DB-60 Control Valve
Instruction Manual MU-21

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## PLANT AND GENERAL OFFICES

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<td>KNORR BRAKE LTD.</td>
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<td>WATERTOWN, NEW YORK USA</td>
<td>KINGSTON, ONTARIO, CANADA</td>
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## SERVICE CENTER

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<td>RIVERSIDE, MISSOURI</td>
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<td>Platte Valley Industrial Center, Building #11</td>
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1.0 Documentation References

This manual covers the description of the design and function of the DB-60 and DB-60L Control Valves.

AAR Standard S-4016
Instruction Manual “AB” Test Rack Code of Tests, DB-60 Control Valve Portions

AAR Standard S-4015
Instruction Manual, Shop Maintenance Brake DB-60 Control Valve Portions

AAR Standard S-4014
Instruction Manual, Repair Track Maintenance, Freight Car Equipment, DB-60 Control Valve

2.0 General Features

2.1 Compliance

The DB-60 and DB-60L Control Valves (Figure 1) are the main components of the Freight Car Brake Equipment (Figure 2). The DB-60 and DB-60L Control Valves are both approved by the AAR and meet all corresponding specifications of the Manual of Standards and Recommended Practices, in particular:

- Specification for Approval of Freight Car Air Brake Control Valve in Interchange Service, Standard S-462.
Figure 2: Piping Diagram of Basic DB-60 Type Single Capacity Freight Brake Equipment
Figure 3: Outline Views of the DB-60 Control Valve
2.2 Installation

The installation of the DB-60 and DB-60L Control Valves is to be made in accordance with installation drawings (Figures 3 and 4) as well as in compliance with AAR Specification No. 2518, Standard S-400.

The DB-60 Control Valve is interchangeable as a complete unit or on a portion-per-portion basis with all control valves presently approved by the AAR.

The DB-60L is interchangeable on long cars as a complete unit or on a portion-per-portion basis on long car pipe brackets presently approved by the AAR.

Note in particular that installation clearance required for the DB-60 and DB-60L Control Valve portions is within those required for any other currently approved control valve portions.

For proper port identification, see Figures 5 and 6.

2.3 Maintenance

The DB-60 and DB-60L Control Valves require no special maintenance during cleaning intervals.

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Figure 5: Port Identification Valve Portions
Figure 6: Port Identification Pipe Bracket

1  Brake Pipe Pressure
1A Brake Pipe Pressure (to Vent Valve)
2  Emergency Reservoir Pressure
3  Brake Cylinder Pressure
3A Brake Cylinder Pressure (to Inshot Valve)
4  Quick Action Chamber Pressure
5  Auxiliary Reservoir Pressure
6  Exhaust (Retainer)
2.4 Technical Data

- Operating pressure

The DB-60 Control Valve operates with standard brake pipe pressures commonly used in AAR interchange service.

- Weight

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<tr>
<td>DB-30 Pipe Bracket</td>
<td>52.8 lbs. (23.9 kg.)</td>
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<tr>
<td>DB-10 Service Portion</td>
<td>62.4 lbs. (28.3 kg.)</td>
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<tr>
<td>DB-20 Emergency Portion</td>
<td>52.3 lbs. (23.7 kg.)</td>
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<td>DB-20L Emergency Portion</td>
<td>52.3 lbs. (23.7 kg.)</td>
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The modern design is reflected in the exclusive utilization of softseated poppet valves, textile reinforced diaphragms, and rubber seating rings for the control of the flow of compressed air. One of the unique features of the DB-60 and DB-60L Control Valves is the use of K Rings in larger diameter pistons. This design, which is an exclusive KNORR development, features low friction, easy installation, and automatic wear composition. Thus, by design, the DB-60 and DB-60L Control Valves are free of any leakage.

New York Air Brake's and KNORR's background of experience with similar equipment assures positive sealing of all corresponding parts. The Test Codes for the DB-60 and DB-60L Control Valves therefore does not allow leakage.

The design advantages are apparent:

2. Less "AB" rack testing time, as leakage test section is shortened.
3. Simplified AB rack testing procedure allowing positively clear decision on test result.
4. Energy saving, as no air is wasted through design deficiencies.

Since the DB-60 Control Valve does not utilize slide or "spool" valve components with varying friction conditions, operation is reliable and consistent over long service periods.

3.0 Design Features (General)

The DB-60 and DB-60L Control Valve design is modern, simple and durable. The DB-60 Control Valve (Figure 7) consists of the following:

- DB-10 Service Portion
- DB-20 Emergency Portion
- DB-30 Pipe Bracket

The DB-60L Control Valve (Figure 8) consists of the following:

- DB-10 Service Portion
- DB-20L Emergency Portion
- DB-30L Pipe Bracket

Portions can easily be applied to and removed from the pipe bracket since the 5/8" standard hex nuts which are used for fastening the portions are openly accessible to socket wrenches used with power tools.

All functions of the control valve portions are performed in a manner which permits interchange on a portion-per-portion basis with all control valves presently approved by the AAR.

The DB-30L Pipe Bracket has one stud longer than the others to accommodate the DB-20L Emergency Portion and thus prevent applying a DB-20 Emergency Portion.

The DB-60 Control Valve (Figure 7) consists of the following:

- DB-10 Service Portion
- DB-20 Emergency Portion
- DB-30 Pipe Bracket

Only one size hex bolt - 3/8" - is used for all control valve covers, including the release valve. All bolts are openly accessible to 9/16" socket wrenches applied to power tools.

Corresponding parts can be freely mixed between like portions and need not be paired. Only elastomer parts and some accessory parts, such as filters, must be replaced during overhaul. No gauging of parts is required; thus, no specially trained personnel are required to perform maintenance of the valve except for testing.

Durability in design is characterized by the use of rigid gray cast iron for body and covers of the valve, featuring mechanical and chemical strength and superior corrosion resistance. All springs are made of stainless steel to eliminate corrosion problems. Stainless steel and brass interior parts will not suffer from corrosion and do not require lubrication during extended service periods. Soft-seated poppet valves feature low compression resulting in limited and controlled permanent set. Note that small "vital" chokes are protected with filter elements to provide long, reliable performance.
Figure 7: **DB-60 Control Valve**

Figure 8: **DB60L Control Valve**
3.1 **DB-30 and DB-30L Pipe Bracket**  
*Figure 9*

The pipe bracket contains:

- a high capacity pleated paper strainer to filter brake pipe air from the combined dirt collector and cut-out cock before the air flows to the control valve portions;

- wire type strainers in the auxiliary reservoir and emergency reservoirs to protect the control valve portions against dirt and foreign matter from the combined reservoir and the associated piping.

**NOTE:** Position numbers shown in Figures 10, 11 and 12 are also used in the nomenclature in Section 5, "Operation of the DB-60 Control Valve."

The service portion consists of the Service Portion Basic Valve *(Figures 10 and 11)* and the attached Release Valve *(Figure 12).*

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**Figure 9:** *DB-30 and DB-30L Pipe Bracket*
Figure 10: Service Portion Basic Valve (Assembly View)
Figure 11: Service Portion Basic Valve (Assembly View)
Figure 12: Release Valve (Assembly View)
3.3 **DB-20 Emergency Portion (Figures 13 and 14)**

**NOTE:** Position numbers shown in Figures 13 and 14 are also used in the nomenclature in Section 5, "Operation of the DB-60 Control Valve."

Figure 13: **Emergency Portion (Assembly View)**
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Figure 14: Emergency Portion (Assembly View)

4.0 Performance Features

4.1 DB-30 and DB-30L Pipe Bracket

The pipe bracket supports and aligns both service and emergency portions and supplies air to the valvular components. The precontrolled flow of air to and from the brake pipe, brake cylinder, combined auxiliary, emergency reservoir and retaining valve is also directed through the pipe bracket to which all connections are made, with butt or socket welded flange fittings.

The DB-30L Pipe Bracket has one stud longer than the others to accommodate the DB-20L Emergency Portion and thus prevent applying a DB-20 Emergency Portion.

4.2 DB-10 Service Portion

The specific functions of the service portion are:

1. a) to supply air to the combined reservoir during initial charging of the system and recharging following release of an application,
b) to direct auxiliary reservoir air into the brake cylinder depending on a predetermined rate and amount of brake pipe pressure reduction,

c) to exhaust brake cylinder air during release after an application,

d) to guarantee stability of the brake system in release condition against undesired application of the brakes which may result from permissible brake system leakage,

e) to guarantee stability of the brake system in service lap condition against undesired release of the brakes which may result from permissible auxiliary reservoir leakage;

2. to support recharge of the brake system during the release of a service application by feeding emergency reservoir air into the brake pipe independent from the main piston system;

3. to guarantee minimum reduction during initial brake pipe reduction and maintain minimum brake cylinder pressure by connecting quick service chamber and brake cylinder pressures;

4. to support initial brake pipe reduction by venting brake pipe air to the atmosphere during the preliminary quick service stage;

5. a) to support recharge of the brake system after manual release subsequent to an emergency application by connecting the pressure of the auxiliary reservoir to the brake pipe,

b) to permit exhaust of retainer held brake cylinder pressure in the retainer pipe and volumes during manual release subsequent to a service reduction;

6. a) to directly release brake cylinder pressure independent of the main piston system after any application by manual activation of the release handle,

b) to provide manual drain means for auxiliary reservoir and emergency reservoir pressures,

c) to release the main piston system after a service application by manual activation of release handle.

In order to perform these functions, the service portion is equipped with the following subcomponents (See Plate 1):

1. **Service Main Piston System (1)**

   The service main Piston compares brake pipe and auxiliary reservoir pressures acting on equal areas.

   Auxiliary reservoir charging, emergency reservoir charging and balancing valves are spaced uniformly at 120° intervals around the same diameter and are mechanically operated by the bottom side of the piston.

   The coaxially arranged balancing piston is pressurized with auxiliary reservoir air by the balancing valve and acts on the balancing spring which stabilizes the main piston system in service lap position.

   The main piston operates the quick service inlet valve, which allows brake pipe air to flow to the quick service chamber (OS-Ch.). The auxiliary reservoir/brake cylinder inlet and brake cylinder/retainer outlet valves are also mechanically operated by the main piston.

   Stability of the main piston system in the release position is provided by means of the sensitivity and stability chokes; stability in the service lap positions is provided by means of the stability choke.

   A separate emergency reservoir charging check valve/choke arrangement prevents uncontrolled return flow of emergency reservoir air into the auxiliary reservoir when releasing the brakes from a service application. Thus, no undesired reapplication of the brakes will occur during release.

2. **Service Accelerated Release Valve (2)**

   The service accelerated release valve's metal reinforced rubber diaphragm also compares brake pipe and auxiliary reservoir pressures acting on equal areas; this component operates independently of the service main piston system. When the service accelerated release valve is triggered, emergency reservoir air passes by the high sensitivity back flow check valve into the brake pipe.

3. **Quick Service Limiting Valve (3)**

   The quick service limiting valve's metal reinforced rubber diaphragm is pressurized by brake cylinder air and allows restricted flow of brake pipe/quick service air to the brake cylinder to a predetermined value. The quick service limiting check valve prevents return flow of brake cylinder air to atmosphere during emergency applications and in the event of a retainer being set in "high pressure retaining" position with the service main piston system in the release position.

4. **Emergency Release Auxiliary Reservoir Reduction Valve (4)**

   The emergency release auxiliary reservoir reduction valve's metal reinforced rubber diaphragm is pressurized by brake pipe and brake cylinder air in opposite sides. After manual release of brake cylinder pressure subsequent to an emergency application, increasing brake pipe pressure during recharging operates the valve and allows auxiliary reservoir air to flow via the emergency release auxiliary reservoir reduction check valve into the brake pipe and assists during brake pipe recharging.
The retaining check valve, by means of a choke, allows reduction of retainer held brake cylinder air to a pressure level which allows the brake cylinder piston to move to release position.

5. Quick Service Valve (5)

The quick service valve piston is pressurized by auxiliary reservoir air on one side and controls the flow of quick service air to atmosphere. As soon as the service main piston system allows the balancing valve to pressurize the larger opposite area of the quick service valve piston with auxiliary reservoir air, the venting of quick service/brake pipe air will be interrupted.

6. Release Valve (6)

The release valve piston is pressurized on both sides with brake cylinder air and seals the connection from brake cylinder to atmosphere.

Upon activation of the release valve handle, the upper side of the piston is vented through the release exhaust valve which allows the piston to open the passage from brake cylinder to atmosphere. The piston remains in this position until brake cylinder lockup pressure below the piston is released by the service main piston system upon its release. Auxiliary reservoir exhaust and emergency reservoir exhaust valves are mechanically operated by the release valve lifter and allow high capacity flow of auxiliary reservoir/emergency reservoir air to the atmosphere in order to drain the brake system.

4.3 DB-20 and DB-20L Emergency Portion

This pamphlet applies to both the DB-20 and DB-20L Emergency Portion operation. While there are subtle differences between the two portions, to affect the strength of the service brake pipe venting function, both portions operate in the same manner with small changes to orifice size and covers.

The specific functions of the emergency portion are:

1. to stabilize the brake system against an emergency application during a service application by controlling the rate of reduction of the quick action pressure,

2. to support recharge of the brake system during release of an emergency application by connecting auxiliary and brake cylinder pressures to the brake pipe depending on a predetermined rate and amount of brake pipe pressure increase;

3. to increase the rate of brake pipe reduction during service application by venting a predetermined amount of brake pipe air to the atmosphere;

4. to time a two-stage brake cylinder pressure build-up during an emergency application;

5. a) to rapidly vent brake pipe air to the atmosphere during an emergency application by connecting the brake pipe directly to the atmosphere, via a separate vent port, which remains open until quick action pressure blow-down has ceased,

b) to increase brake cylinder pressure during an emergency application by connecting the emergency reservoir to the brake cylinder until quick action pressure blow-down has ceased,

c) to protect the brake system against premature release after an emergency application by means of a quick action pressure blow-down choke to time the reset feature of the brake system after an emergency application.

In order to perform these functions, the emergency portion is equipped with the following subcomponents (See Plate 1.):

1. Emergency Main Piston System (7)

The emergency main piston compares brake pipe and quick action pressures acting on equal areas.

The piston is designed to mechanically operate the quick action pressure discharging valve in order to stabilize the system against an emergency application during a service application.

A lost motion arrangement provides piston travel to independently operate the accelerated application sensor valve located on the upper side of the piston.

2. Emergency Accelerated Release Valve (8)

The emergency accelerated release valve's metal reinforced rubber diaphragm is pressurized by brake pipe and quick action pressures on opposite sides. Independently of the emergency main piston system, it allows brake cylinder and auxiliary reservoir air to assist the brake pipe pressure build-up during recharging following an emergency application.

The emergency accelerated release check valve prevents return flow of brake pipe air into the brake cylinder during (initial) charging of the system.

3. Accelerated Application Valve (9)

The metal reinforced rubber diaphragms of the brake pipe discharging valve and the pulsating valve are pressurized on one side by quick action air supplied by the accelerated application sensor valve.

A choke provides the stability margin of the valve by permanently bleeding quick action air to atmosphere.
Quick action pressure build-up at the brake pipe discharging valve opens the valve seat at a predetermined value and allows brake pipe air to flow to the pulsating valve and further on to atmosphere.

4. Inshot Valve (10)

The inshot valve piston is pressurized by brake cylinder air on both sides during service applications.

Upon an emergency application, the piston switches to its lefthand stop (restricted brake cylinder flow position) to time a two-stage pressure build-up.

5. High Pressure/Vent Valve (11)

The vent valve piston on different areas compares quick action chamber pressure and quick action pressure controlled by the emergency main piston system.

Upon emergency applications, the emergency main piston system creates a pressure differential between quick action chamber air and controlled quick action air to allow the vent valve to open against its spring forces.

The mechanically coupled high pressure valve switches to open the emergency reservoir/brake cylinder connection and increases the final brake cylinder pressure.

Quick action pressure blow-down choke prohibits premature charging of brake pipe by holding the vent valve in the open position for a predetermined time.

5.0 Operation of the DB-60 and DB-60L Control Valves

5.1 DB-60 and DB0-60L Control Valves Subcomponents

--- Plate 1 ---

The DB-60 and DB0-60L Control Valves are shown in unpressurized condition; all subcomponents are designated and numbered for reference throughout the instruction manual.

5.2 Charging Lap Position

--- Plate 2 ---

Compressed air from the brake pipe flows into the pipe bracket via the combined dirt collector and cut-out cock. One flow path leads through the pipe bracket strainer into the service and emergency portions to supply those with filtered air. The other flow path bypasses the pipe bracket strainer and leads to the ventil valve in the emergency portion to allow unrestricted venting of brake pipe air during an emergency application. During charging, brake pipe air pressurizes the following valve components:

Service Portion/Service Main Piston System (1)

Brake pipe air pressurizes main piston 1.46, the valve seat area V1.3, and flows to the service accelerated release valve (2) and the emergency release auxiliary reservoir reduction valve (4).

The auxiliary reservoir is charged directly by the service main piston system. From the brake pipe, the air flows via choke C1.6 and the open valve seat V1.8 to the volume below main piston 1.46, pressurizing the upper side of balancing piston 1.59. Auxiliary reservoir air further flows to the AR/BC inlet valve 1.38.1, to the service accelerated release valve (2), to the release valve (6), to the valve seat V1.9 in the balancing valve, to the quick service valve (5) and the auxiliary reservoir via the pipe bracket. Additional auxiliary reservoir charging is accomplished by air flow via stability choke C1.3.

If, during charging, the pressure differential created by chokes C1.6 and C1.3 across the main piston exceeds a predetermined value, main piston 1.46 moves into retarded recharge position (See Plate 8.) and returns to charging lap position when brake pipe and auxiliary reservoir pressures approach equalization.

The emergency reservoir is charged from auxiliary reservoir air via open valve seat V1.8. The auxiliary reservoir air in the volume below the main piston 1.46 flows via the open valve seat V1.5 in the emergency reservoir charging check valve 1.62 to the service accelerated release valve (2), to the release valve (6), to the emergency portion and via the pipe bracket into the emergency reservoir.

Service Portion/Service Accelerated Release Valve (2)

The left side of diaphragm 2.83 is pressurized with brake pipe air, the right side with auxiliary reservoir air. Emergency reservoir air flows to closed valve seat V2.2 via back flow check valve 2.89.

Service Portion/Emergency Release Auxiliary Reservoir Reduction Valve (4)

The left side of diaphragm 4.74 is pressurized with brake pipe air. The diaphragm is thereby forced on its righthand stop against the force of spring 4.90. Simultaneously, the emergency release auxiliary reservoir reduction check valve is forced on valve seat V4.1 by the combined forces of spring 4.91 and brake pipe pressure.
Service Portion/Quick Service Valve (5)

Auxiliary reservoir air in the volume below main piston 1.46 also pressurizes the upper area of piston 5.104. The piston is thereby forced downward and opens valve seat V5.1 against the force of spring 5.108.

Service Portion/Release Valve (6)

Auxiliary reservoir air pressurizes auxiliary reservoir exhaust valve 6.32.1. Emergency reservoir air pressurizes emergency reservoir exhaust valve 6.32.2.

Emergency Portion/Emergency Main Piston System (7)

Brake pipe air pressurizes main piston 7.34 on its upper side and valve stem 7.24 of the accelerated application sensor valve 7.28 on its lower side. Brake pipe air also flows to the emergency accelerated release valve (8) and to the accelerated application valve (9). Valve seat V7.3 is closed by spring force acting on the quick action pressure discharging valve 7.10.

Quick action chamber charging choke C7.1 allows flow of air to the quick action volume below main piston 7.34, the quick action chamber in the pipe bracket, to the emergency accelerated release valve (8) and to the high pressure/vent valve (11). The accelerated application sensor valve 7.28 seals its corresponding valve seat by quick action pressure and the aid of spring 7.29.

Emergency Portion/Emergency Accelerated Release Valve (8)

Diaphragm 8.40 is pressurized with brake pipe air on its left side and allows air to flow to the seated emergency accelerated release check valve 8.74. With the pressure differential brake pipe/quick action across diaphragm 8.40 becoming smaller, spring 8.39 forces the diaphragm on its seat.

Emergency Portion/Accelerated Application Valve (9)

Brake pipe air pressurizes the diaphragm area of valve seat V9.1 after charging the volume of the brake pipe discharging valve through choke C9.1; however, diaphragm 9.40 seals valve seat V9.1 permanently by spring force 9.51.

Emergency Portion/High Pressure/Vent Valve (11)

Brake pipe air pressurizes the vent valve piston 11.72 on its right side and assists spring 11.61 in sealing valve seat V1 1. 1. Quick Action air pressurizes both sides of vent valve piston 11.72 on different areas. Springs 11.61, 11.63 and 11.84 are balanced to force high pressure valve seat 11.10 on its valve seat by means of valve guide 11.57 and valve stem 11.56. Thus, emergency reservoir air is isolated from the brake cylinder air flow path.

In fully charged condition, brake pipe, quick action, auxiliary reservoir and emergency reservoir pressures are equalized on the desired brake pipe level. All subcomponent valves have assumed stable charging lap positions and have reached equilibrium of forces.

5.3 Preliminary Quick Service

--- Plate 3 ---

When an application of the brakes is initiated by a brake pipe reduction at a minimum predetermined rate, the following sequence during "Preliminary Quick Service" is established:

Service Portion/Service Main Piston System (1) and Quick Service Valve (5)

During this brake pipe reduction, chokes C1.6 and C1.3 prevent auxiliary reservoir pressure reduction at the same rate as brake pipe pressure.

The pressure difference building up across the main piston 1.46 moves the piston upward and opens the quick service inlet valve seat V1.3 at a value primarily defined by the spring 1.43. Brake pipe air flows to quick service chamber (QS-Ch.) via the restricted cross section between the upper end of the stem of main piston 1.46 and the free flow area of valve seat V1.3, further on to the atmosphere via open valve seat V5.1 and choke C5.1 of the quick service valve. This increases the pressure differential and accelerates the upward movement of the service main piston system. After the main piston 1.46 has lifted the quick service inlet valve 1.38.2, the quick service pressure moves the service main piston stem 1.41 upward in relation to the spring guide 1.44, so that the passage from brake cylinder to retainer via valve seat V1.2 is closed. The valve seat V1.1 is still closed at this time. The charging connections from brake pipe to auxiliary reservoir via valve seat V1.8, and from auxiliary reservoir to emergency reservoir via valve seat V1.6 are closed. Following this, valve seat V1.10 closes and valve seat V1.9 of the balancing valve opens, pressurizing the balancing piston 1.59 and the piston 5.104 of the quick service valve with auxiliary reservoir air. The piston 1.59 moves upward against the spring guide 1.67 and introduces a force into the service main piston system.

Emergency Portion/Emergency Main Piston System (7)

The reduction of brake pipe pressure causes the main piston 7.34 to unbalance. As soon as the quick action pressure cannot follow the brake pipe pressure reduction at the same rate via choke C7.1, the quick action

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pressure moves the main piston 7.34 upward, and opens valve seat V7.1 of the accelerated application sensor valve 7.28 by means of valve stem 7.24. Quick action air flows via choke C7.3 to the accelerated application valve (9) and through further restrictions to atmosphere. As the maximum rate of quick action pressure reduction is therefore limited, additional pressure reduction is necessary in order to obtain stability at the emergency main piston system, valve seat V7.3 of the quick action pressure discharging valve 7.10 opens after piston 7.34 has passed the lost motion travel stem 7.13 and after spring 7.15 engages its stop. The quick action pressure discharging valve 7.10 is opened by spring 7.8 in such a way that the difference between brake pipe and quick action pressure does not surpass a predetermined level as quick action air passes to atmosphere through the open valve seats V7.2 and V7.3 and through choke C7.2.

**Emergency Portion/Accelerated Application Valve (9)**

As far as the sequential operation of the accelerated application valve is concerned, refer to Plate 5, "Accelerated Application."

### 5.4 Service Application --- Plate 4 ---

The control valve moves from "Preliminary Quick Service" to "Service" position once the initial quick service activity has ceased.

**Service Portion/Service Main Piston System (1)**

Upon pressurization with auxiliary reservoir air, piston 5.104 of the quick service valve has moved upward, allowing check valve 5.32 to seal valve seat V5.1 under the force of spring 5.108. Thus, the quick service chamber is isolated from atmosphere but remains connected to brake pipe via valve seat V1.3. The main piston 1.46, the quick service inlet valve 1.38.2 and the spring guide 1.44 move further upward until the quick service inlet valve 1.38.2 applies force to the service main piston stem 1.41. This results in lifting the auxiliary reservoir/brake cylinder inlet valve 1.38.1, which is forced by spring 1.37 onto the service main piston stem 1.41, from the valve seat V1.1 and opens a flow path from auxiliary reservoir to brake cylinder. Brake cylinder air flows through the quick service limiting valve (3) to the area of the valve seat V4.1 of the emergency release auxiliary reservoir reduction valve (4) and through the release valve (6) to the right side of the emergency release auxiliary reservoir reduction valve (4) and the retaining check valve 4.32; further on to the emergency portion and via the pipe bracket to the brake cylinder.

The valve stem 1.50 of the balancing valve follows the main piston 1.46 by the force of spring 1.53 to its stop. The balancing piston 1.59 moves to its upper stop under the force of auxiliary reservoir pressure.

**Service Portion/Quick Service Limiting Valve (3)**

Brake cylinder air pressurizes the left side of diaphragm 3.74 and moves it against the force of spring 3.76 to its right. As soon as the brake cylinder pressure has reached a predetermined value, diaphragm 3.74 rests against spring guide 3.75.

This results in closing valve seat V3.2 with check valve 3.12.1 by the force of the spring 3.79, and interrupts the flow between quick service chamber and brake cylinder. Quick service limiting check valve 3.12.2 closes the valve seat V3.1 by spring force 3.79 and prevailing pressure.

**Service Portion/Emergency Release Auxiliary Reservoir Reduction Valve (4)**

Brake cylinder pressure acts on the righthand side of diaphragm 4.74 in the emergency release auxiliary reservoir reduction valve, which moves toward the left under assistance of the force of spring 4.90, against the prevailing brake pipe pressure, forcing the emergency release auxiliary reservoir reduction check valve 4.38 further on the valve seat V4.1 via spring guide 4.86.

**Service Portion/Release Valve (6)**

Brake cylinder air entering the release valve flows via choke C6.3 to the bottom side of piston 6.17, and via choke C6.2 and open valve seat V6.3 to the upper side of piston 6.17. The valve seat V6.2 is closed, the passage for brake cylinder air flow via valve seat V6.1 is open.

**Emergency Portion/Emergency Main Piston System (7)**

During a service application, the emergency main piston system remains in a "stabilizing position," i.e. venting quick action pressure as described in Plate 3.

**Emergency Portion/Emergency Accelerated Release Valve (8)**

The brake cylinder pressure passes from the service portion through the pipe bracket and the open inshot valve (10) to the emergency accelerated release check valve 8.74, which remains in its closed position because of spring force and pressure action on its left side.

**Emergency Portion/Inshot Valve (10) and High Pressure/Vent Valve (11)**

Brake cylinder pressure from the service portion passes through the pipe bracket to the high pressure/vent valve. Air flows via valve seat V1.2 and choke C1.02 to the left-hand side of the inshot valve piston.
10.78. Spring 10.79 keeps the piston in its neutral position. Brake cylinder air also flows through the annular section of the open inshoot valve to the righthand side of the piston 10.78 via choke C1.0.1 and through the pipe bracket to the brake cylinder.

5.5 Accelerated Application

--- Plate 5 ---

Emergency Portion/Emergency Main Piston System (7)

During a brake pipe pressure reduction which cannot be performed at the same rate by quick action pressure via choke C7.1, a pressure differential builds up at the main piston 7.34, which opens the accelerated application sensor valve 7.28. This establishes a flow path to reduce the pressure differential by connecting quick action pressure to atmosphere via valve seat V7.1 and chokes C7.3, C9.2 and C9.3.

Further increase of the pressure differential across piston 7.34 provides sufficient quick action air to activate the accelerated application valve (9) as described in the following sequences.

For further reduction of quick action pressure as may be required during a service application, the main piston 7.34 moves further upward and opens the quick action pressure discharging valve 7.10 (as described in Plate 3, "Preliminary Quick Service").

Stage 1

Quick action air passes through choke C7.3 to the annular lefthand side of the brake pipe discharging valve diaphragm 9.40 and to the valve seat area V9.2 of the pulsating valve diaphragm 9.42. Simultaneously, quick action air is vented to atmosphere through chokes C9.2 and C9.3. The valve seat area V9.1 of the brake pipe discharging valve 9.40 is already pressurized by brake pipe air through choke C9.1 in the initial stage. However, springs 9.51 and 9.49 keep the valves closed in this stage.

Stage 2

By suitable sizing of chokes C7.3 and C9.2, pressure increases on the annular lefthand side of the diaphragm 9.40 and in the valve seat area V9.2 of diaphragm 9.42. The brake pipe discharging valve diaphragm 9.40 is opened against the force of spring 9.51 with assistance of the brake pipe pressure acting on the valve seat area V9.1. The sudden pressurization of the total lefthand diaphragm area with the higher brake pipe/quick action "mixed" pressure assures that the diaphragm 9.40 snaps against the righthand stop. This allows the flow of air from the brake pipe via choke C9.1 and the volume to the pulsating valve diaphragm 9.42.

Stage 3

The "mixed" air flow cannot be vented fast enough to atmosphere via chokes C9.2 and C9.3 to prevent a pressure build-up within the valve seat area V9.2. Subsequently, diaphragm 9.42 of the pulsating valve is moved against the force of spring 9.49 and snaps safely to the righthand stop with "mixed" pressure acting on the total diaphragm area. Brake pipe and quick action air flow through choke C9.3 to atmosphere. Valve seat V9.1 of the brake pipe discharging valve remains open during this stage.

Stage 4

Further reduction of the pressure acting on diaphragm 9.42 of the pulsating valve enables spring 9.49 to close the valve seat V9.2.

In the meantime, pressure in the brake pipe volume has been fully reestablished via choke C9.1. As soon as quick action pressure acting on the diaphragm 9.40 has risen to the required level, the brake pipe discharging valve switches and the cycle described above starts anew.

This process is repeated until the accelerated application sensor valve 7.28 no longer provides sufficient quick action air to operate the accelerated application valve (9).

5.6 Service Lap Position

--- Plate 6 ---

Service Portion/Service Main Piston System (1)

During a service brake application, the brake cylinder is charged from the auxiliary reservoir by the service main piston system. As soon as the auxiliary reservoir pressure is reduced to approximately the value of the brake pipe pressure, the service main piston system moves from the service position to the service lap position. Herewith, valve seat V1.1 is closed and the flow path between auxiliary reservoir and brake cylinder is interrupted. The balancing piston 1.59 acts on the balancing spring 1.69 through the spring guide 1.67. This introduces a defined force in the service main piston system, which holds it in the service lap position.

Brake pipe and auxiliary reservoir are connected through the very small stability choke C1.3 which determines the release stability.

During a further brake pipe reduction, the service main piston system will again move the service
position, and the flow path from auxiliary reservoir to brake cylinder will be opened. Subsequently, the same procedure as described above will take place and move the service main piston system back again to service lap position. The reduction of brake pipe pressure and hence the increase in brake cylinder pressure can be continued until the auxiliary reservoir pressure is equal to the brake cylinder pressure. A further reduction of brake pipe pressure does not affect the level of the brake cylinder pressure during a service application, but moves the main piston system to the service position.

**Service Portion/Quick Service Limiting Valve (3)**

The quick service limiting valve assures a predetermined minimum brake cylinder pressure. Should the brake cylinder pressure drop below this value - for example, due to brake cylinder leakage - the quick service limiting valve will open and feed brake pipe pressure via the quick service chamber to brake cylinder. (Refer to Plate 3.)

**Emergency Portion/Emergency Main Piston System (7)**

After reduction of quick action pressure to brake pipe via choke C7.1 to atmosphere via the accelerated application sensor valve 7.28 and the quick action pressure discharging valve 7.10, the balance of forces is reestablished at the main piston 7.34, and all valves are in their neutral position.

**5.7 Release from Service Application --- Plate 7 ---**

To release the brakes, the brake pipe pressure has to be increased by a predetermined margin above the level of the auxiliary reservoir pressure of the individual control valve. The complete release sequence is shown in Plates 7 and 8 and their descriptions.

**Service Portion/Service Main Piston System (1)**

The increase of brake pipe pressure produces a pressure difference at the main piston 1.46. The pneumatic force acts against the mechanical force of the balancing spring 1.69. At a predetermined pressure difference, the main piston 1.46 moves downward and contacts the valve stem 1.50 of the balancing valve. The service main piston stem 1.41 remains in the service lap position under the action of the quick service pressure, while the spring guide 1.44 and the quick service inlet valve 1.38.2 follow the main piston 1.46 by spring force 1.43. The valve seat V1.2 of the BURET outlet valve is still closed during this release stage. Further downward movement of the main piston 1.46 closes valve seat V1.9 and opens valve seat V1.10 through valve stem 1.50. Auxiliary reservoir air under the balancing piston 1.59 and under the piston 5.104 of the, quick service valve (5) starts to vent to atmosphere via choke C1.7. The main piston 1.46 moves further into the release position corresponding to the pressure reduction under the balancing piston 1.59.

**Emergency Portion/Emergency Main Piston System (7)**

The prevailing brake pipe pressure pushes the main piston 7.34 downward against its stop. The quick action chamber is recharged from brake pipe via QA chamber charging choke C7.1 to the brake pipe pressure level.

**5.8 Service Accelerated Release and Retarded Recharge --- Plate 8 ---**

During release of a service application, the service accelerated release valve (2) is activated. It connects the emergency reservoir to the brake pipe, such that the release impulse is locally amplified and passes rapidly through the train.

**Service Portion/Service Main Piston System (1) and Quick Service Valve (5)**

During further downward travel of the service main piston system, the following functions are performed:

The connection between brake cylinder and retainer is opened since the lost motion between spring guide 1.44 and service main piston stem 1.41 has been exceeded by the further travel of the service main piston system to the release position. Brake cylinder pressure is vented through open valve seat V1.2 and via the release choke C1.8 to atmosphere. Subsequently, the charging connections from brake pipe to auxiliary reservoir and from auxiliary reservoir to emergency reservoir are opened by the valve stems 1.95.1 and 1.95.2. Emergency and auxiliary reservoir pressures can only equalize via choke C1.5, thus preventing an undesired brake reapplication caused by a fast increase in auxiliary reservoir pressure under main piston 1.46. After balancing piston 1.59 has moved downward to its stop, the flow path from brake pipe to quick service chamber is safely closed by the quick service inlet valve 1.38.2, which seals on valve seat V1.3.

As soon as the auxiliary reservoir air under piston 5.104 has been vented to atmosphere via choke C1.7, the quick service valve piston 5.104 opens the flow path for quick service chamber air to atmosphere, via valve seat V5.1 and choke C5.1.

As long as the pressure differential between brake pipe and auxiliary reservoir across the main piston 1.46 exceeds the forces of the balancing spring 1.69 and the charging and balancing valve springs, the service main piston system is locked to its lower stop in the retarded recharge position. This allows the valve stem 1.95.1 to seat on the sealing ring 1.100, and charging of auxiliary reservoir is now performed via chokes C1.6 and C1.4. When the pressure difference drops, the service main
piston moves back to the charging lap position (See Plate 2.), and only choke C1.6 determines the further charging time.

**Service Portion/Service Accelerated Release Valve (2)**

When the pressure difference between brake pipe and auxiliary reservoir across the diaphragm 2.83 overcomes the force of the spring 2.87, the emergency reservoir pressure at valve seat V2.2 lifts check valve 2.38, thus establishing a flow path from emergency reservoir to brake pipe via the backflow check valve 2.89 and valve seat V2.1. The diaphragm 2.83 is moved to its righthand stop against the force of spring 2.87. This flow path remains open until brake pipe pressure reduces. Emergency reservoir pressures have nearly equalized. Then, the backflow check valve 2.89 closes the valve seat V2.1. When the pressure difference between brake pipe and auxiliary reservoir pressures have nearly equalized. Then the backflow check valve 2.89 closes the valve seat V2.1. When the pressure difference between brake pipe and auxiliary reservoir pressures have nearly equalized. Then the backflow check valve 2.89 closes the valve seat V2.1. When the pressure difference between brake pipe and auxiliary reservoir pressures have nearly equalized. Then the backflow check valve 2.89 closes the valve seat V2.1.

**Emergency Portion/Emergency Main Piston System (7)**

As long as the difference between brake pipe and quick action pressures across the main piston 7.34 exceeds the balance of the spring forces acting on the emergency main piston system, the main piston remains in its lowermost position; the quick action chamber is charged through QA-chamber charging choke C7.1. When the pressure difference is reduced, the main piston 7.34 moves back to its neutral position. (See Plate 2.)

**5.9 Emergency Application First Stage --- Plate 9 ---**

**Service Portion/Service Main Piston System (1)**

The service main piston system operates during an emergency application in general as described in Plates 3 and 4.

However, deviating from above, the main piston 1.46 is forced against its upper stop by auxiliary reservoir pressure, because brake pipe pressure is completely vented. The stability choke C1.3 is closed by sealing ring 1.99. Auxiliary reservoir and brake pipe are separate. A constant connection between auxiliary reservoir and brake cylinder pressures remains open via valve seat V1.1

**Emergency Portion/Emergency Main Piston System (7)**

A rapid brake pipe pressure reduction disturbs the balance of forces at the main piston 7.34 such that it cannot be reestablished by venting of quick action chamber air to atmosphere.

The difference between brake pipe and quick action pressure, caused by chokes C7.1, C7.2 and C7.3, leads to an emergency application. During the resulting upward movement of the main piston 7.34, the accelerated application sensor valve 7.28 opens first. After passing through the lost motion travel of piston stem 7.13, the valve seat V7.3 at the quick action pressure discharging valve 7.10 opens, too. However, quick action pressure reduction rate through choke C7.2 is insufficient, and the main piston 7.34 moves further upward to its uppermost position. Valve seat V7.2 is closed, thereby separating quick action pressure in the QA-Ch., the volumes under the main piston 7.34 and the lefthand side of the piston 11.72 from a smaller volume of quick action pressure between the valve seat V7.2 and the righthand side of the vent valve piston 11.72. This volume is rapidly vented to atmosphere through the choke C7.2.

**Emergency Portion/High Pressure/Vent Valve (11)**

The resulting sole pressurization of piston 11.72 with quick action pressure on its lefthand side moves piston 11.72 quickly to its righthand stop against the force of spring 11.61 and pressurized valve seat area V11.1. Valve seat V1 1.1 opens and brake pipe air flows rapidly to atmosphere through a large cross-section port. Simultaneously, the quick action chamber is vented through chokes C11.1, C7.1, C7.3, C9.2 and C9.3 in the accelerated application valve (9).

Spring 11.84 forces the high pressure valve 11.10 and the piston stem 11.56 to follow the movement of the vent valve piston 11.72 to the right. This causes valve seat V1 1.3 to open and valve seat V1 1.2 to close. Air from the emergency reservoir can now enter the brake cylinder to produce a higher equalization pressure with the emergency/auxiliary reservoirs and the brake cylinder than that obtained during a full service application.

**Emergency Portion/Inshot Valve (10)**

The brake cylinder pressure, produced in the service portion from auxiliary reservoir air and in the emergency portion from emergency reservoir air flows through the open passage on the righthand end of the inshot valve piston 10.78 to the brake cylinder. By closing valve seat V11.2 of the high pressure valve (11), brake cylinder pressure in the spring chamber on the lefthand side of the inshot valve piston 10.78 cannot occur. The brake cylinder pressure on the righthand side of the piston, therefore, can move the inshot piston 10.78 against the force of spring 10.79 to the left. The previously open passage to the brake cylinder is thus reduced to a gap cross-section at the righthand end of the piston stem.
5.10 Emergency Application
Final Stage
--- Plate 10 ---

Emergency Portion/Emergency Main Piston System (7)

During final venting of the quick action chamber, the main piston 7.34 moves back to its neutral position.

Emergency Portion/High Pressure/Vent Valve (11)

During final venting of the quick action chamber, spring 11.61 moves piston 11.72 toward the left, which closes valve seat V11.1 and thereby interrupts the passage from brake pipe to atmosphere.

High pressure valve 11.10 seals valve seat V11.3 by means of spring force 11.63, valve guide 11.57 and valve stem 11.56 and interrupts the air flow from emergency reservoir to brake cylinder; both pressures, however, are equal and also equalized with auxiliary reservoir pressure through the open auxiliary reservoir/brake cylinder inlet valve in the service main piston system (1).

Emergency Portion/inshot Valve (10)

After reset of the vent valve piston 11.72 and the high pressure valve 11.10, brake cylinder pressures on both sides of the inshot piston 10.78 are equalized via choke C 10.2, which allows the piston to move back to its neutral position under the force of spring 10.79.

5.11 Release from Emergency
--- Plate 11 ---

Release Valve not operated Emergency Portion/Emergency Accelerated Release Valve (8)

Dependent on a previous release valve operation, two subcomponents in the control valve assist a fast recharging of the brake pipe after an emergency application.

Release Valve not operated Emergency Portion/Emergency Accelerated Release Valve (8)

Recharging of the brake pipe subsequent to an emergency application causes quick action pressure to rise via quick action chamber charging choke C7.1. At a predetermined difference between brake pipe and quick action pressures across the emergency main piston 7.34, it moves to its lowermost position. The diaphragm 8.40 in the emergency accelerated release valve moves to its righthand stop when the pressure difference across diaphragm 8.40 overcomes spring force 8.39 and opens valve seat V8.1. Brake cylinder and auxiliary reservoir air flow into the brake pipe through the open valve seat V8.2 of the emergency accelerated release check valve 8.74. Spring 8.76 prevents full equalization of auxiliary reservoir/brake cylinder and brake pipe pressures.

With decreasing difference of brake pipe and quick action pressure, the emergency accelerated release valve closes.

Further increase of brake pipe pressure also activates the service accelerated release valve (2) in the service portion, which connects the emergency reservoir to the brake pipe. The flow of emergency reservoir air into the brake pipe also supports the recharge of the brake system subsequent to an emergency application. Brake cylinder pressure in the control valve portions and the brake cylinder is released to atmosphere once the service main piston system (1) has moved to release position. (See Plate 8.)

Release Valve operated Service Portion/Emergency Release Auxiliary Reservoir Reduction Valve (4)

Subsequent to an emergency application, brake cylinder pressure is vented by activation of the release valve (6) as described under Plate 13, "Manual Release after Emergency Application."

During recharging of the brake pipe, the following functional sequence is established:

Brake pipe air pressurizes the left side of diaphragm 4.74 while the right side is connected to atmosphere through the open valve seat V6.2 in the release valve. At a predetermined brake pipe pressure, the force of spring 4.90 is compensated and diaphragm 4.74 is forced against its righthand stop.

Emergency release auxiliary reservoir reduction check valve 4.38 is lifted from its valve seat V4.1 by auxiliary reservoir pressure. Through this connection, auxiliary reservoir and brake pipe pressure equalize; only a small pressure differential - caused by the spring 4.91 - is maintained.

Further increase of brake pipe pressure also activates the service accelerated release valve (2) in the service portion, which connects the emergency reservoir to the brake pipe. The flow of emergency reservoir air into the brake pipe also supports the recharge of the brake system subsequent to an emergency application.

The increase of the brake pipe pressure will cause the service main piston system to move to release position, thereby venting the lock-up pressure acting on the lower side of piston 6.17 in the release valve (6). Spring 6.20 moves piston 6.17 to its lowermost position, thus reestablishing the connection to the brake cylinder via valve seat V6.1 and closing valve seat V6.2.
5.12 Manual Release after Service Application
--- Plate 12 ---

Service Portion/Release Valve (6)

After a service application, the service main piston system (1) has stabilized in service lap position as described in Plate 6.

A short pull at the release valve handle 6.1 to its fullest extent against the force of spring 6.6 will establish the following functional sequence:

Release valve lifter 6.9 and the exhaust valve stems 6.27.1, 6.10 and 6.27.2 are moved upward.

The auxiliary reservoir exhaust valve 6.32.1 opens and auxiliary reservoir air is vented to atmosphere through valve seat V6.5. This will cause the service main piston system (1) to move to release position and will also trigger the service accelerated release valve (2).

The release exhaust valve 6.12 is lifted off its seat V6.4 and subsequently valve seat V6.3 is closed. Brake cylinder air pressurizing the upper side of position 6.17 is vented to atmosphere via open valve seat V6.4 and choke C6.1. Piston 6.17 moves upward, as soon as the pressure difference across the piston overcomes the force of spring 6.20. Valve seat V6.2 is opened, valve seat V6.1 is closed and brake cylinder pressure is rapidly vented.

The emergency reservoir exhaust valve 6.32.2 opens and emergency reservoir air is vented to atmosphere through valve seat V6.6.

When the release valve handle 6.1 is released, venting of auxiliary and emergency reservoir air through exhaust valves 6.32.1 and 6.32.2 is terminated. Release exhaust valve stem 6.10 returns to its neutral position and the release exhaust valve opens valve seat V6.3 and closes valve seat V6.4.

Herewith, the upper side of piston 6.17 is again connected to the brake cylinder line; as the main piston system has already moved to release position, the lower side of piston 6.17 is connected to atmosphere. This causes piston 6.17 to move downward by the aid of spring 6.20, thereby opening valve seat V6.1 and closing valve seat V6.2.

5.13 Manual Release after Emergency Application
--- Plate 13 ---

Service Portion/Release Valve (6)

After an emergency application, the service main piston system (1) has stabilized in emergency position. (See Plate 10.)

A short pull at the release valve handle 6.1 to its fullest extent against the force of spring 6.6 will establish the same functional sequence as described under Plate 12, "Manual Release after Service Application," with the following exception:

The release of auxiliary reservoir air via the open valve seat V6.5 of the auxiliary reservoir exhaust valve 6.32.1 by permanently pulling the release valve handle 6.1. At an auxiliary reservoir pressure which allows the service main piston system (1) to move to release position by the forces of its springs, air from the lower side of piston 6.17 flows via choke C6.3 and the now open brake cylinder release passage to atmosphere, thus allowing spring 6.20 to move the piston 6.17 to its lowermost position.

Release of Reservoir Air

In order to drain the auxiliary reservoir, it is necessary to pull the release valve handle 6.1 far enough to open the auxiliary reservoir exhaust valve 6.32.1.

In order to drain the auxiliary and emergency reservoirs, it is necessary to pull the release valve handle 6.1 through the full travel to open the auxiliary and emergency reservoir exhaust valves 6.32.1 and 6.32.2.

a) initiation of a regular "Release from Emergency" (See description of Plate 11, "Release Valve Operated.");

b) continuous venting of auxiliary reservoir air via the open valve seat V6.5 of the auxiliary reservoir exhaust valve 6.32.1 by permanently pulling the release valve handle 6.1. At an auxiliary reservoir pressure which allows the service main piston system (1) to move to release position by the forces of its springs, air from the lower side of piston 6.17 flows via choke C6.3 and the now open brake cylinder release passage to atmosphere, thus allowing spring 6.20 to move the piston 6.17 to its lowermost position.
6.0 List of Diagrammatic Views of the DB-60 and DB-60L Control Valve

Plate 1 ...............DB-60 Control Valve Subcomponents (shown unpressurized)
Plate 2 ...............Charging Lap Position
Plate 3 ...............Preliminary Quick Service
Plate 4 ...............Service Application
Plate 5 ...............Accelerated Application
Plate 6 ...............Service Lap Position
Plate 7 ...............Release from Service Application
Plate 8 ...............Service Accelerated Release and Retarded Recharge
Plate 9 ...............Emergency Application, First Stage
Plate 10 ............Emergency Application, Final Stage
Plate 11 ............Release from Emergency
  - Emergency Accelerated Release Valve
    (Release Valve operated)
  - Emergency Release Auxiliary Reservoir Reduction Valve (Release Valve operated)
Plate 12 ............Manual Release after Service Application
Plate 13 ............Manual Release after Emergency Application

Color Guide

Orange ............ Brake Pipe (BP)
Yellow ............ Auxiliary Reservoir (AR)
Red ............ Emergency Reservoir (ER)
Pink ............ Brake Cylinder (BC)
Blue ............ Quick Action (QA)
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