

AIR BRAKE HANDBOOK

For over 75 years, Bendix Commercial Vehicle Systems LLC has been a leading supplier of Bendix air-braking systems to the heavy trucking industry. From the first concept of using air as a braking force, years of development and refinement have produced dependable stopping power for thousands of vehicles traveling millions of miles each year.

Our customer-driven approach to business has helped us as part of a global organization with technical and manufacturing centers keeping us on the leading edge of new-development and applications engineering.

Consequently, all Bendix products are backed by a team of highly-trained experts...people ready to provide technical support, systems information or troubleshooting help. Our fully-staffed technical hotlines (1-800-247-2725-2) are just a phone call away and both on and off-site technical training is also available.

This manual presents only an overview of the air brake system and its components for more detailed information on systems and components Bendix Commercial Vehicle Systems LLC offers the following variety of training aids:

ADDITIONAL AIR BRAKE SYSTEM INFORMATION
Bendix Audiovisual Programs

Bendix offers several audiovisual programs on many Bendix air-brake devices and systems. These moderately priced programs describe the operation and troubleshooting of air brake components and systems. The programs are described in our Sales Promotion & Training Materials Brochure, BWI699, available upon request at no charge. Please send requests to the address shown below.

Bendix Air Brake Maintenance Manual

This maintenance manual consists of instruction and service data sheets and provides complete information on most air brake system components. In addition to information on how each device operates, the sheets contain information on installation, maintenance and disassembly/assembly instructions.

To order a complete manual, BW9600, contact your local distributor, visit www.bendix.com or write to:

support@bendix.com, or,
Bendix Commercial Vehicle Systems LLC
Marketing & Communications Department - S32
P.O. Box 4016
Elyria, Ohio 44036-4016

Manual Layout

The products presented in this manual are introduced in a building format. Each device is introduced as it is presented in the system beginning with the compressor of the supply system, building to a complete straight vehicle and then adding the components necessary to build a tractor. Mini systems are presented throughout the manual to assist in the understanding of the application and function of the components.

IMPORTANT!

The systems presented in this manual are intended for illustrative purposes only and are not intended for actual vehicle piping.

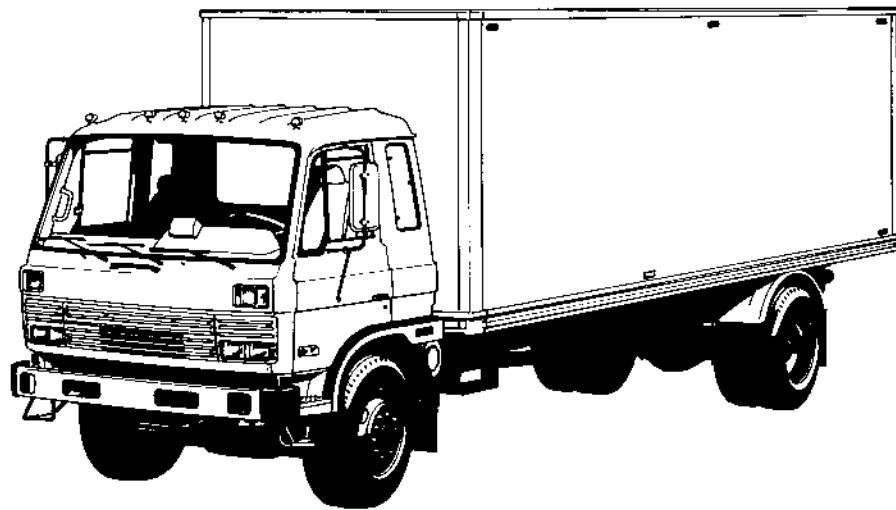
We hope this booklet will provide useful information regarding the application and operation Bendix air brake devices. Each device shown includes a description of operation, a schematic showing the device in a typical system as well as the DIN representation of the device. The manual is divided into four basic sections: Supply system, service brake system, emergency and parking brake systems and trailer system.

GENERAL INDEX

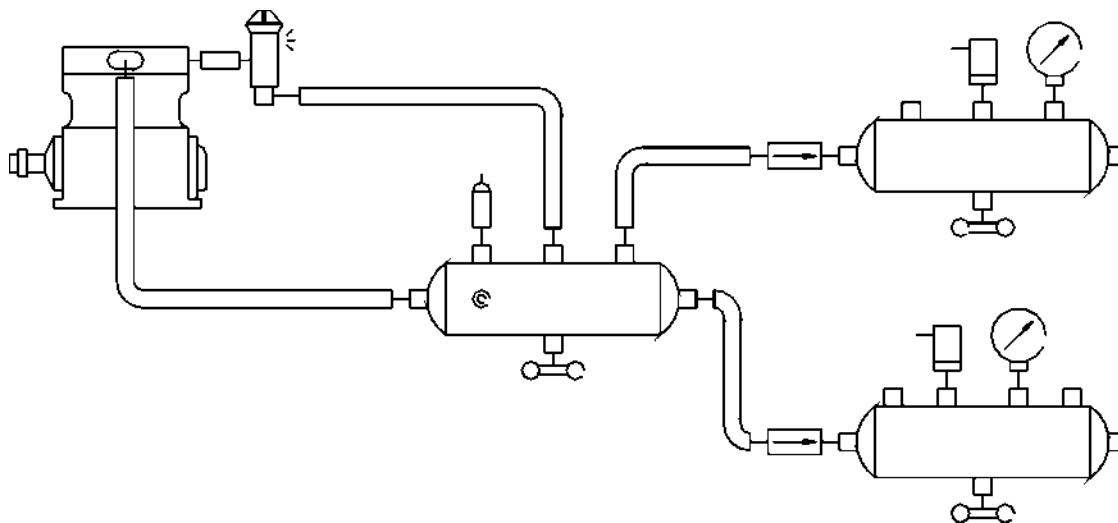
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SUPPLY SYSTEM



TYPICAL CHARGING OR AIR SUPPLY SYSTEM

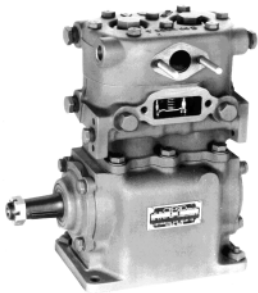


BX-2150

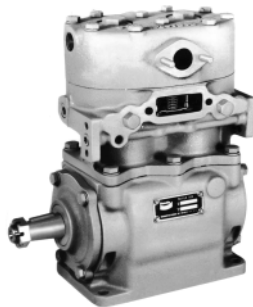


DuraFlo 359

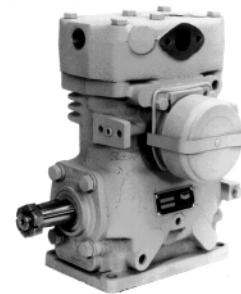
**Single
Cylinder
Compressors**



Tu-Flo 400



Tu-Flo 500



Tu-Flo 501

**Two Cylinder
Compressors**



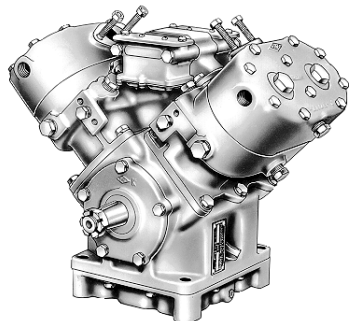
Tu-Flo 700



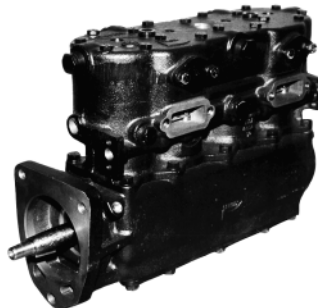
DuraFlo 596



**Tu-Flo 550
Tu-Flo 750**



Tu-Flo 1000



Tu-Flo 1400

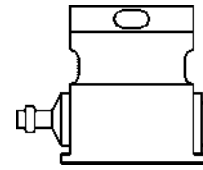
**Four Cylinder
Compressors**

AIR COMPRESSOR

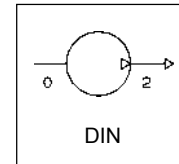
The **air compressor** is the source of energy for the air brake system. It is driven by the vehicle engine, either by belt or drive gear, and on most vehicles, utilizes the vehicle lubrication and cooling system; however, self-lubricated and air-cooled compressors are available in some models.

All Bendix reciprocating type compressors feature automatic inlet and discharge valves and an unloading mechanism.

Several sizes in various mounting configurations to meet a wide range of vehicle needs are available. Refer to the chart below for specific information.



COMPRESSOR



Compressor Type	Compressor Displacement at 1250 RPM	No. of Cylinders	Lubrication		Cooling		Typical Application	Comments
			Engine	Self	Air	Water		
Tu-Flo 400	7.25	2	Yes	Yes	Yes	Yes	Straight air and air/hyd. class 6&7	
BX-2150	9.5	1	Yes	No	No	Yes	Straight air and air/hyd. class 6&7	
Tu-Flo 500	12	2	Yes	Yes	Yes	Yes	Straight air class 7 & 8	Becoming Obsolete
Tu-Flo 501	12	2	Yes	No	No	Yes	Straight air class 7 & 8	
Tu-Flo 550	13.2	2	Yes	No	No	Yes	Straight air class 7 & 8	Replaces most TF 500, 501
Tu-Flo 600	14.5	2	Yes	No	No	Yes	Straight air class 7 & 8	Obsolete, replaced by 700, 750
Tu-Flo 700	15.5	2	Yes	No	No	Yes	Straight air class 7 & 8	
Tu-Flo 750	16.5	2	Yes	No	No	Yes	Straight air class 7 & 8	Replaces most TF 600, 700
Tu-Flo 1000	24	4	Yes	Yes	Yes	Yes	Special, ie; tank trailer pump-off	V4 cylinder configuration
Tu-Flo 1400	32	4	Yes	No	No	Yes	Special, ie; tank trailer pump-off	In-line 4 cylinder configuration
DF-596	27	2	Yes	No	No	Yes	Special, ie; tank trailer pump-off	
DF-359	13	1	Yes	No	No	Yes	Straight air class 7 & 8	

INLET REGULATING VALVE

The **inlet regulating valve** or IRV is intended for use on multi-cylinder compressors which receive their induction air supply from the pressure side of the engine turbocharger. The IRV **may not** be used in conjunction with single cylinder compressors including the BX-2150. The IRV which is generally mounted to the compressor inlet is designed to regulate compressor inlet pressure to 10 PSI or less. The outlet flange of the IRV will mount to all Bendix Tu-Flo Compressors except the Tu-Flo 300.



INLET REGULATING VALVE

ST-4 SAFETY VALVE

The **ST-4 Safety Valve** is installed in the extra compressor discharge port if available, or in the discharge line to prevent compressor damage in the event of discharge line blockage. Because this valve is specifically designed for this application a standard safety valve may not be used in lieu of the ST-4.



ST-4

INLET CHECK VALVE

The **inlet check valve** may be used on naturally aspirated compressors to prevent oil misting during the unloaded cycle. The inlet check valve mounts to the intake side of the compressor and must be used in conjunction with an inlet valve stop or inlet adapter.



INLET CHECK VALVE

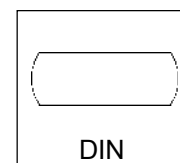
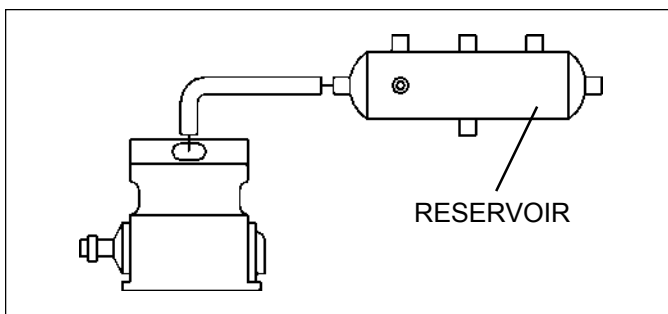
RESERVOIR

The **reservoir** serves the air brake system as a storage tank for a volume of compressed air. The reservoir is sized by the vehicle manufacturer to provide an adequate volume of air for use by the braking system and auxiliary control devices. Generally, more than one reservoir is used in air brake systems. A secondary function of reservoirs is to provide a location where the air heated by compression, may be cooled and the water vapor condensed.

Bendix reservoirs are built in accordance with SAE specifications and are available in various sizes in both single and double compartment design configurations, and are certified per FMVSS 121.



RESERVOIR



SAFETY VALVE

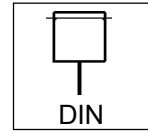
The **safety valve** protects the air brake system against excessive air pressure buildup. It must be installed in the same reservoir that the compressor discharge line is connected to. Safety valves are available in both adjustable (ST-1) and non-adjustable (ST-3) styles, in various pressure settings, and with either 1/4" or 3/8" N.P.T.



ST-1



ST-3



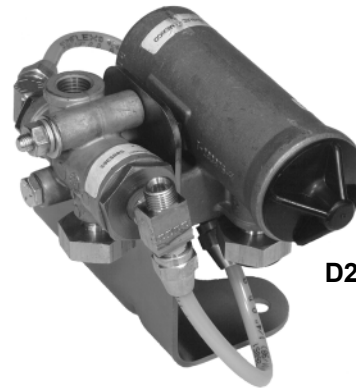
GOVERNOR

The **governor** operates in conjunction with the compressor unloading mechanism and maintains reservoir air pressure between a predetermined maximum and minimum pressure.

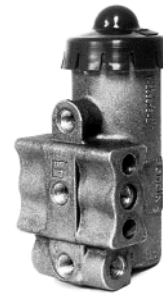
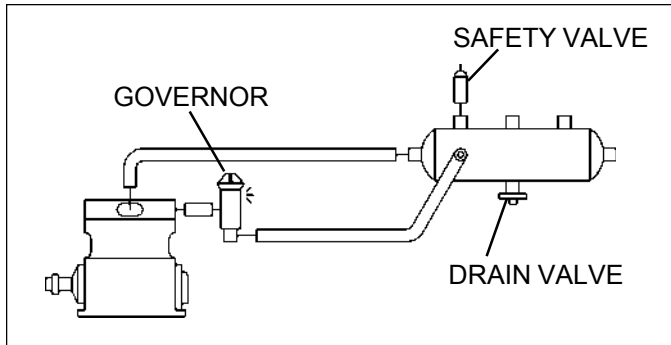
The D-2 governor is an adjustable piston-type valve available in various pressure settings. A non-adjustable pressure range between specified cut-in and cut-out pressures is designed into the D-2 governor. Provisions are made for direct mounting to the compressor or for remote mounting if desired. The D-2 governor is available in weatherproof and high temperature versions for special installations. The D-2A is a non-adjustable version of the D-2 governor.

The **D-2/SV-1 governor module** is for use with the DuraFlo™ 596 compressor. The module offers convenient installation of the required components in a single, factory pre-assembled component group and provides for either direct mounting to the compressor or remote mounting as required by a specific application.

The module is primarily intended for use when changing over to (retrofitting) the DuraFlo™ 596 compressor.



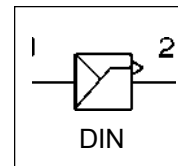
D2 / SV-1



D-2A



D-2



RESERVOIR DRAIN DEVICES

Reservoir draining devices are installed in air-brake reservoirs. They allow the accumulation of contaminants collected in the reservoir to be drained off to atmosphere, and are available in both manual and automatic styles.

Manual draining devices consist of drain cocks which require manual operation at the point at which they are installed. Drain Cocks are available in various styles with pipe thread sizes of 1/8", 1/4" and 3/8".



DRAIN COCK

DRAIN VALVES

The **DV-2 automatic reservoirs drain valve** is a completely automatic draining device. It is installed directly into the end or bottom drain port of the reservoir and does not require any additional control lines. It operates automatically from ascending and descending reservoir pressures. It is available in either the end port or bottom port version, and with or without a 12v or 24v heater.

The **DV-1 remote control drain valve** consists of a drain valve installed into the reservoir and a control valve such as the **RD-2** which is installed within the cab of the vehicle or any convenient servicing point.



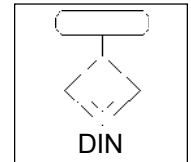
**DV-1
DRAIN VALVE**



**DV-2
DRAIN VALVE**



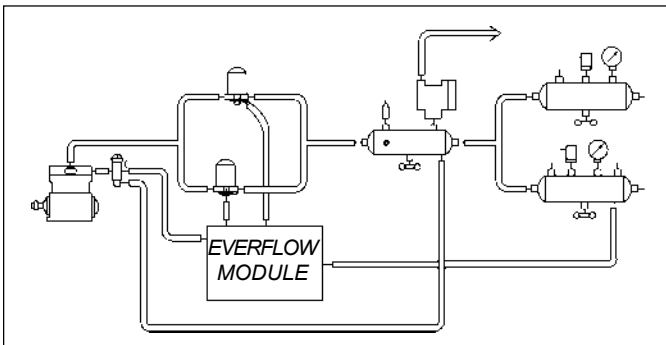
RD-2



DIN

EVERFLOW™ MODULE

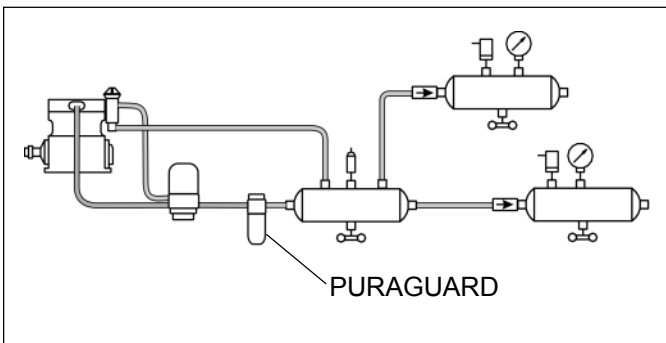
The **EverFlow™ Air Dryer Module** when used in an air dryer system is intended to remove moisture and other contaminants normally found in the air brake system. The air dryers are plumbed in parallel, splitting from a common compressor discharge line, then recombining to a common delivery line to the compressors.



EverFlow™ Module

PURAGUARD™

The **PuraGuard™ System Filter** is used to assist the production of purified compressed air on high air use vehicles. The PuraGuard™ System Filter consists of a filter element mounted in a die cast aluminum housing. The Sump Housing contains a drain valve for maintenance.



PuraGuard™

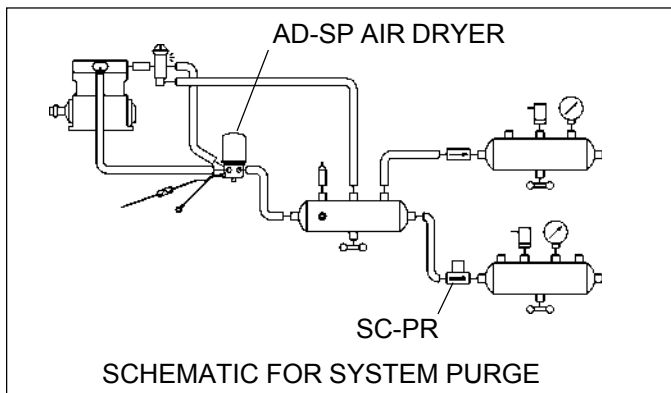
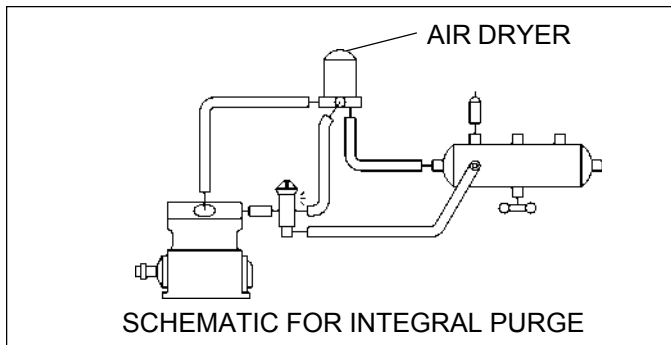
AIR DRYERS

The **air dryer** is a desiccant type in-line filtration system that removes both liquid and water vapor from the compressor discharge air before it reaches the air brake reservoirs. This results in only clean, dry air being supplied to the air brake system, aiding in the prevention of air line freezups.

The air dryer utilizes a replaceable desiccant material which has the unique ability to strip water vapor from moisture laden air. The desiccant material is regenerative, in that its adsorptive properties are renewed each time the compressor is unloaded.

The air dryer end cover is equipped with an automatic drain valve, controlled by the air system governor and is equipped with an integral heating element and is available for either 12 or 24 volt systems.

The AD-2, AD-3, AD-4, AD-9 and AD-IP air dryers are equipped with an integral storage of dry air for the purge cycle (purge volume). The AD-IP EP includes an extended purge volume. The AD-SP uses a small amount of air from the supply and front axle (secondary) reservoirs to perform the purge function. Because of this difference the AD-SP is considerably smaller and lighter than the integral purge dryers.



SINGLE CHECK PROTECTION VALVE

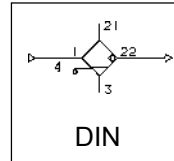
The **SC-PR single check protection valve** is a combination of 2 separate devices, a single check valve and a pressure protection valve. It serves as a means of protecting the air pressure in the front axle service reservoir and replaces the standard single check valve. The SC-PR must be used in conjunction with the AD-SP Air Dryer.



AD-3



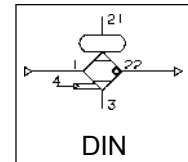
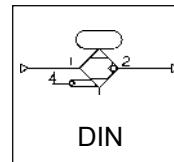
AD-9



AD-4



AD-2



AD-IP



AD-IP EP



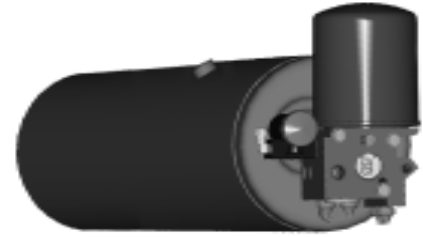
SC-PR



AD-SP

DRM

The function of the **Dryer Reservoir Module (DRM)** is to provide heavy vehicles with an integrated vehicle Air Dryer, Secondary Reservoir, purge reservoir, governor and a number of the charging valve components in a module. The DRM includes an **Integrated Solution Air Dryer (AD-IS)**, a reservoir (including a separate purge reservoir section) a governor and four pressure protection valves. These have been designed as an integrated air supply system.



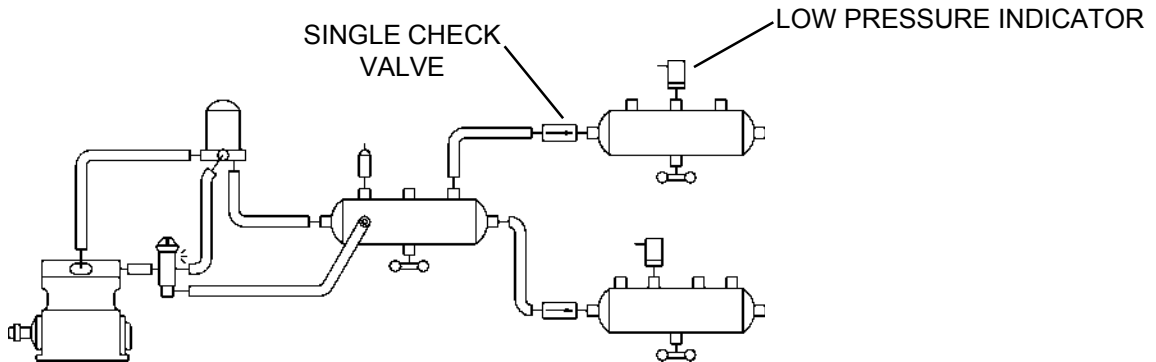
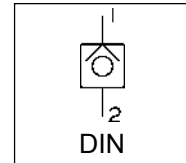
DRM

SINGLE CHECK VALVES

The in-line **single check valve** allows air flow in one direction only, preventing the flow of air in the reverse direction. Many styles of single check valves are available with either integral or replaceable seats, rubber and metal seats, and with ball or disc valves. Several sizes and configurations are available to accommodate various piping arrangements.

See double check valves page 18 and pressure protection valves page 28.

SC-1
SINGLE CHECK

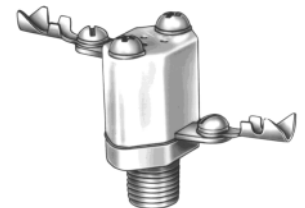


LOW PRESSURE INDICATOR

Low pressure indicators are pressure operated electro-pneumatic switches that are designed to complete an electrical circuit and actuate a warning light and buzzer for the driver in the event air pressure in the service brake system is below a safe minimum for normal operation. The low pressure indicator is available in various pressure settings, is not adjustable, and is generally used in conjunction with a dash mounted warning lamp or warning buzzer or both.

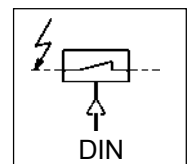


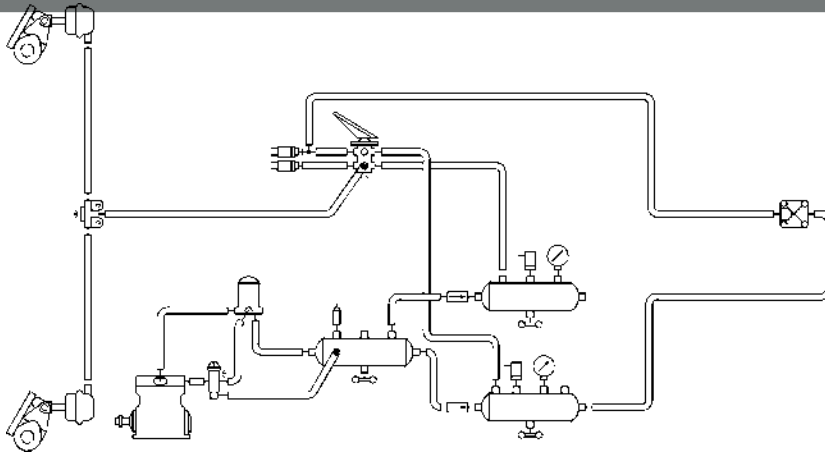
DIN



LP-3

LP-2





DUAL CIRCUIT BRAKE VALVE

Dual circuit brake valves utilize two separate supply and delivery circuits for service and secondary braking. The number one or primary circuit portion is mechanically operated through the action of the treadle/pedal and plunger. The number two or secondary circuit normally operates similar to a relay valve, with control air delivered from the number one primary circuit. In the emergency mode (failure of the primary supply), the secondary inlet valve is mechanically opened by a push through mechanical force from the driver's foot via the treadle/pedal, plunger and primary piston.

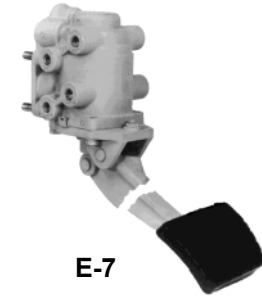
The **E-6, E-8P, E-10P, E-10, E-12 and E-15 dual brake valves** are floor mounted, treadle operated valves with two separate supply and delivery circuits.

The **E-7 and E-14 dual brake valves** are firewall mounted, suspended pedal valve with two separate supply and delivery circuits. Threaded supply and delivery ports for both circuits are provided at the back of the valve. For engine side firewall connections, an optional manifold is available.

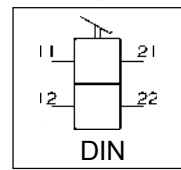
The **E-10PR Retarder Control Brake Valve** is used with retarder systems installed on automatic transmissions. Automatic transmission retarders are used to retard forward motion of the vehicle above 5 mph. Retarders are most popular in the transit (buses/coaches) industry and are used to extend the life of brake system components.



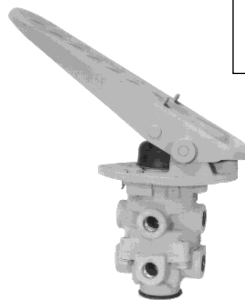
E-14



E-7



E-10



E-6



E-12
E-15



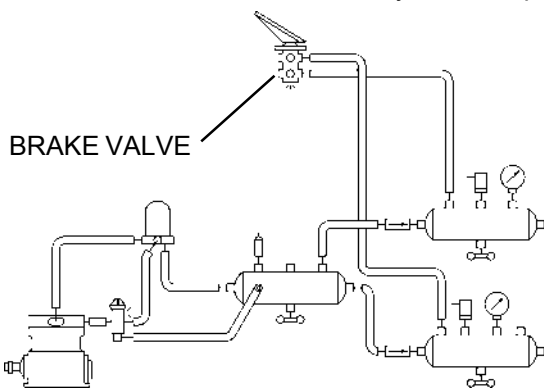
E-10PR

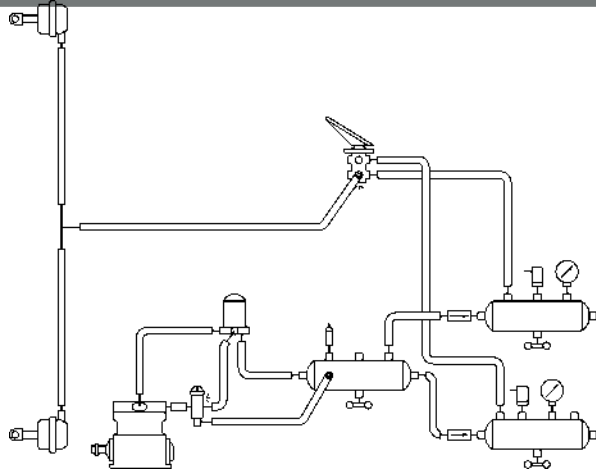


E-8P



E-10P



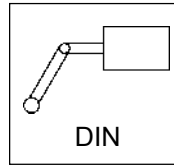


ACTUATORS

Brake chambers and slack adjusters convert the energy of compressed air into mechanical force and motion. This actuates the brake camshaft which in turn operates the foundation brake mechanism forcing the brakes shoes against the brake drum.

Brake chambers are available in several sizes, providing a wide range of output forces and strokes. Different size brake chambers are identified by numbers which specify the effective area of the diaphragm. A Type 30 brake chamber has 30 square inches of effective area.

Rotochambers are also available in several sizes, providing a wide range of output forces. The rolling type diaphragm provides long life and gives a constant output force throughout the entire stroke. Rotochambers are frequently used in industrial applications.



BRAKE CHAMBER



ROTOCHAMBER

BRAKE CHAMBER SPECIFICATIONS

Dimensions in inches

CLAMP TYPE BRAKE CHAMBER

Type	Effective Area (sq.in.)	Outside diameter	Maximum stroke	Maximum stroke at which brakes should be adjusted
6	6	4 1/2	1 5/8	1 1/4
9	9	5 1/4	1 3/4	1 3/8
12	12	6 11/16	1 3/4	1 3/8
16	16	6 3/8	2 1/4	1 3/4
20	20	6 25/32	2 1/4	1 3/4
24	24	7 7/32	2 1/4	1 3/4
30	30	8 3/32	2 1/2	2
36	36	9	3	2 1/4

Chamber stroke with brakes adjusted should be as short as possible without brakes dragging.

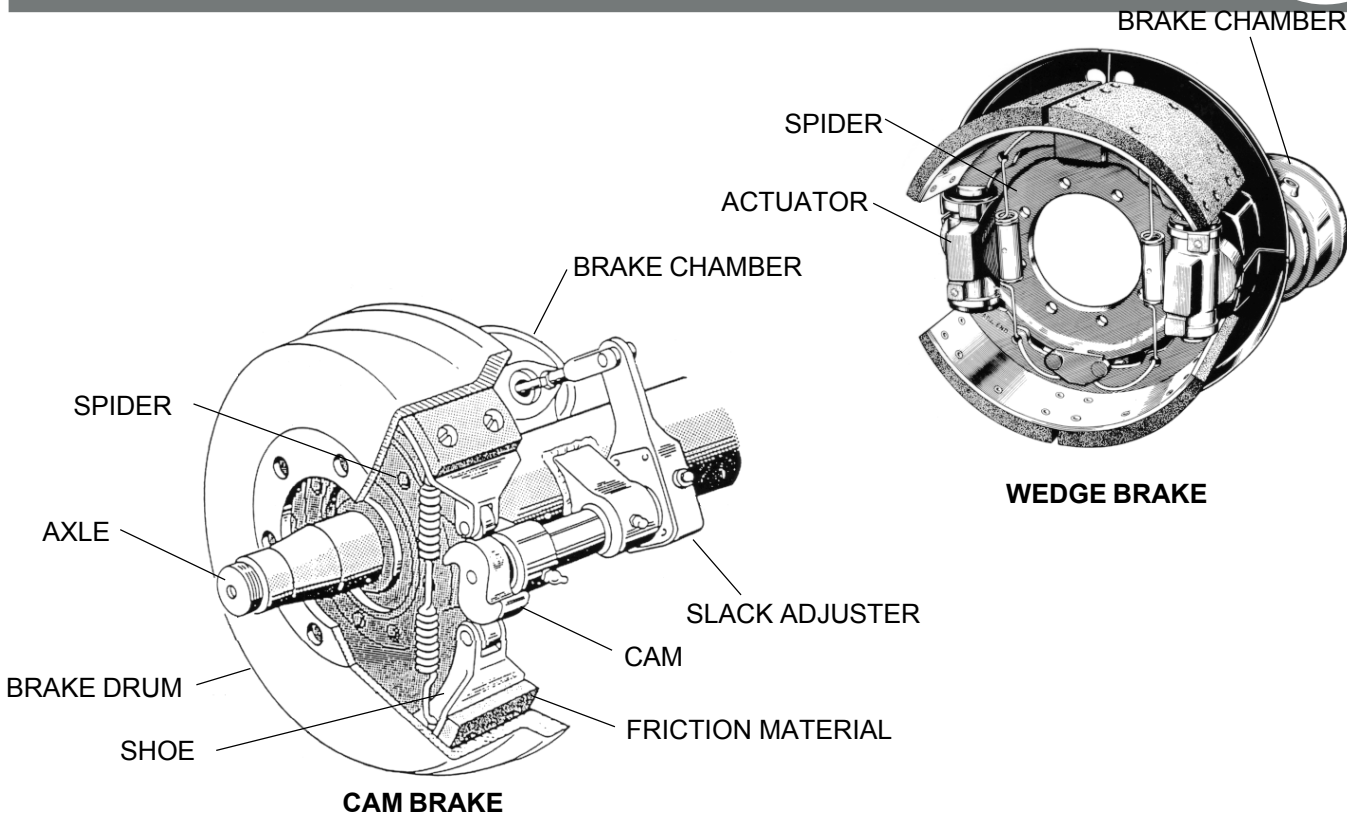
ROTOCHAMBER SPECIFICATIONS

Dimensions in inches

Type	Effective Area (sq.in.)	Outside diameter	Maximum stroke	Maximum stroke at which brakes should be adjusted
9	9	4 9/32	2	1 1/2
12	12	4 13/16	2	1 1/2
16	16	5 13/16	2 1/2	1 7/8
20	20	5 15/16	2 1/2	1 7/8
24	24	6 13/32	2 1/2	1 7/8
30	30	7 1/16	3*	2 1/4
36	36	7 5/8	3 1/2*	2 5/8
50	50	8 7/8	4*	3

Maximum chamber stroke with brakes adjusted should be as short as possible without brakes dragging.

*Available in 6" stroke chambers.



FOUNDATION BRAKE

The foundation brake is the actual braking mechanism located at each end of the axle. It generally consists of the air or spring actuator, slack adjuster or wedge assembly, the mechanical brake mechanism including the shoes and attached friction material and the brake drum.

CAM BRAKE

In a cam type foundation brake the pneumatic system is linked to the foundation brakes by the slack adjuster. The arm of the slack adjuster is fastened to the push rod of the chamber with a yoke. The spline of the slack adjuster is installed on the brake cam shaft. The slack adjuster is a lever, converting linear force of the chamber push rod into a torsional or twisting force needed to apply the brakes.

When torque is applied to the cam shaft, the "S" shaped cam spreads the brake shoes, forcing the brake lining into contact with the brake drum stopping the vehicle.

Cam brakes are offered in various diameters to meet vehicle braking requirements, with the most commonly encountered being 16 1/2". The cam brake is "leading-trailing" shoe design with fixed anchor points for each shoe, opposite the cam end of the shoe.

WEDGE BRAKE

Although the S-cam foundation brake is the most common foundation brake in use today, some vehicles are equipped with the wedge type foundation brake. In this brake, the slack adjuster and cam shaft are replaced by a wedge/roller mechanism that is used to spread the brake shoes and force them against the drum.

The air (spring) chamber is attached directly to the brake spider and the wedge and roller actuation mechanism is enclosed within the actuator and chamber tube. A self adjusting mechanism is standard and is contained within the wedge brake actuator. Bendix wedge brakes are offered in Twinplex®, non-servo and heavy duty non-servo versions. All are 15" diameter and feature a floating shoe design which imparts a higher degree braking efficiency when compared to the cam brake. The Twinplex® is a twin leading shoe (either direction) design. With the appropriate friction material and air actuators the 15" wedge brake is capable of the same stopping power as a 16 1/2" cam brake but is considerably lighter and has the advantage of a "built-in" self adjusting mechanism.

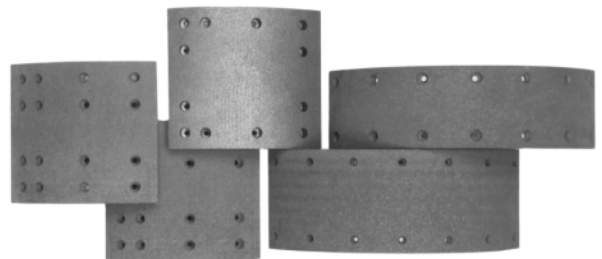
BRAKE BLOCK AND LINING

Although it takes a 450 hp engine approximately 90 seconds to accelerate a 40 ton vehicle to 55 miles per hour, it should only take 5 seconds to come to a stop. Accomplishing this task takes the right combination of a braking system, which supplies the power and the foundation brakes, which do the actual braking.

When brakes are applied the friction material contacts the brake drum producing heat energy. For optimal performance the heat that is generated must dissipate rapidly to prevent damage to the friction material. Therefore the friction material used in the brake must have the capability of withstanding the heat until dissipated through the drum. It takes the right combination of ingredients to formulate the friction material that provides all the desirable characteristics, including long life.

All friction material is identified by a stencil on its edge. This identification code consists of the name of the manufacturer, the formula identification and the friction class. The friction class is indicated by two letters. The first letter represents the normal coefficient of friction, and the second represents the hot coefficient of friction. The numerical range is shown below.

LETTER	NUMERICAL RANGE
D	Over .150 But less than .250
E	.250 to .350
F	.351 to .450
G	.451 to .550
H	Over .550



BRAKE BLOCK

BRAKE LINING

