this goal in mind, the Alberta Government implemented the Airbrake Endorsement Program in 1985 to ensure drivers have a thorough understanding of airbrake systems and are able to detect problems and take appropriate action.

Your skills and knowledge can help prevent collisions. Please share the Department's commitment to keeping our streets safe for yourself and others.

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INTRODUCTION

The purpose of the Alberta Air Brake Endorsement Program is to ensure that air brake systems on vehicles so equipped are maintained and operated in the most effective manner. This program became mandatory November 1, 1989 for all operators holding a Class 1 License. All other operators of air brake equipped vehicles were required to have the endorsement by November 1, 1990. Persons driving vehicles registered as "farm" vehicles do not require an airbrake endorsement. Such persons must, however, prove they have airbrake endorsement entitlement if they are attempting to obtain a Class "1" driver license. The air brake endorsement program is intended to provide drivers with the knowledge and skill to inspect their vehicle's brake system and ensure its road worthiness.

The information contained in this manual is intended to assist drivers who are attempting to obtain their Alberta Air Brake Endorsement. The Air Brake Manual is not intended to serve as a service manual. This text deals with general principles and procedures that apply to all systems that comply with Canadian Motor Vehicle Safety Standard 121 (C.M.V.S.S. 121) which was enacted in 1975. **The systems and circuits described in the manual are typical and do not apply to specific vehicles.** Information relating to specific vehicles must be obtained from the manufacturer's service manual.

This manual is not intended to provide the operator with the skill and knowledge required to repair the air brake system. **Repair of the system's components should be performed by a licensed mechanic.**

It is the responsibility of operators of air brake equipped units to ensure that the brakes on their vehicles are functioning properly. To do this, the driver must be able to:

1. understand how the air brake system works;
2. perform an effective pre-trip inspection to ensure proper brake system operation before the unit is put into service;
3. use the system effectively while driving; and
4. understand how the system will react in the event of a malfunction.

The instructional units in this text are designed to provide the information necessary for a driver to achieve those goals.

UNIT I
BRAKING FUNDAMENTALS

UNIT I
BRAKING FUNDAMENTALS

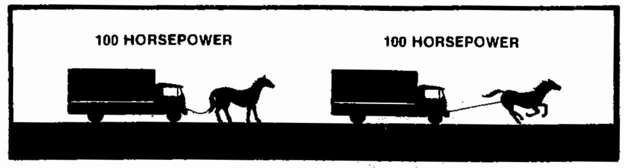
1. Power, Friction and Heat

The function of any braking system is to retard the motion of a moving vehicle. In order to understand how the brake system accomplishes this task, we must first appreciate the tremendous forces required to stop a modern heavy duty vehicle.

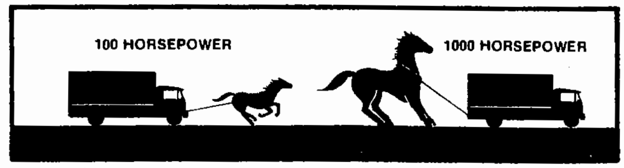
We know that the vehicle's engine must produce power to accelerate the unit, but how much power must be developed to stop one?

Figure #1 illustrates a body loaded truck that has been accelerated from a standing position to 100 km/h in 60 seconds. The engine had to produce 100 hp to accomplish this task.

Power is the rate of doing work. We all know that the faster we do a job, the more power is required. If the truck is to be stopped from 100 km/h in six seconds, (1/10 of the acceleration time) then vehicle's brakes must develop 1000 hp (10 times the power required to accelerate the unit.)



STOPPED - TO 100 KM/H - IN ONE MINUTE



100 KM/H - TO STOPPED - IN LESS THAN SIX SECONDS
FIGURE 1 - FORCES INVOLVED IN BRAKING

The power required for braking is generated through friction between the brake lining and the brake drum. In this manner, the energy of the rolling vehicle is converted to heat and dissipated into the surrounding atmosphere. All of the brakes on the unit must share the task. If one brake is not doing it's share of the work, due to maladjustment for example, the remaining brakes will have to generate more friction and therefore more heat to stop the unit. Excessive heat could result in brake fade or complete brake failure.

2. Traction

Traction is the term used to describe the friction between the road surface and the tire contact area. Traction greatly effects the stopping distance of the vehicle. Some factors that influence traction are:

- road conditions (wet or dry pavement, snow, ice, etc.);
- gross vehicle weight;
- tire condition and inflation pressure;
- tire contact area; and
- rotational speed of the wheel (wheels that are locked up or skidded due to over braking provide less traction than those which are allowed to rotate while the brakes are applied).

It is important that the driver attend to each of the above factors. Loading a vehicle to its proper G.V.W., maintaining serviceable tires, keeping them at the correct inflation pressure, and using appropriate caution when driving on slippery road surfaces will ensure maximum traction is available when the vehicle must be stopped.

3. Stopping Power

The following factors have a direct effect upon the power required to bring a vehicle to a stop.

A. Gross Vehicle Weight Rating (G.V.W.R.)

Heavy vehicle manufacturers design their braking systems to effectively stop a vehicle loaded to its G.V.W.R. If the G.V.W.R. is exceeded, then the demand on the braking system is increased. Figure #2 illustrates the effect of doubling the G.V.W.R. Assuming all other factors to be equal, the power required to stop the vehicle would be doubled.

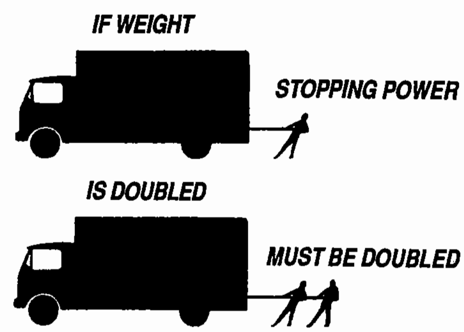


FIGURE 2

B. Vehicle Speed

Increasing vehicle speed has a more pronounced effect on the power required to stop the unit. Figure #3 shows that doubling vehicle speed will require four times the power to bring the unit to a stop.

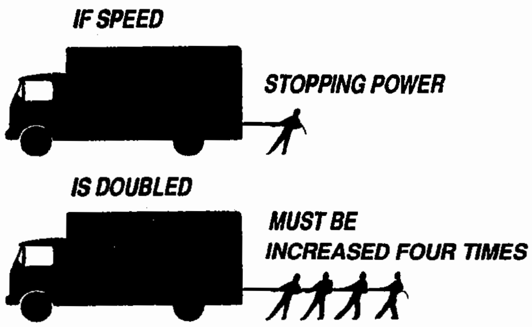


FIGURE 3

The result of increasing both G.V.W.R. and vehicle speed is graphically illustrated in Figure #4. If both weight and speed are doubled, the power required to stop the unit will be increased by eight times.

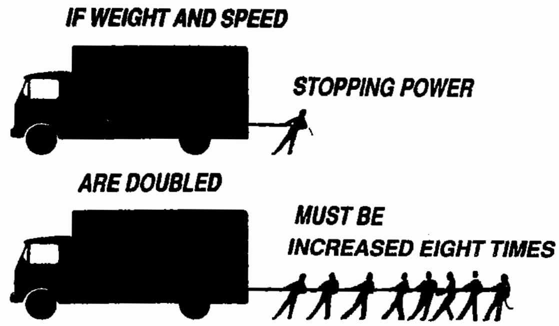


FIGURE 4

4. Stopping Time Weight & Speed.

The time required to bring a vehicle to a stop is measured from the time the driver decides to apply the vehicle's brakes until the vehicle comes to a full stop. The following factors influence stopping time.

A. **Driver's Reaction Time**

This refers to the elapsed time between the point at which the driver decides to apply the brakes and the point at which he depresses the foot pedal. Normal reaction time is approximately 3/4 of a second. A person's reaction time may become slower, (increasing reaction time) if the driver is affected by:

- driver fatigue;
- consumption of alcohol;
- the use of drugs, including prescription, non-prescription, and illegal substances;
- physical illness; or
- age

B. **Lag Time**

Lag time refers to the amount of time required for the air to flow through the air brake system and apply the brakes. No matter how well designed and maintained, an air brake system always has some lag time. Normal lag time on a well maintained brake system is approximately 3/10 of a second. Lag time can be kept to a minimum by:

3/10 - .5 sec
(1 sec)

- ensuring that a
adjusted; and
- regularly draining the air reservoirs to remove moisture and contamination which may restrict air flow or interfere with the operation of brake components.

C. **Braking Time**

This is the time required to stop the vehicle once the brakes have been applied. The factors that influence braking time are:

Rolly all
all

- the force with which the brakes are applied;
- brake lining and drum condition;
- tire to road traction;
- vehicle weight; and
- vehicle speed

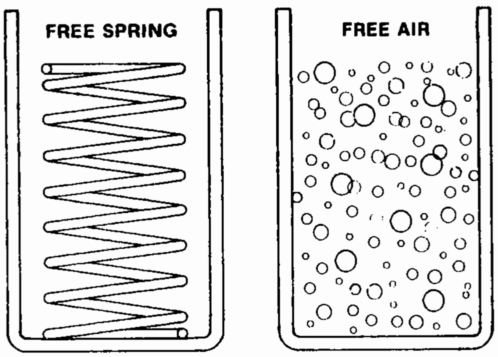
UNIT II
FUNDAMENTALS OF COMPRESSED AIR

UNIT II
FUNDAMENTALS OF COMPRESSED AIR

The air that surrounds us is a gas that can be compressed. A gas is compressed when it is forced to occupy a smaller volume. Compressing a gas causes its pressure and temperature to increase. The characteristics of compressed air are very similar to those of a coil spring. Figure #5 illustrates those similarities.

The uncompressed or "free" spring can generate no power and of course, neither can free air. When the spring is compressed, however, energy stored in the spring can be used to do work. In the same manner, compressed air contains stored energy which can be utilized to operate a vehicle's braking system.

In an air brake system, the compressor forces a continuous flow of air into the air reservoirs (Figure #6). This causes the pressure in the reservoirs to rise until it reaches its maximum limit. The pressurized air in the reservoirs is utilized to supply the power required to operate the vehicle's braking system.



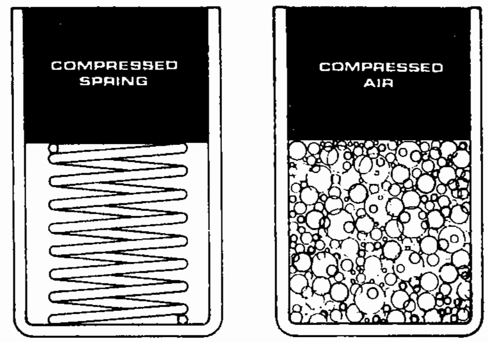


FIGURE 5

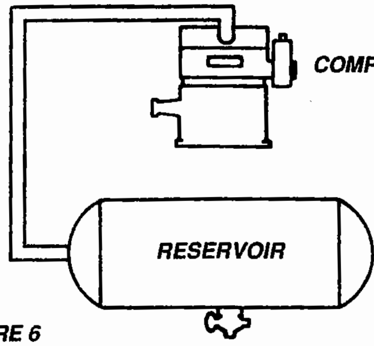
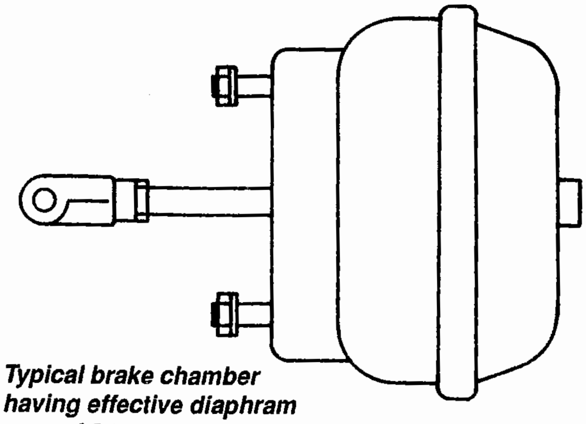


FIGURE 6



Typical brake chamber having effective diaphram area of 24 square inches

AIR PRESSURE (P.S.I.)	5	10	20	30	40	60	80	100
DEVELOPED FORCE (LBS.)	120	240	480	720	960	1440	1920	2400

FIGURE 7 - BRAKING FORCES - EFFECT OF AIR PRESSURE

Force can be generated by applying pressurized air to the diaphragm of a brake chamber. The amount of force generated by the brake chamber depends upon:

- Brake chamber diaphragm area.
- The air pressure applied to the diaphragm.

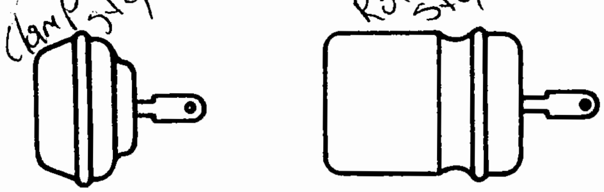
Figure #7 illustrates the effect of increasing brake application pressure on a brake chamber having a 24 square inch diaphragm area. As the application pressure is increased from 5 PSI (35 kPa) to 100 PSI (690 kPa), the force generated by the chamber increases from 120 lb (529 N) to 2400 lb (100672 N). Increased brake chamber force causes a harder application of the vehicle's brakes.

Figure #8 shows that the brake chamber diaphragm area affects the force it can generate. If 60 PSI (414 kPa) is applied to a chamber having a nine sq. in. diaphragm area, a force of 540 lb. (2406 N) will result. Applying the same 60 PSI (414 kPa) to a brake chamber whose diaphragm is 30 sq. in. in area will cause 1800 lbs. (8016 N) of force to be generated.

Governor - controlls the amount of air flow through the system.

Purge - Pressurized cleaning

Cooler - dryed (Keeps system cool - Keeps system dry)



BRAKING FORCES

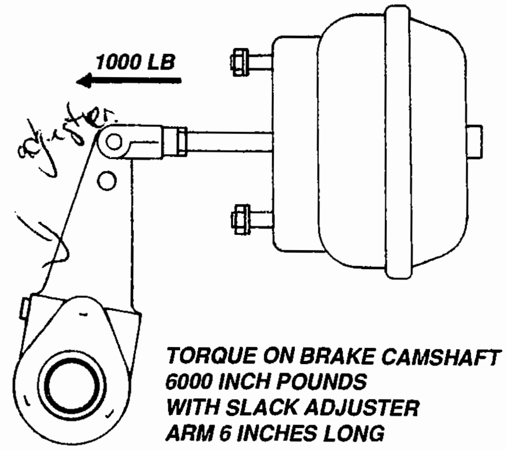
EFFECT OF BRAKE CHAMBER AND ROTOCHAMBER SIZES

CLAMP RING TYPE BRAKE CHAMBER		9	12	16	20	24	30	36	
ROTOCHAMBER		9	12	16	20	24	30	36	50
EFFECTIVE AREA OF DIAPHRAGM SQUARE INCHES	6	9	12	16	20	24	30	36	50
POUNDS FORCE DEVELOPED WITH 60 P.S.I.	360	540	720	960	1200	1440	1800	2160	3000

FIGURE 8 - BRAKING FORCES - EFFECT OF BRAKE CHAMBER SIZE

****CAUTION****

Compressed air, if given the opportunity, will expand with extreme velocity. Use caution when draining the air from reservoirs and ensure that the air is drained from the system before removing any lines or fittings. Failure to do so could result in personal injury.



BRAKING FORCES: EFFECT OF SLACK ADJUSTER ARM LENGTH

FIGURE 9 - BRAKING FORCES - EFFECT OF SLACK ADJUSTER ARM LENGTH

Braking force is further multiplied through the slack adjuster. The slack adjuster acts like a lever to multiply brake chamber force to the brake shaft. Figure #9 illustrates that a brake chamber force of 1000 lb. (4459 N) is increased to 6000 lb.in. (67885 N.cm) through a six inch slack adjuster.

UNIT III
VEHICLE BRAKING SYSTEMS

30"
60 Psi
1800 Psi
6 → Length of slack adjuster. 6 7 exerted force.
10,800 P. force.

weight W = 2×
speed S = 4×
~~double~~

To Keep system dry.
(Brake line Antifreeze).
Alcohole.
Add to sniffer.
Betwen Airdryed And compressor

TRUCK/TRACTOR SYSTEM

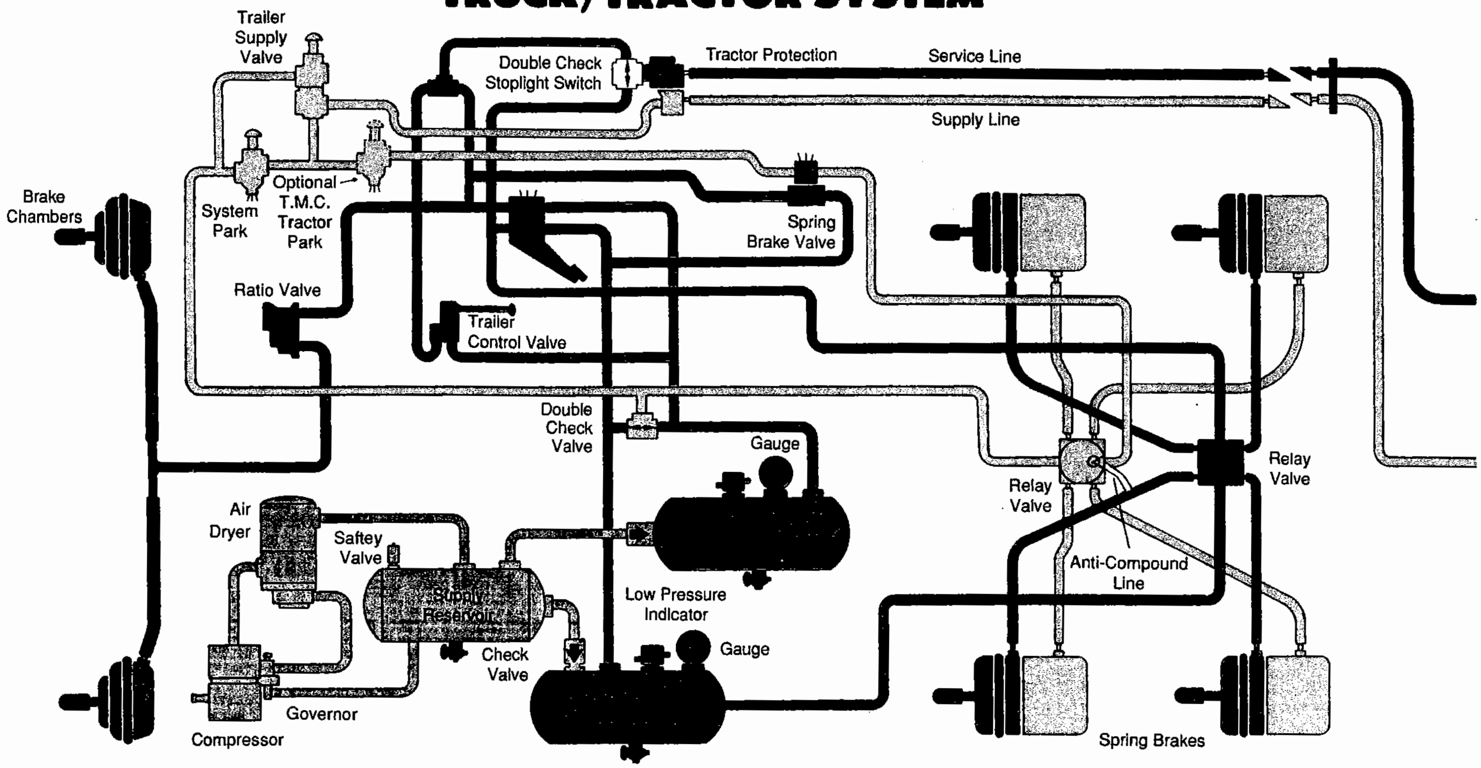
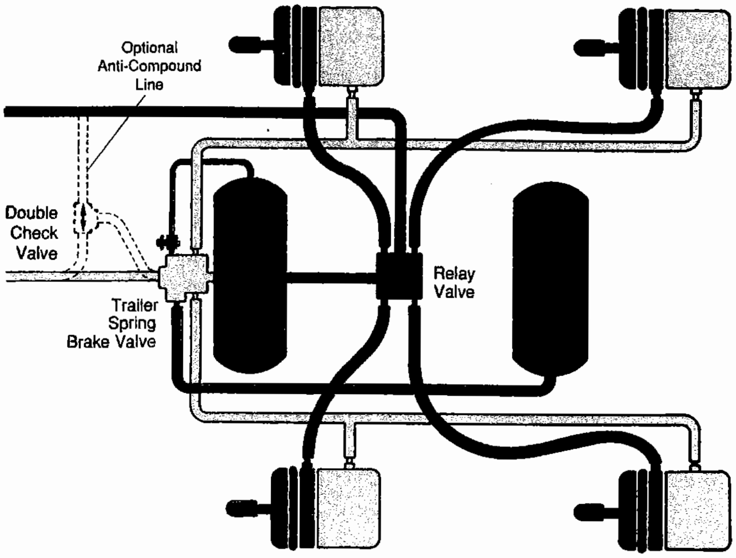


FIGURE 10

TRAILER SYSTEM



UNIT III
VEHICLE BRAKING SYSTEMS

This unit will explain the basic operating principles of air brake systems found on typical truck, tractor and trailer units. The systems that are dealt with in this unit are those which comply with C.M.V.S.S. 121 standards.

Figure #10 illustrates a typical C.M.V.S.S. 121 air brake system. Although the system is complex, it can be simplified by breaking it down into the following circuits:

- supply circuit;
- primary brake circuit;
- secondary brake circuit;
- park/Emergency brake circuit;
- tractor air circuit; and
- trailer air circuit.

A basic knowledge of air brake system operation will help the operator to recognize when the system is not functioning properly.

TRUCK/TRACTOR SYSTEM

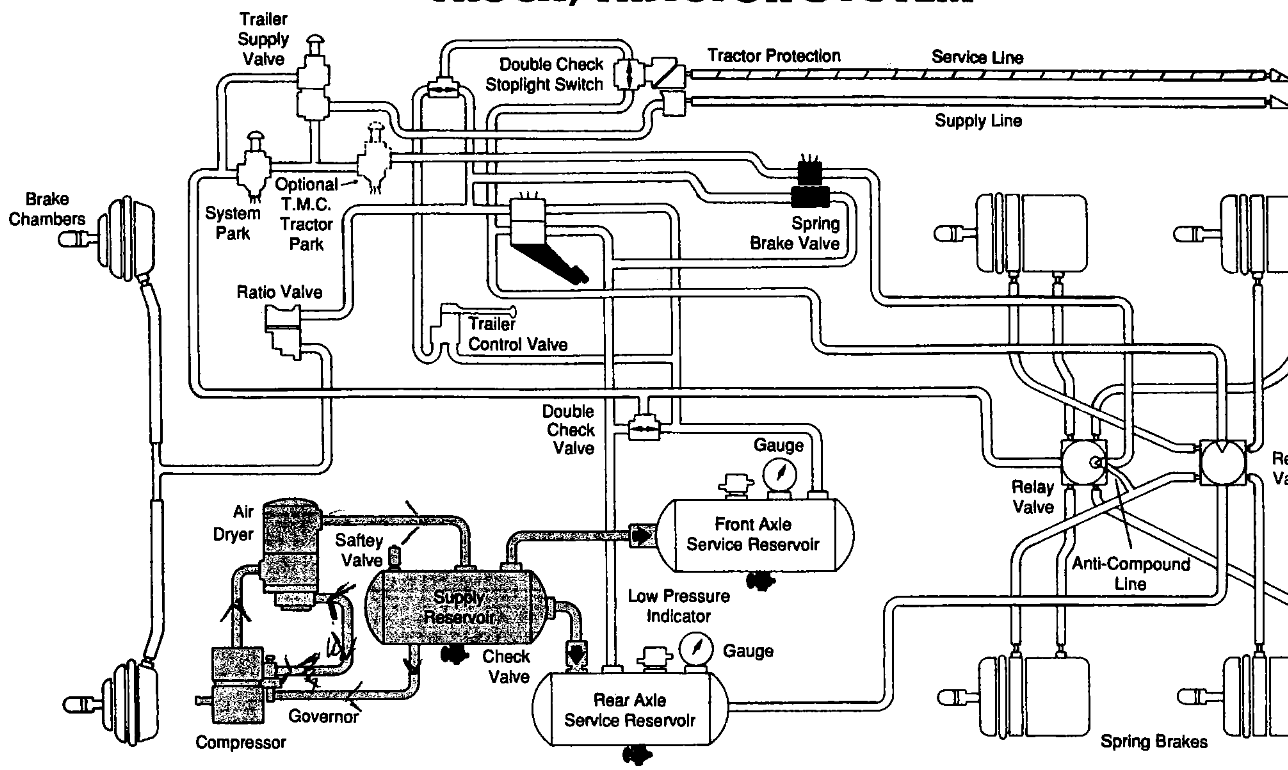


FIGURE 11

1. *The Supply Circuit*

The supply circuit of a C.M.V.S.S. 121 truck or tractor is highlighted in blue in Figure #11. The function of the circuit is to provide a continuous supply of air for system operation. The major components of the supply system are:

A. The Compressor

The compressor is driven by the engine and provides a flow of compressed air to the reservoirs. The compressor must have sufficient capacity to build air pressure from 50 PSI (345 kPa) to 90 PSI (621 kPa) in 3 minutes or less with the engine running at 1200 RPM. This is known as the compressor "build-up" time and is used to measure the compressor's performance. If air build-up time becomes excessive, the problem could be:

- a plugged compressor intake;
- slipping compressor drive belts;
- excessive system leakage; or
- a faulty or worn compressor.

- size of line. (Kinked)

B. The Governor

The governor limits maximum air pressure in the system. Maximum air pressure on vehicles manufactured after 1975 is 120 - 130 PSI (828 - 897 kPa). Some vehicles manufactured prior to 1975 were equipped with air brake systems that had a maximum pressure of 105 PSI (725 kPa). The governor stops the air flow from the compressor when maximum pressure is reached. Maximum air pressure is often referred to as cut-out pressure, as this is the point at which the governor "cuts-out" the compressor preventing further air pressure build-up. As air is drawn from the reservoirs, air pressure in the system drops. When system pressure drops approximately 25 PSI (173 kPa), the governor causes the compressor to "cut-in" and supply air to the reservoirs which increases system pressure. If cut-out or cut-in pressures are not within these specifications, governor adjustment should be performed by a mechanic.

Minimum opperation is 100 psi.

C. The Supply Reservoir

The supply reservoir provides a place for incoming air to cool, which causes any moisture vapour in the air to condense. The supply reservoir is also a gathering place for other contamination such as oil. **Daily draining of all reservoirs is mandatory to prevent this contamination from entering the system and interfering with system operation. If excessive oil is discovered when draining the reservoirs, you may suspect a faulty compressor and the unit should be checked by a mechanic.**

D. The Safety Valve

The safety valve prevents excessive air pressure build-up in the system should the governor fail to cut-out the compressor. The safety valve is located on the supply reservoir and is set to vent air to the atmosphere should the pressure in the reservoir exceed 150 PSI (1035 kPa).

E. Moisture and Contamination Controls

These devices are installed in the system to prevent freeze-up and/or damage to components in the system caused by contamination such as moisture or oil. There are many types of these devices on the market. The most commonly used are listed below:

- Automatic Ejectors

  These units automatically drain moisture and contamination from the reservoirs.

- Alcohol Evaporators

  Alcohol evaporators do not remove contamination from the system, but prevent freeze-up by metering a small amount of vapourized alcohol into the system.

  ***NOTE* Excessive use of straight methyl hydrate will wash the lubrication from air brake components causing erratic operation. Solutions containing an acceptable lubricant should be used.**

- Air Dryers

  These devices remove moisture and contamination from the air before it enters the reservoirs. The contamination that is gathered by the dryer is expelled into the atmosphere when the governor cuts-out the compressor.

***NOTE* The use of moisture and contamination control devices does not mean that the operator can be negligent about draining the reservoirs on a daily basis. Frequent draining of the reservoirs will let the driver know if these controls are functioning properly.**

Moisture and contamination control devices must be serviced on a regular basis to ensure efficient operation.

2. The Primary Brake Circuit

Vehicles which comply to C.M.V.S.S. 121 are equipped with two separate service brake circuits known as primary and secondary. These systems are commonly known as "dual braking systems." The primary and secondary service brake circuits are isolated from one another and from the supply circuit by single check valves, which prevent air from flowing backward through the system and being lost from a circuit that has failed. These check valves ensure that at least one service brake system will remain fully pressurized in the event of an air failure in one of the other circuits. The circuit that remains pressurized can be used to keep the emergency brakes released and allow the driver to bring the vehicle to a controlled stop. This feature provides a significant advantage over those units manufactured prior to C.M.V.S.S. 121. These earlier vehicles were equipped with a single service brake circuit which caused an application of the emergency brakes when an air loss occurred.

Figure #12 illustrates four common variations of the dual braking system. For the purpose of simplifying instruction, this manual will deal with the tandem axle truck/tractor unit identified as Unit #2 in the illustration. This system uses primary service air pressure to control the brakes on the rear tandem axles.

SEE FIGURE 12 ON FOLLOWING PAGE

Green Needle – ~~primary~~ Supply
White. –
Pressure Gauge –

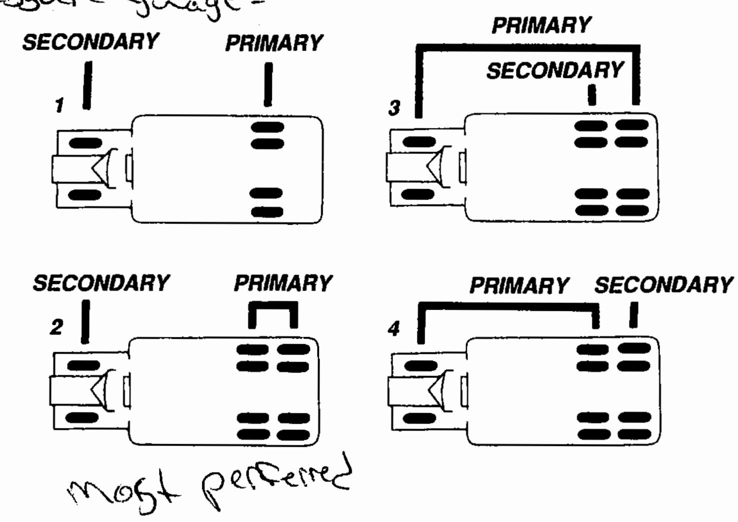


FIGURE 12

The components of the primary brake circuit are highlighted in green in Figure #13. The major components of the system are:

A. Primary Service Reservoir

This reservoir stores the air which is used to control the rear tandem brakes of the vehicle. It receives its air supply from the supply reservoir through a single check valve, which prevents air loss if an air failure occurs in the supply or secondary circuit.

B. Pressure Gauge

A pressure gauge is mounted on the dashboard to indicate the available air pressure in the primary reservoir. Some units may be equipped with a gauge having two needles; one indicating primary reservoir pressure, the other to indicate secondary reservoir pressure.

C. Low Pressure Warning Device

A low pressure warning device is used to visually warn the driver when pressure within the primary reservoir falls below 60 PSI (414 kPa). The most common type of low pressure warning device is a red dash mounted lamp which is accompanied by a warning buzzer. A "wig-wag" or "flagman" is another form of low pressure device. This device drops into the driver's view when an air loss occurs.

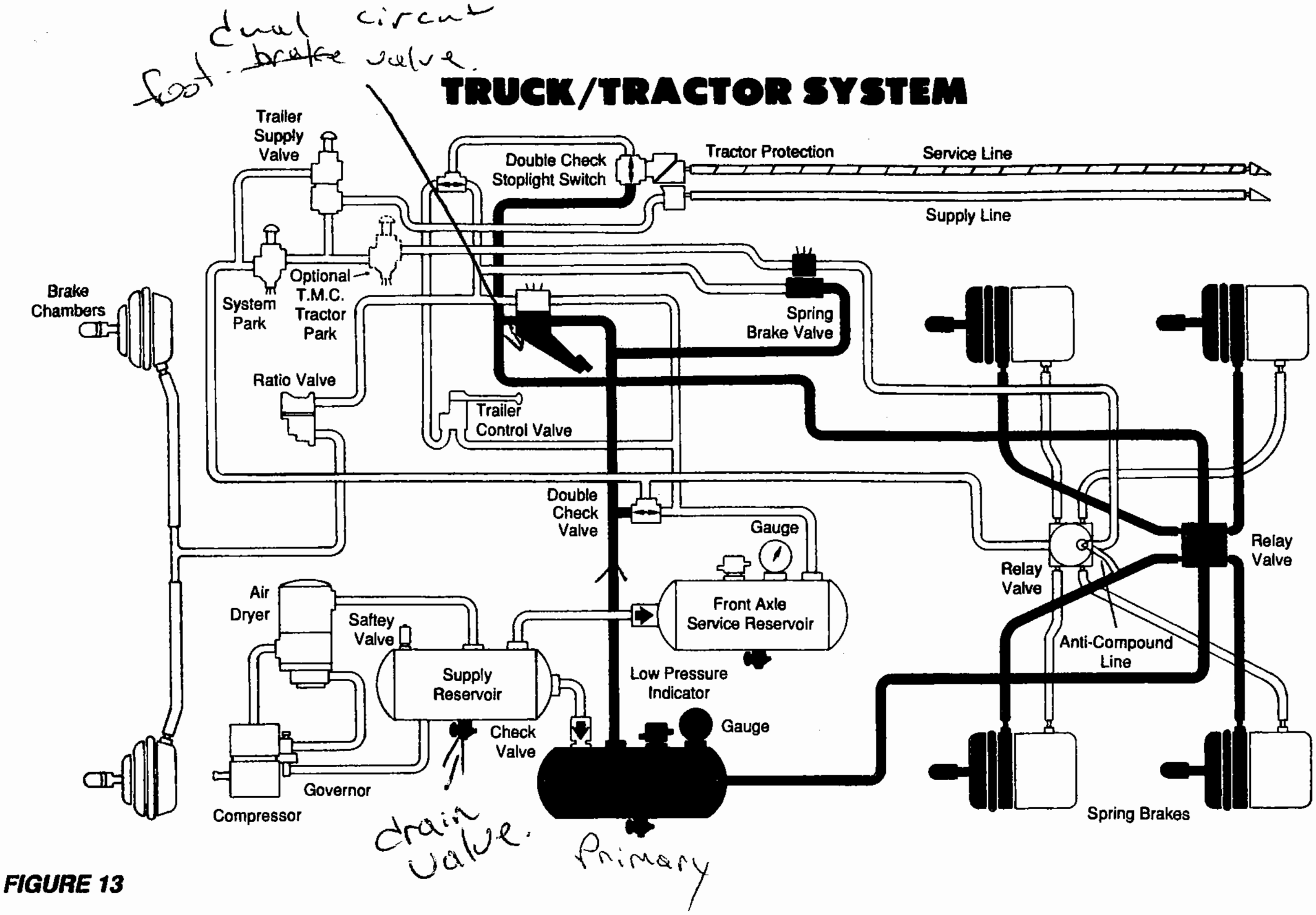

dual circuit
foot brake valve.
TRUCK/TRACTOR SYSTEM
Trailer Supply Valve
Double Check Stoplight Switch
Tractor Protection
Service Line
Supply Line
Brake Chambers
System Park
Optional T.M.C. Tractor Park
Spring Brake Valve
Ratio Valve
Trailer Control Valve
Double Check Valve
Gauge
Relay Valve
Relay Valve
Air Dryer
Saftey Valve
Front Axle Service Reservoir
Supply Reservoir
Low Pressure Indicator
Anti-Compound Line
Check Valve
Gauge
Governor
Compressor
Spring Brakes
drain valve.
Primary

FIGURE 13

D. The Dual Circuit Foot Valve

The dual circuit foot valve allows the operator to apply and release both primary and secondary service brakes simultaneously. The foot valve allows the operator to regulate brake application force by regulating the amount of air pressure supplied to the brake chambers. Braking force is determined by the force that the driver applies to the treadle of the brake valve.

***NOTE* Brake application pressure cannot exceed the air pressure in the reservoir.**

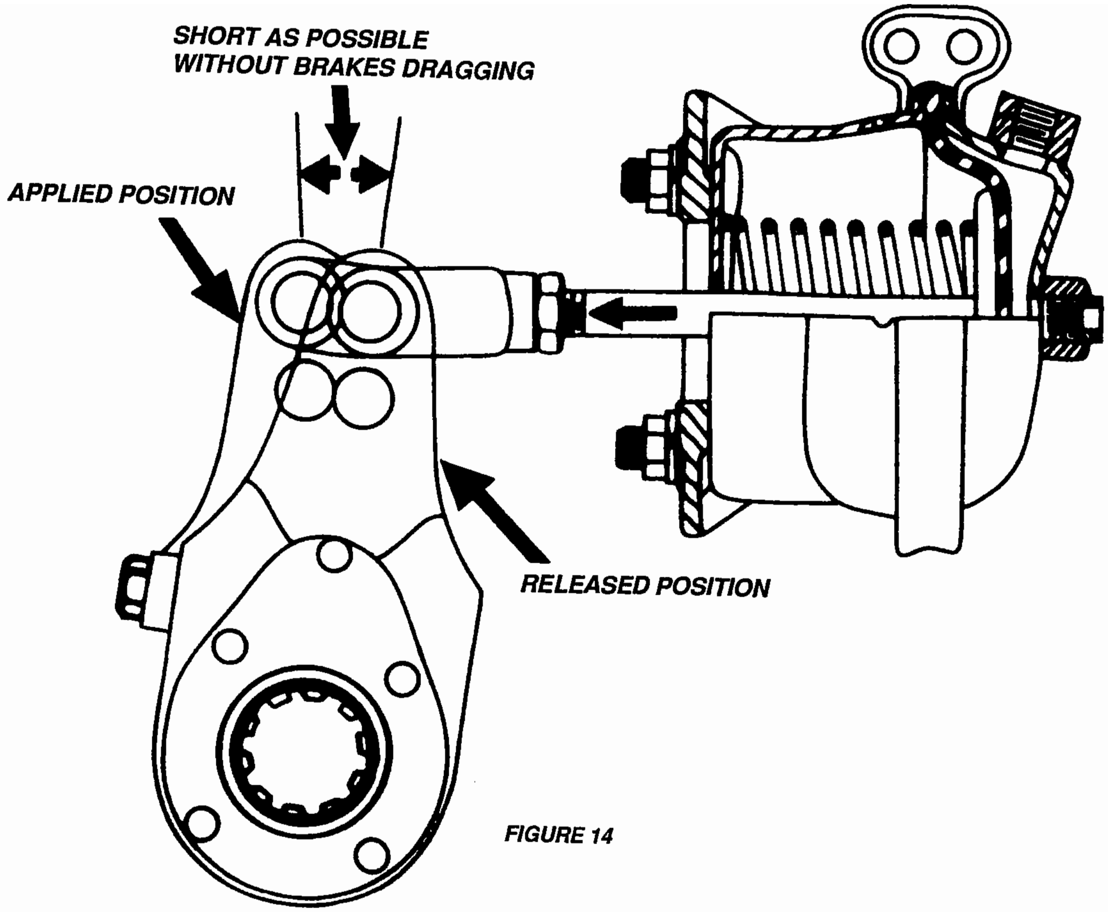
The brakes are released by removing the force from the treadle of the foot valve, which causes air pressure in the brake chambers to exhaust to the atmosphere.

E. The Relay Valve

This valve is commonly used in the primary brake circuit to provide quick brake application and release. The relay valve is located near the primary brake chambers and has a supply of air from the primary reservoir connected to it. Depressing the foot valve triggers the relay valve to supply air to the brake chambers. This arrangement reduces brake lag on long wheelbase vehicles. Air in the brake chambers is released more quickly because it is exhausted through the relay valve rather than having to travel the length of the vehicle to exhaust at the foot valve, when the driver releases the brakes.

F. The Brake Chambers

Brake chambers (Figure #14) convert the air pressure supplied to them to mechanical force for applying the vehicle brakes. The brake chamber consists of two circular metal housings held together by a clamping ring, a rubber diaphragm, a piston, a push rod and a return spring. Air pressure supplied to the brake chambers from the relay valve, acts on the diaphragm to extend the push rod which applies the brakes. When application pressure is exhausted, the return spring causes the piston and push rod to retract releasing the brakes. Primary brake chambers are usually mounted "piggy-back" with a spring brake assembly that is used for parking and emergency brake operation. These units will be discussed in the explanation of the parking and emergency brake circuit.


SHORT AS POSSIBLE
WITHOUT BRAKES DRAGGING
APPLIED POSITION
RELEASED POSITION
FIGURE 14

Supply
Secondary
Primary

The secondary brake circuit is highlighted in red in Figure #15. This circuit is used to apply and release the steering axle service brakes. Units equipped with properly functioning steering axle brakes provide the advantage of shorter stopping distances and greater vehicle stability. This circuit consists of the following components:

A. The Secondary Service Reservoir

This reservoir stores the air for secondary brake application. It is isolated from the supply and primary circuits by a single check valve.

B. Pressure Gauge

The dash mounted gauge indicates to the operator how much air pressure is available for secondary brake application.

C. Low Pressure Warning Device

This device warns the driver of any air failure causing the pressure in the secondary service reservoir to drop below 60 PSI (414 kPa).

D. The Dual Circuit Foot Valve

The foot valve performs the same function for the secondary circuit as it did for the primary circuit. The foot valve allows the operator to regulate the application and release of the steering axle brakes.

E. Quick Release Valve

This valve is located near the steering axle brake chambers to allow air pressure from the brake chambers to escape to atmosphere when the brakes are released. This provides a faster release than would be possible if application air pressure from the brake chambers had to travel to the foot valve to be exhausted.

F. Brake Chambers

Steering axle brake chambers activate the steering axle brakes. These chambers are usually smaller than primary brake chambers because the front axle does not carry as much weight as the rear tandem axles.

TRUCK/TRACTOR SYSTEM

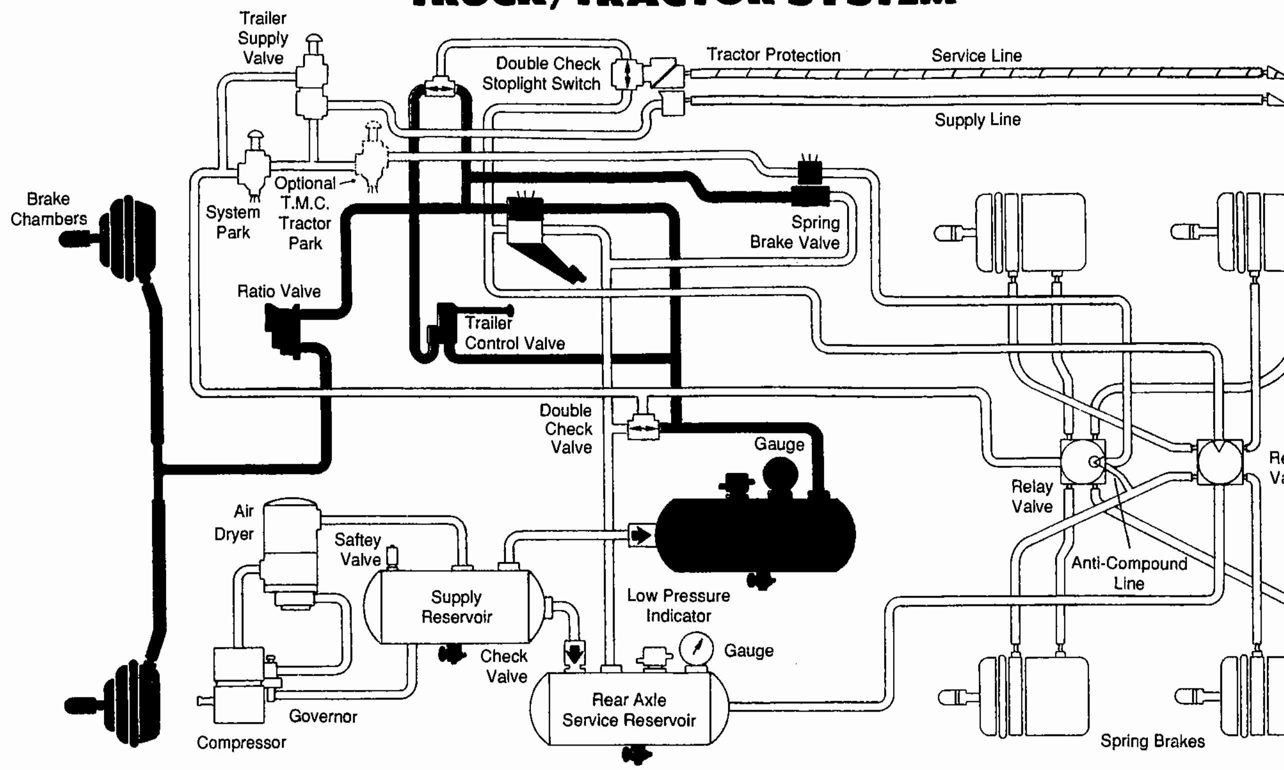


FIGURE 15

G. Steer Axle Brake Limiting Devices

Some vehicles are equipped with devices that are used to limit steering axle brake application force. These devices are installed to reduce the possibility of front wheel lock up in conditions of reduced traction. When the steering axle wheels are locked, the ability to steer the vehicle is lost.

There are two types of devices currently in use:

- Manually Controlled Devices

  Allow the operator to reduce steering axle braking force by 50% when slippery road conditions are encountered. The operator reduces the brake force by selecting the "slippery road" position on the dash mounted two-way control valve.

  ***NOTE* - steering axle brake force must not be reduced when traction is good. The reduction in brake force will result in longer stopping distances.**

- Automatic Limiting Devices

  Reduce steering axle brake force when applications of 40 PSI (276 (kPa) or less are made. Application above 60 PSI result in unreduced brake force.

4. The Park/Emergency Brake Circuit

The park and emergency brake circuit of a C.M.V.S.S. 121 vehicle is responsible for:

- Holding a fully loaded vehicle on a 20% grade without the use of air pressure.
- Automatically applying the brakes on all axles equipped with spring brake chambers if the air pressure in **both** primary and secondary service circuits falls below 45-20 PSI (311-138 kPa).

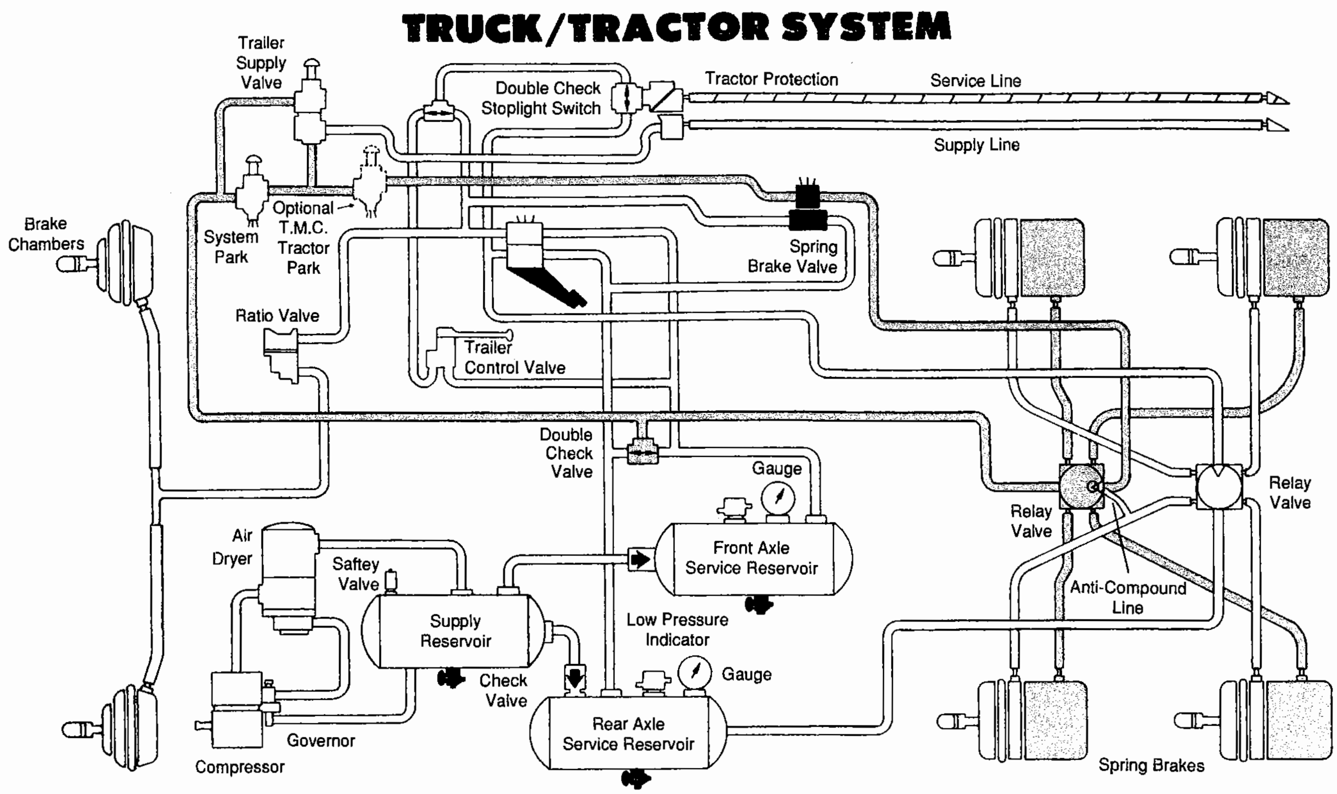

TRUCK/TRACTOR SYSTEM
Trailer Supply Valve
Double Check Stoplight Switch
Tractor Protection
Service Line
Supply Line
Brake Chambers
System Park
Optional T.M.C. Tractor Park
Spring Brake Valve
Ratio Valve
Trailer Control Valve
Double Check Valve
Gauge
Relay Valve
Relay Valve
Front Axle Service Reservoir
Air Dryer
Saftey Valve
Supply Reservoir
Anti-Compound Line
Low Pressure Indicator
Check Valve
Gauge
Rear Axle Service Reservoir
Governor
Compressor
Spring Brakes

FIGURE 16

The park and emergency brake circuit is highlighted in orange in Figure #16. Parking and emergency brake function is accomplished through the brakes of the vehicle which are operated by spring brakes. Spring brake units are mounted "piggy back" on the service brake chambers of truck/tractor drive axles and trailer axles. Spring brakes apply and hold the vehicle's brakes by using spring force rather than air pressure. Air pressure is required to hold the brakes off. This means that air pressure must be available to release the park brakes of a unit before it can be moved; and the spring brakes will be applied if air pressure falls due to a complete failure in the system.

Figure #17 illustrates a typical spring brake assembly during normal operation. The spring used to apply park and emergency brakes is compressed by the force of system air pressure acting on the spring brake diaphragm. Air pressure keeps the park and emergency brakes released.

A normal service brake application is shown in Figure#18. Service air pressure is allowed to act on the service brake diaphragm to apply the vehicle's brakes. The brake is released by exhausting the service air pressure to atmosphere.

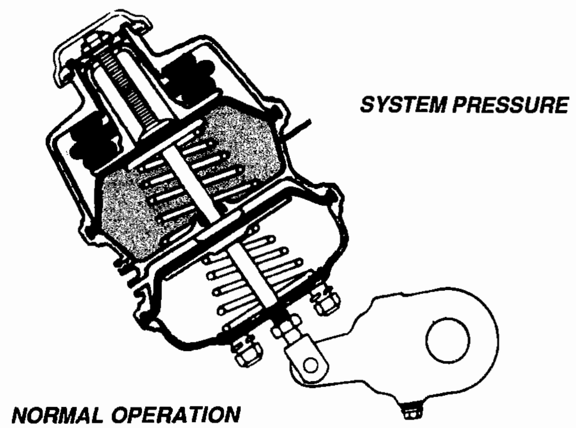


FIGURE 17

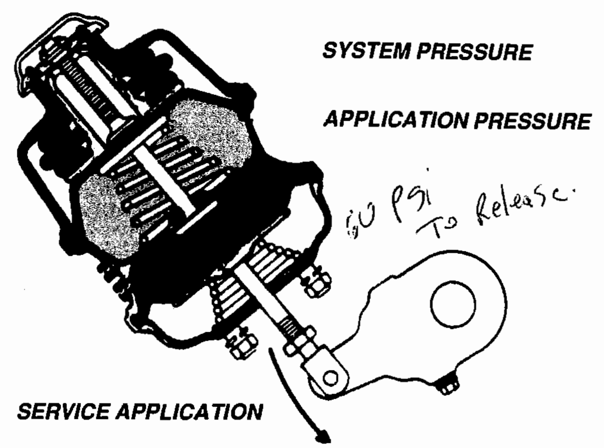


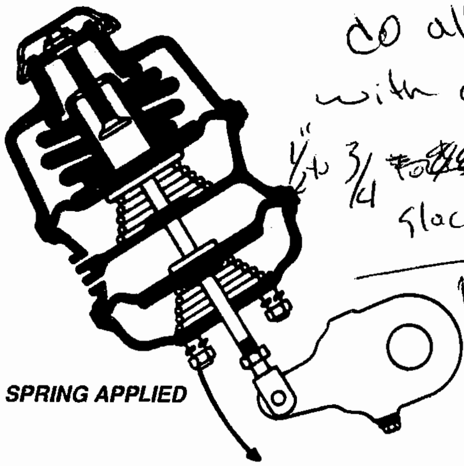
FIGURE 18

Loss of system air pressure on the spring brake diaphragm causes the spring to expand and apply the vehicle's brakes (Figure #19). Spring brakes are applied when:

- An air system failure occurs that causes system pressure to fall below 45 - 20 PSI (311-138 kPa) in the primary and secondary service reservoirs; or
- The park control valve is activated.

Following an emergency brake application, the spring brakes may be released by:

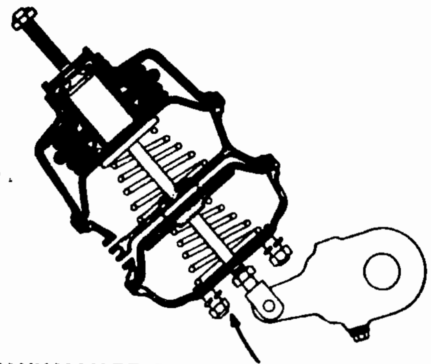
- Repairing the system failure so that air may be restored to the spring brake chambers; or
- Mechanically "caging" the spring using the caging bolt supplied with most spring brake chambers (Figure #20). Mechanical caging of the spring brakes is performed only to allow the unit to be safely towed, **not to allow the driver to operate the unit with reduced braking capability.**



SPRING APPLIED

FIGURE 19

do all adjustment with cold Brakes. 1/4" to 3/4 [illegible] of Play in slack adjust By hand. No further than an Inch



MANUALLY RELEASED

FIGURE 20

CAUTION

- **Be sure to chock the vehicle's wheels before mechanically releasing the spring brakes. Failure to do so may result in a runaway.**

- **The spring used in these units is capable of causing severe injury if allowed to escape from the chamber. Use extreme caution when working around these units and leave the servicing of them to a trained mechanic.**

The air supplied to the spring brakes comes from either the primary or secondary service air reservoir through a double check valve. This arrangement ensures that the spring brakes will remain released in the event of an air failure in one of the service systems. Air pressure in the remaining intact system will hold the emergency brakes off.

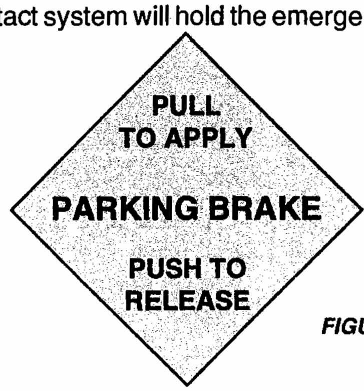


FIGURE 21

Control of the spring brakes comes from the park control valve which is a pressure sensitive, dash mounted valve (Figure #21). It is used to direct air to the spring brakes to release them or exhaust air for brake application. The park control valve requires 20 - 45 PSI (138 - 311 kPa) to hold it in the released position. If system pressure falls below those values, the park control valve will automatically apply all the emergency brakes on the unit. Note: When releasing the park control valve 50 - 55 PSI (345 - 380 kPa) may be required.

Some units (body loaded trucks and buses in particular) are equipped with a spring brake valve in the parking and emergency brake circuit. These valves allow the spring brakes to be used as a back-up to primary service brakes if the primary air system fails. This feature allows the operator to stop the unit in a shorter distance, under greater control than he could if he had only the secondary brake circuit to stop the vehicle.

5. The Tractor/Trailer Air Circuit

The tractor air circuit performs the following function:

- Supplies air from the tractor supply circuit to charge the reservoirs on the trailer.

- Allows the operator to control trailer service brakes together with or independent of tractor service brakes.
- Allows the operator to apply and release trailer parking brakes.
- Maintains a safe level of air pressure in the tractor service reservoirs in the event of a trailer air circuit failure.

The tractor air system is highlighted in Figure #22.

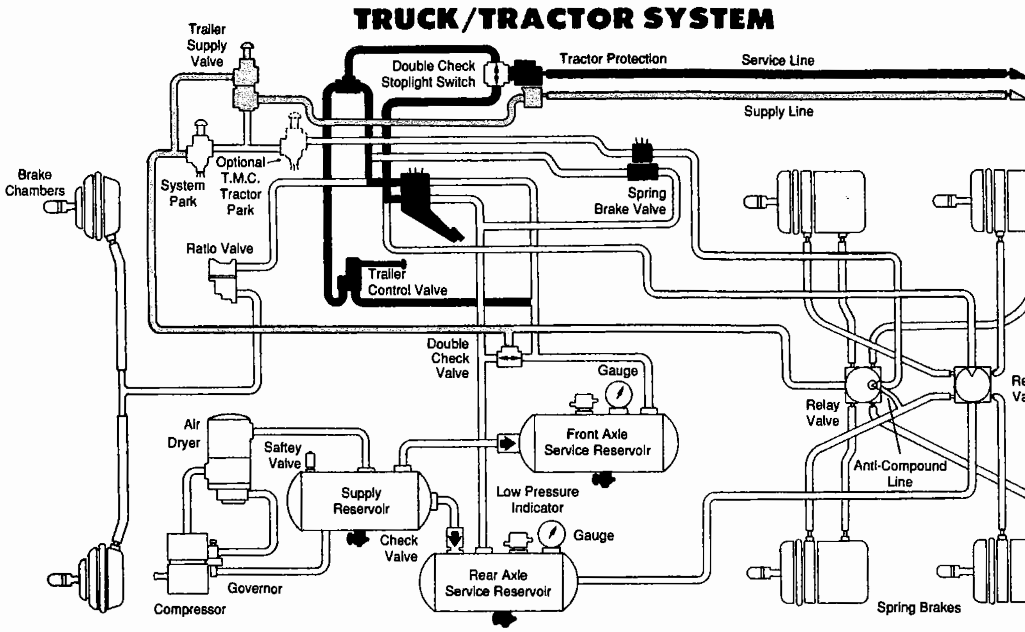


FIGURE 22

The components of the tractor air circuit are:

A. Supply Line

The supply line carries air from the tractor service reservoirs (primary and secondary) to charge the trailer reservoirs. If a failure occurs in one of the tractor service reservoirs, the intact service system is used to keep the trailer reservoirs charged. This arrangement allows the operator to apply trailer service brakes to bring the unit to a stop.

B. Service Line

The service line carries control air pressure from the tractor to apply the trailer's service brakes. Service air pressure to the trailer is supplied by either the primary or secondary service circuit, which ensures that the trailer brakes can be controlled in the event of an air loss in one of the tractor's service circuits.

C. Glad Hand Connectors

These devices are used to connect tractor supply and service lines to the trailer supply and service lines (Figure #23). The connectors are locked into position by friction lock and are sealed by rubber gaskets. It is important that the driver inspect the condition of the gaskets prior to connecting the glad hands. Damage to the sealing surfaces of the gaskets will cause air leakage. The lines should be free of dirt, moisture or contamination before connection is made. Service and supply lines that are not in use should be connected to "dead-end" couplers to prevent the entrance of water and dirt. Once connection has been made, the operator should ensure that the lines are secured to prevent chafing and damage caused by contact with vehicle components.

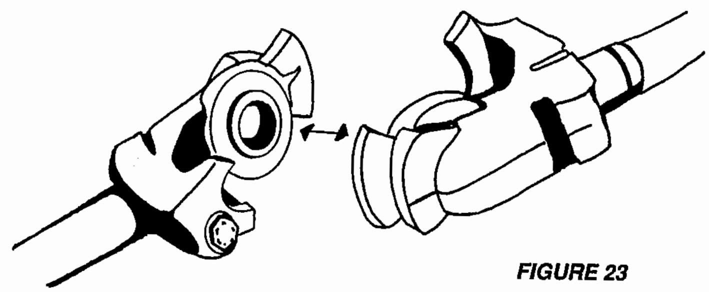


FIGURE 23

Care should be taken to ensure that the supply and service lines are connected correctly. Some units are equipped with "polarized" glad hands to prevent connecting the supply line to the service line and vice versa. Color coding is also used to identify these lines. The most common color code is red for supply and blue for service.

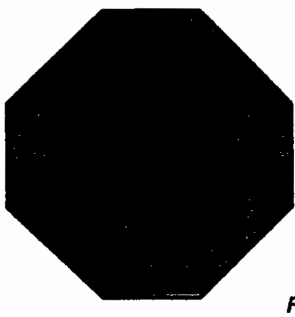


FIGURE 24

D. **Trailer Supply Valve**

The trailer supply valve (Figure #24) allows the operator to open and close the service and supply lines so that the tractor may be operated as a single unit without a trailer. This is a dash mounted pressure sensitive valve that, when activated, triggers the closing of the service and supply lines to the trailer and applies the trailer parking brakes.

Any malfunction in the trailer air circuit will cause primary and secondary service reservoir pressure to fall. The trailer emergency brakes will apply automatically if system air pressure falls below the supply valve setting.

E. **Tractor Protection Valve**

This valve works together with the trailer supply valve to prevent excessive air loss from the tractor's service reservoirs in the event of a trailer air system failure. Air supply from the trailer supply valve and service air from the tractor's service brake circuits are routed through the tractor protection valve. If a trailer malfunction causes the trailer supply valve to automatically close, the tractor protection valve will close the service line preventing a loss of service air pressure if a brake application must be made.

F. Optional Tractor Parking Valve

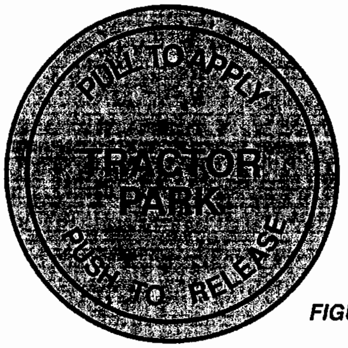


FIGURE 25

Some tractors are equipped with an optional tractor parking valve (Figure #25) which allows the operator to apply and release the tractor parking brakes independent of the trailer parking brakes. This valve is used to set the tractor's parking brakes to hold a combination vehicle while the trailer reservoirs are being charged. Without this valve, a service brake application must be made to hold the unit.

G. Trailer Control Valve (Hand Valve)

The trailer control valve is mounted in the cab and is used to apply the trailer's service brakes independent of tractor service brakes. Service air pressure to the trailer comes from either the trailer control valve or the foot valve through a double check valve. This arrangement ensures that the highest application pressure is used to apply trailer brakes. An operator can make a heavier application of trailer service brakes than tractor brakes but can never apply the tractor brakes harder than the trailer, eliminating the possibility of jackknifing the unit.

CAUTION

Operators should restrict the practice of braking combination vehicles using trailer brakes only. This promotes rapid trailer brake wear which may result in trailer brake failure and possible jackknifing of the unit when all of the vehicles brakes must be used to stop the vehicle.

The trailer service brakes should not be used to park the unit. A loss of air pressure could result in a runaway.

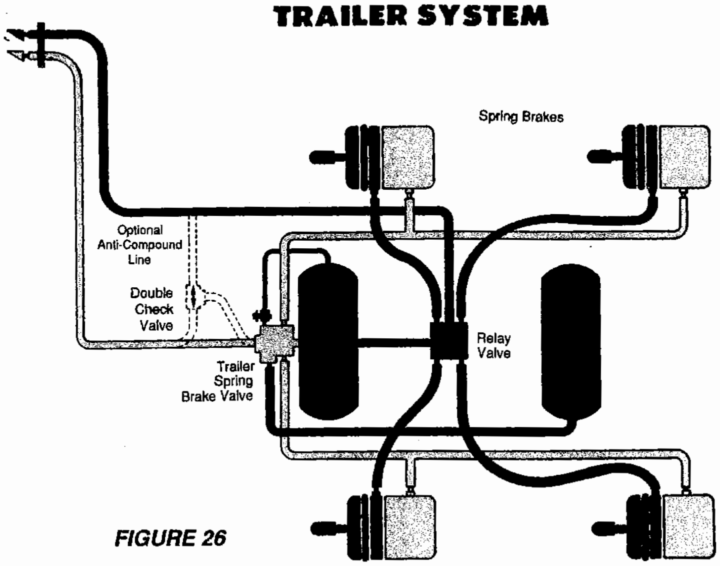


FIGURE 26

6. The Trailer Air Circuit

There are many variations of trailer air brake circuits in use today. This manual will deal with two of the most common circuits.

Figure #26 represents a typical C.M.V.S.S. 121 trailer air circuit. This trailer circuit offers the following features.

A. Trailer parking is accomplished through the use of spring brakes. Trailer parking brakes can be applied or released by activating the park control valve (which applies all parking brakes on the tractor/ trailer) or by activating the trailer supply valve (which controls only the trailer spring brakes).

B. Trailer spring brakes will automatically apply if the air pressure in the trailer supply lines falls below the pressure setting of the trailer supply valve.

C.

The trailer illustrated is equipped with two service reservoirs. Air for trailer service brake application is drawn from the front service reservoir. The trailer shown is equipped with a trailer spring brake valve which will prevent application of trailer spring brakes in the event of trailer reservoir failure, providing the supply glad hand remains connected and charged.

Figure #27 illustrates a typical trailer manufactured prior to C.M.V.S.S. 121. It is important to note the following differences between this trailer circuit and the C.M.V.S.S. 121 trailer:

- There are no spring brakes on this unit. All service, parking and emergency brake functions are performed through the service brake chambers which are activated by air pressure; and
- There is a single service air reservoir which serves to supply air for service and emergency brake applications.

These trailers do not provide the safety of a C.M.V.S.S. 121 trailer in the event of an air loss caused by a malfunction in the trailer circuit. Loss of air pressure in the trailer service reservoir will result in a loss of both service and emergency brakes. If the operator is unable to apply the trailer brakes while stopping the vehicle, it will be much less stable and may even jackknife.

It is important to remember to chock the trailer wheels when parking a pre-121 trailer. The parking brakes on these trailers will eventually release due

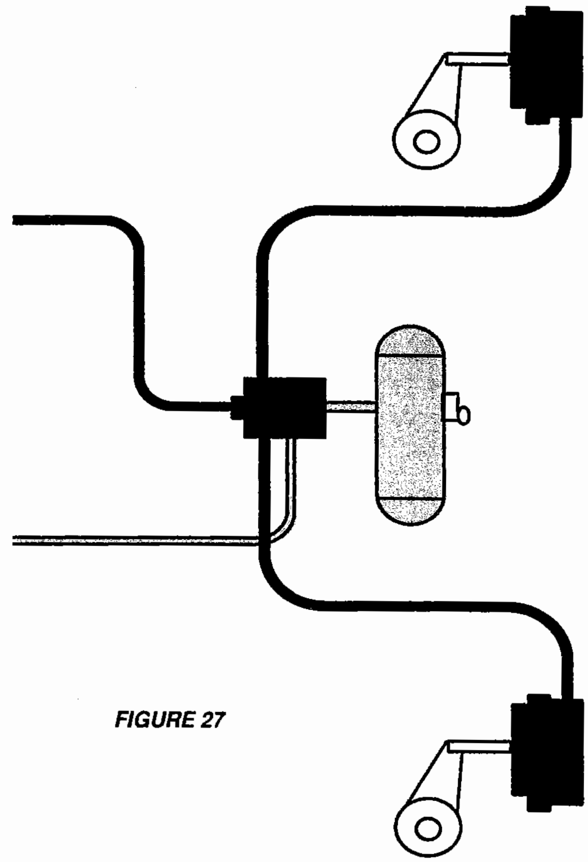


FIGURE 27

to normal air leakage and the trailer may run away.

When connecting either of these trailers, the following sequence should be followed:

Step 1: Back the tractor close enough to the trailer to connect the supply and service glad hands.

Step 2: Charge the trailer reservoirs by depressing the park control valve and trailer supply valve.

Step 3: When the trailer is fully charged, apply the trailer parking brakes by activating the trailer supply valve.

Step 4: Back the tractor into the trailer to make engagement between the trailer kingpin and tractor fifth wheel.

Step 5: Tug gently against the trailer's parking brakes to ensure kingpin to fifth wheel lockup.

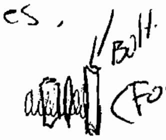
*** CAUTION ***

Modern diesel engines are capable of developing high torque at low engine R.P.M. Use of excessive engine speed to perform this step could result in damage to the vehicle's powertrain components.

Step 6: The driver should test the operation of the trailer emergency braking system and tractor protection system by opening the supply line glad hands with the vehicle parking brakes released. If both tractor and trailer are functioning properly, the trailer emergency brakes should apply immediately and air leakage from the tractor should be shut off when the trailer supply valve trips.

Step 7: The driver should perform a brake response test by moving the vehicle ahead one meter and applying the trailer hand valve. In this way trailer brake response is felt. This test should be repeated using the vehicles foot valve to ensure effective operation of all of the vehicle's brakes.

- manual caging your Brakes.

manualy Releases Brakes  (Found on each chamber)

- When

Service controlle lines.

supply lines

Tractor protection valve.

UNIT IV
SYSTEM OPERATION

UNIT IV
SYSTEM OPERATION

Modern air brakes have undergone an evolution which has resulted in a system that allows the operator to stop the vehicle in the event of a failure of any of the system's circuits. The following is a description of the reaction of a typical C.M.V.S.S. 121 tractor-trailer unit when one of its air circuits experiences an air loss.

1. *Loss of Air in the Supply Circuit*

If a failure of one of the components of the supply circuit causes a loss in air pressure, the following sequence of events should occur:

- Low air warning at 60 PSI (414 kPa)
- Air pressure is held in the primary and secondary service reservoirs by single check valves. This air pressure is used to hold the spring brakes off and to allow the operator to stop the unit by making a normal brake application. Single Brake application

*** CAUTION ***

Failure of the supply circuit prevents air from being replenished in the service reservoirs. It is important that the driver conserve air by holding a steady brake application and not "fan" the brakes which could result in an emergency brake application.

2. *Loss of Air in the Secondary Circuit*

This type of failure would result in:

- Low air warning at 60 PSI (414 kPa)
- Air pressure in the primary reservoir is held by a single check valve. This air is used to control tractor drive axle and trailer brakes so that the vehicle may be stopped.
- Steering axle brakes are inoperative.
- Conservation of air is a must because primary and trailer reservoirs will not receive air from the supply circuit.

Loose air in secondary, still have air remaining in primary, Supply gets sucked out.

Supply — Secondary

3. Loss of Air in the Primary Circuit

- Low air warning occurs at 60 PSI (414 kPa).
- Spring brakes are held off by air pressure in the secondary reservoir.
- Application of the vehicle's service brakes will apply the vehicle's steering axle brakes and trailer brakes on most tractor-trailer units. On body loaded trucks, buses and some tractor-trailers equipped with a spring brake control valve, the spring brakes may be used as a back up for primary service brakes.
- Air conservation is a must.

Still have enough for 1 brake application.

4. Air Loss in the Park and Emergency Brake Circuit

- Low air warning at 60 PSI (414 kPa).
- Both primary and secondary service reservoirs lose air pressure as well.
- Trailer supply valve triggers the trailer emergency brakes to apply at 45-20 PSI (311-138 kPa).
- Truck/tractor emergency brakes are applied by the park control valve at 45-20 PSI (311-138 kPa).

5. Failure of the Trailer Supply Line

- Trailer emergency brakes apply immediately.
- Expect a significant air loss in both the primary and secondary service reservoirs until the tractor protection valve triggers the trailer supply valve.

Caution: *Air loss will vary depending on the configuration of the tractor protection valve in conjunction with the trailer air supply valve*

- Low pressure warning occurs at 60 PSI (414 kPa).

6. Failure of the Trailer Service Line

- No loss of air will occur until the service brakes are applied.
- Trailer service brakes will not operate.

- Trailer emergency brakes can be applied by activating the trailer supply valve.

7. Air Loss in One of the Trailer Service Reservoirs (C.M.V.S.S. 121)

- Low pressure warning occurs at 60 PSI (414 kPa).

- Air pressure in the system will be held just high enough to keep the spring brakes released.

- Trailer service brakes may not operate.

- Trailer emergency brakes can be applied by activating the trailer supply valve.

8. Air Loss in the Trailer Service Reservoir (Trailer Manufactured prior to C.M.V.S.S. 121)

- Low pressure warning at 60 PSI (414 kPa).

- Trailer service and emergency brakes will be inoperative.

- Trailer supply valve will trigger the closure of the supply line to the trailer, which will allow air pressure to build in the tractor.

*** CAUTION ***
Care must be exercised to avoid a jackknife while attempting to stop the vehicle.

9. Crossed Trailer Service and Supply Lines

- Trailer service reservoirs will not be charged with air.

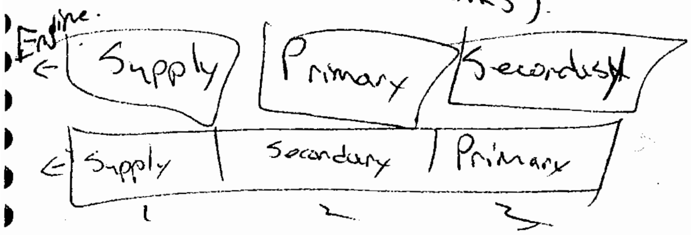
- Spring brakes will not release on C.M.V.S.S. 121 trailers.

- Parking brakes will not release on pre-121 trailers if the service reservoir has maintained its air pressure. If the air in the service reservoir has leaked down, there will be no parking or service brakes.

NOTE
Regardless of the reason for system failure, the unit, once safely stopped, must not be driven until after repairs have been made.

UNIT V
FOUNDATION BRAKES AND BRAKE ADJUSTMENT

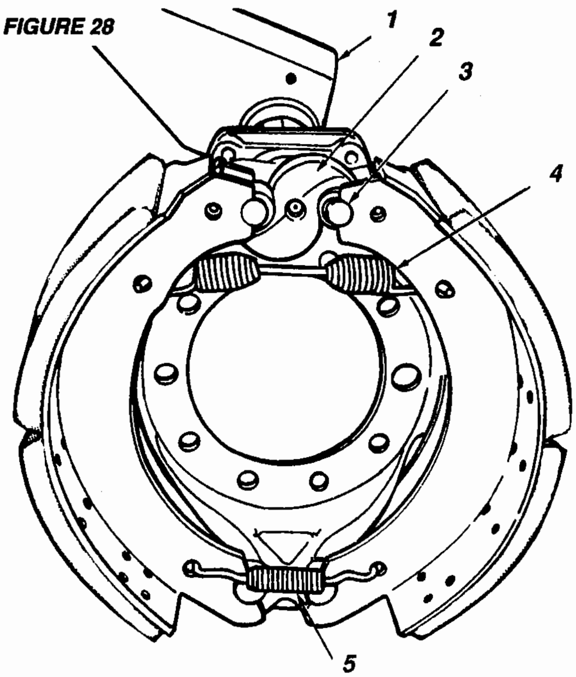
3 seperat section. (min)
(Tanks).



— Drain Tank go to truck if gauge doesn't move you got right tank

UNIT V
FOUNDATION BRAKES AND BRAKE ADJUSTMENT

FIGURE 28



1. CHAMBER BRACKET
2. CAMSHAFT
3. ROLLER PIN
4. RETURN SPRING
5. ANCHOR PIN

The most common type of foundation brake used on vehicles in Alberta is known as the cam brake. Figure #28 illustrates a typical cam foundation brake.

1. Cam Brakes

The components of this assembly are:

A. The Slack Adjuster

The slack adjuster connects the brake chamber to the brake shaft of the foundation brake. It converts the force of the brake chamber to torque which is used to apply the brake.

As its name implies, the slack adjuster provides a means to reduce the clearance created between the brake linings and brake drum as wear occurs. The slack adjuster is equipped with an adjustment capscrew and lock which is used for this purpose. Figure #29 illustrates a typical slack adjuster.

Some units are equipped with automatic slack adjusters which automatically keep brake lining to drum clearance to a minimum.

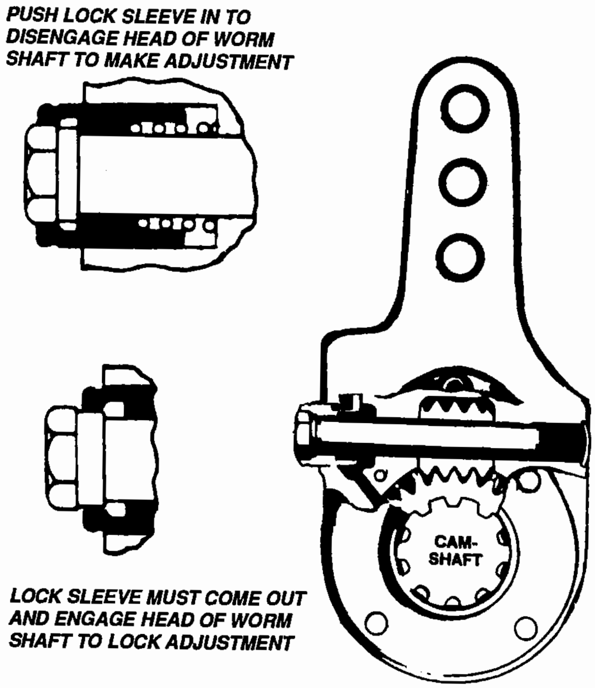


FIGURE 29

B. Brake Shaft and Cam

The slack adjuster rotates the brake shaft and cam assembly. As the cam rotates, it forces the brake shoes to expand causing the brake linings to contact the brake drum.

C. Brake Linings

The brake linings are attached to the brake shoe and may be constructed of a variety of different materials that provide different coefficients of friction and heat resistance. Lining temperatures can reach 316° C (600° F). It is critical that the lining material be able to withstand these temperatures and resist breakdown which would cause brake fade (loss of brake efficiency).

D. Brake Drums

The brake linings create friction when contacting the inner surface of the brake drum. The heat created by friction is dissipated by the brake drum. Drum condition is critical to brake effectiveness. Drums that are cracked, excessively worn, distorted or otherwise damaged should be repaired immediately.

2. Other Types of Brakes

Some units may be equipped with wedge activated or disc brakes. Both of these types of brakes utilize automatic adjusters to keep brake clearance to a minimum. Service and adjustment of these brakes should be referred to a qualified mechanic.

FIGURE 30

AIR DISC BRAKES

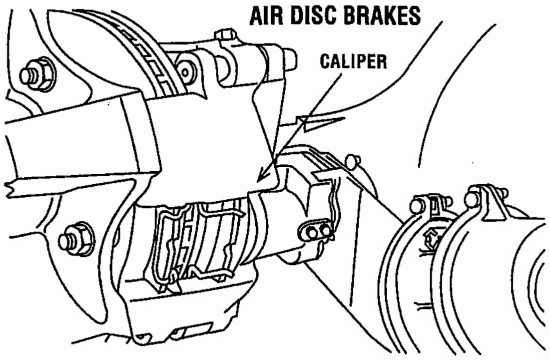


FIGURE 31

WEDGE BRAKES

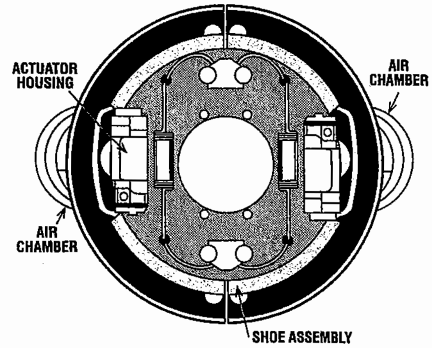
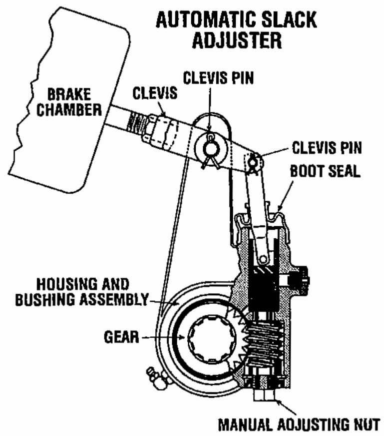


FIGURE 32

AUTOMATIC SLACK ADJUSTER



3. Brake Adjustment of Cam Brakes

Studies have shown that two of the most common causes of brake failure is lack of brake adjustment or incorrect adjustment. Units with properly adjusted brakes:

- require less air to apply the brakes;
- apply more quickly than those that are out of adjustment; and
- will provide maximum braking effort.

A properly adjusted brake is one that provides the shortest brake push rod travel without brake lining to drum contact when the brake is released. The best way to determine if a brake requires adjustment is to measure how far the brake chamber push rod must travel to fully apply the brake. The maximum allowable push rod stroke before readjustment is necessary is listed in Figure #33. Maximum stroke varies with the type and size of brake chamber used.

Push rod travel increases due to the wear that occurs between brake linings and brake drum and should be checked on every pre-trip inspection. If push rod travel is excessive, the following procedures may be used to adjust the vehicle's brakes.

Method #1

This is the best method to adjust brakes, and requires that the unit be lifted off the ground.

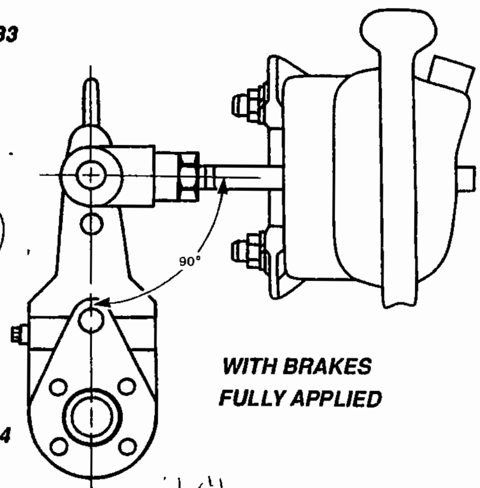
Step #1
Lift unit so that the wheel is clear of the ground.

Step #2
Be sure park brakes are released.

Type	Dimensions in Inches Effective area (sq. in.)	Outside diameter	Maximum stroke	Max. stroke with brakes adjusted	Max. stroke at which brakes should be readjusted
6	6	4 1/2	1 5/8	adjusted	1 1/4
9	9	5 1/4	1 3/4	as short as	1 3/8
12	12	5 11/16	1 3/4	possible	1 3/8
16	16	6 3/8	2 1/4	without	1 3/4
20	20	6 25/32	2 1/4	brakes	1 3/4
24	24	7 7/32	2 1/4	dragging	1 3/4
30	30	8 3/32	2 1/2		~~2~~ 1/2 max.
36	36	9	3		2 1/4

FIGURE 33

and Adjust. 1/2" – 3/4" (1").



WITH BRAKES FULLY APPLIED

FIGURE 34

Aplication. max 1 1/2"

Step #3
Release the lock on the adjusting capscrew of the slack adjuster and turn the capscrew while rotating the wheel.

*** CAUTION ***

Be sure to turn the capscrew in the correct direction. Brake push rod travel should decrease, and the brake shaft should rotate in the direction it would if a brake application were made.

Step #4
Adjust the brakes until the brake linings contact the brake drum and the wheel can no longer be rotated.

Step #5
Reverse the rotation of the adjustment capscrew until no drag is felt between the brake lining and drum.

Step #6
Be sure adjustment capscrew locking device engages the head of the capscrew to prevent the brake from coming out of adjustment during operation.

Step #7
Adjust the remaining brakes on the unit.

Step #8
Make and hold a 100 PSI (690 kPa) brake application and check push rod travel. Push rod travel should be within the specifications listed in Figure #33 and should not vary more than 1/2" side to side on drive and trailer axles. Steering axles should have less than 1/4" side to side variance.

Step #9
Check the angle formed between the brake chamber push rod and slack adjuster (Figure #34). This angle should not be less than 90°. An angle of less than 90° will cause the push rod to travel "over center" and reduces brake application force. Incorrect brake chamber pushrod to slack adjuster angle must be adjusted by a qualified mechanic.

Method #2

In instances where it is not possible to elevate the unit to rotate the wheels the following procedure must then be used:

Step #1
Block the vehicle's wheels and release the parking brakes. Shut off the engine and leave the transmission in the lowest gear.

Step #2
Make and hold a 100 PSI (690 kPa) brake application. Check push rod travel and slack adjuster angle.

Step #3
If readjustment is necessary, rotate the adjustment capscrew on the slack adjuster until the brake linings contact the drum. This can be checked visually or by rapping the drum with a hammer. When the linings are not in contact with the drum, the drum will ring. When the linings contact the drum, a dull thud is heard.

Step #4
Back off the adjustment capscrew 1/4 - 1/2 turn. Be sure the linings are not contacting the drum.

Step #5
Recheck push rod travel, slack adjuster angle and side to side balance as in Method #1.

***NOTE* Be sure that you are aware of your company's policy with respect to drivers performing brake adjustment. Many companies do not permit their drivers to perform brake adjustment, preferring to leave this task to their service department.**

UNIT VI
BRAKE SYSTEM INSPECTIONS

UNIT VI
BRAKE SYSTEM INSPECTIONS

1. Pre-Trip Inspections

Well maintained vehicles are safe vehicles and usually are more economical to operate. The driver is a key link in the maintenance chain of an air brake unit. The driver should be alert and knowledgeable of system operation. Brake problems should be reported and repaired immediately.

Before a pre-trip inspection is performed, visually inspect the unit. Check for:

- compressor security, belt condition and adjustment,
- conditions of lines, fittings, hoses and couplers,
- visible portions of drums for cracks,
- brake linings for condition and thickness on those assemblies with no dust plates.

The steps in performing a pre-trip inspection are as follows:

Step #1
Position the vehicle on as level ground as possible.

• chock the wheels

• drain reservoirs from maximum system pressure to zero

• check low pressure warning devices. They should be activated at a minimum of 60 PSI (414 kPa)

NOTE: Reservoirs must be drained at least daily to ensure removal of all moisture and contamination. Clean dry air is a MUST for proper air system operation. Excessive moisture can cause freeze up of brake system components. Excessive oil in the reservoirs could be an indication of a faulty compressor and should be reported.

NOTE: When draining the air reservoirs, be sure to open the drain cocks fully, draining from maximum system pressure to zero pressure. This will maximize the expulsion of contamination. Always drain the supply reservoir prior to draining service reservoirs.

Step #2

Build system pressure to maximum.

- Check:
  - operation of low pressure warning devices. They should cut out at 60 PSI (414 kPa) minimum.
  - pressure build-up time from 50-90 PSI (350-600 kPa). Buildup time should be in 3 minutes or less with the engine running at 1200 RPM.
  - governor cutout pressure 120-130 PSI (828-897 kPa) depending on unit.

Step #3

With the engine idling, fan the brakes until the governor cuts the compressor back in. Cut in pressure should not be more than 20–25 PSI (138–173 kPa) lower than cut out pressure.

Step #4

Check reservoir pressure leakage. With the system at full pressure, engine shut off and the park brakes released:

- allow pressure to stabilize for one minute.
- check dash gauges for two minutes and note pressure drop.
- single vehicle pressure drop should not exceed two PSI for either reservoir.
- tractor-trailer pressure drop should not exceed four PSI for either reservoir.

Step #5

Build the system pressure to maximum. Make and hold a full brake application:

- Allow pressure to stabilize for one minute.
- Check dash gauges for two minutes and note pressure drop.
- A single vehicle pressure drop should not exceed four-PSI in either service reservoir.
- Tractor – trailer pressure drop should not exceed six PSI.

Step #6

Make and hold a 100 PSI (690 kPa) brake application.

- Check brake chamber push rod travel and slack adjuster angle. If the push rod travel is excessive, a brake adjustment is required. (Refer to Unit V - Brake Adjustment)

Step #7
Check the manual emergency system.
For body loaded truck and bus applications:

- Manually operate the park control valve with the engine idling. Park brakes should apply and release promptly.

For tractor-trailer units:

- manually operate trailer supply valve with the engine idling. Trailer park brakes should apply and release promptly.

- manually operate the park control valve, all parking brakes on the unit should apply.

Step #8
Check the automatic emergency system.
For body loaded trucks and buses:

- build air system pressure to maximum.

- shut off engine.

- fan brakes until pressure drops low enough to activate the park control valve.

- all spring brakes on the unit should apply.
  For tractor-trailer units the following additional check should be made:

- build system pressure to maximum, disconnect the trailer supply line. Trailer brakes should apply immediately. Tractor air pressure should fall until the trailer supply valve closes the supply line.

Step #9
The driver should perform a brake response test by moving the vehicle ahead one meter and applying the trailer hand valve. In this way trailer brake response is felt. This test should be repeated using the vehicle's foot valve to ensure effective operation of all of the vehicle's brakes.

2. In-Service Inspections

In the course of vehicle operation, drivers may encounter signs prior to steep or long downhill grades that read:

TRUCKS STOP
AND
CHECK BRAKES
300 METERS AHEAD

The driver must stop in the designated inspection area and inspect the vehicle's braking system before proceeding.

The following inspection procedure must be observed.

Step #1
Check the air pressure gauges to ensure that reservoirs are at maximum system pressure.

Step #2
Reduce reservoir pressure to 50 psi (350 kPa) by fanning the vehicle's brakes.

Step #3
Run the engine at 1200 rpm and observe the air pressure gauges. The compressor should build up pressure in the reservoirs from 50 psi (350 kPa) to 90 psi (600 kPa) in three minutes or less. This check will ensure that the compressor and governor are operating properly.

Step #4
Block the vehicle's wheels and release the parking brakes. Make and hold a 100 pound brake application. Check brake chamber push rod travel and adjust the brakes if necessary.

Step #5
Visually inspect the vehicle's brake drums, linings and check for overheating, cracking or damage. Look for any indication of oil leakage from wheel seals.

Step #6
Listen for any audible air leaks.

Step #7
Release the vehicle's service brakes and perform a brake response test.

Step #8
On combination vehicles, check trailer automatic emergency brake operation by disconnecting the trailer supply line glad hands. This should cause an immediate application of the trailer emergency brakes. Air leakage from the tractor will continue until the tractor protection system closes the leak.

UNIT VII
LONG DOWNHILL GRADES / BOBTAILING

UNIT VII
LONG DOWNHILL GRADES/BOBTAILING

1. Use of Airbrakes on Long Downhill Grades

Long downhill grades, particularly when road conditions are slippery, present operators of airbrake equipped vehicles with one of their greatest challenges. To ensure that these grades are negotiated safely, the driver should:

- Make himself/herself aware of the route to be travelled, noting the location of steep grades.
- Perform an in-service inspection where required prior to proceeding down a steep downgrade.
- Control vehicle speed by the use of lower gears. ***NOTE*** It is critical that the appropriate gear be selected prior to descending the hill. Downshifting on a steep grade would require an interruption to the engine braking capability, and could result in a runaway. A good rule of thumb is to select the same gear that would be required to climb the hill.
- Use of engine brakes or retarders if the vehicle is so equipped.
- If service brakes are required to control vehicle speed, a continuous, steady application of no more than 10 psi is recommended. If a higher application pressure is required, the operator should select a lower gear to control vehicle speed. Continuous application of the brakes at pressures higher than 10 psi will result in brake overheating and fade.

2. Tractor Bobtailing

"Bobtailing" refers to the operation of a tractor without a trailer. A tractor equipped with a trailer has considerable weight applied to its drive axle which results in good traction. When the trailer is removed, traction on the drive wheels is reduced. Brake application while bobtailing results in weight transfer from the drive axles to the steering axle, further reducing traction on the driving wheels. Transferring traction from the drive to steering axles can result in a serious loss of vehicle stability when a heavy brake application is made. This problem is compounded when slippery road conditions are encountered.

To safely operate a bobtail tractor the driver must drive more defensively and:

- Avoid excessively heavy brake applications;
- Reduce vehicle speed when road surfaces are slippery;
- Use engine braking devices and retarders to slow down the vehicle as much as possible; and
- Leave an appropriate distance between your vehicle and the one you are following.

GLOSSARY OF TERMS

Air brake: A vehicle braking system that initiates air pressure at an engine-driven compressor and transmits the pressure through a series of hoses, reservoirs and control valves to the vehicle foundation brakes. (NOTE: This definition does not include "air over hydraulic" or "vacuum over hydraulic" systems as the braking force in such systems is applied through hydraulics.)

Brake Fade: Loss of brake effectiveness due to excessive heat, water or oil on brake linings or mechanical failure.

Brake Lag: The time required for the air to flow through the system and apply the brakes once the driver has depressed the brake valve's treadle.

Force: A push or pull. Some common units of force are:
- Pounds (lb)
- Newtons (N)

Power: The rate of doing work.

Pressure: A force per unit area. The common units of pressure are:
- Pounds per square inch (P.S.I.)
- Newtons per square metre (kPa)
- (kPa = Kilopascals)

Torque: A twisting force such as that applied to the brake cam shaft. Some common units of torque are pound-inch (lb.in) or Newton-centimetres (N.cm).

Traction: Friction between the tire and road surface.

Alberta Infrastructure oversees many types of driver training. To find out about driver training in Alberta, please contact:

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