Bendix® M-30™ AntiLock Modulator Assembly

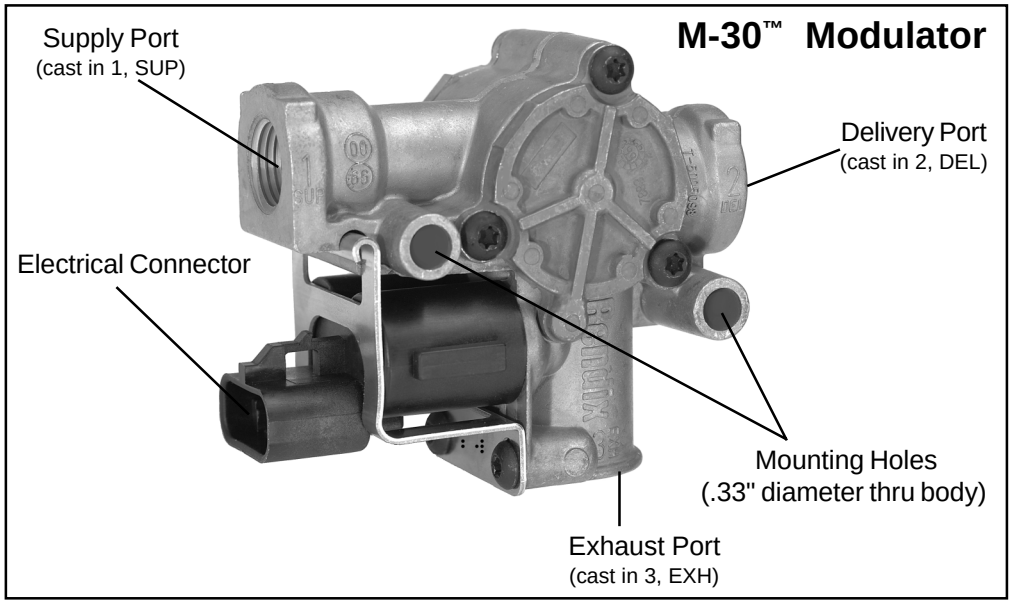

FIGURE 1: ***M-30™ MODULATOR***

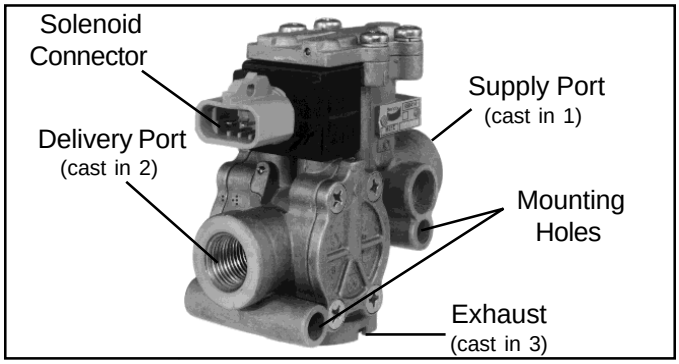

FIGURE 2: ***M-21™ MODULATOR***

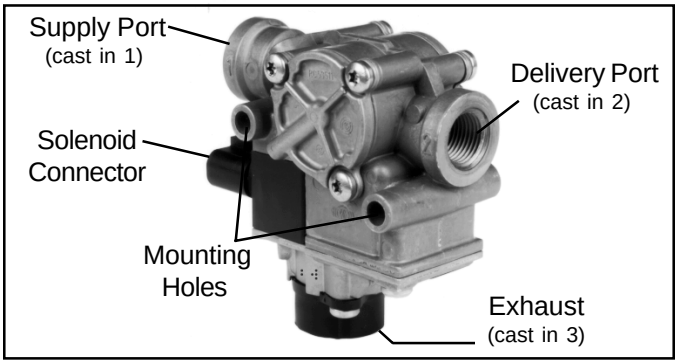

FIGURE 3: ***M-22™ MODULATOR***

DESCRIPTION

The Bendix® M-30™ modulator replaced both the M-21™ (Figure 2) and M-22™ (Figure 3) modulators in all applications.

The M-30™ antilock system modulator (Figure 1) is a high capacity, on/off air valve that incorporates a pair of electrical solenoids for control. The solenoids provide the electro-pneumatic interface between the antilock controller electronics and the air brake system. The modulator is used to control the braking function on individual or dual service actuators during antilock activity. When used to control both service chambers on an axle or two chambers on the same side of a tandem axle, the modulator is sometimes mounted ahead of a quick release valve, which provides quick exhaust of service applications during normal braking (Figure 4). In the case of individual wheel control applications, the modulator is always the last control valve through which air passes on its way to the service brake actuator.

The modulator consists of a die cast aluminum body and a solenoid assembly which contains one normally open solenoid, one normally closed solenoid, and an inlet and exhaust diaphragm valve. A three pin, weather resistant electrical connector is an integral part of the modulator solenoid assembly and serves to carry control commands from the antilock controller to the modulator. Two mounting holes are provided for frame or cross member mounting of the valve.

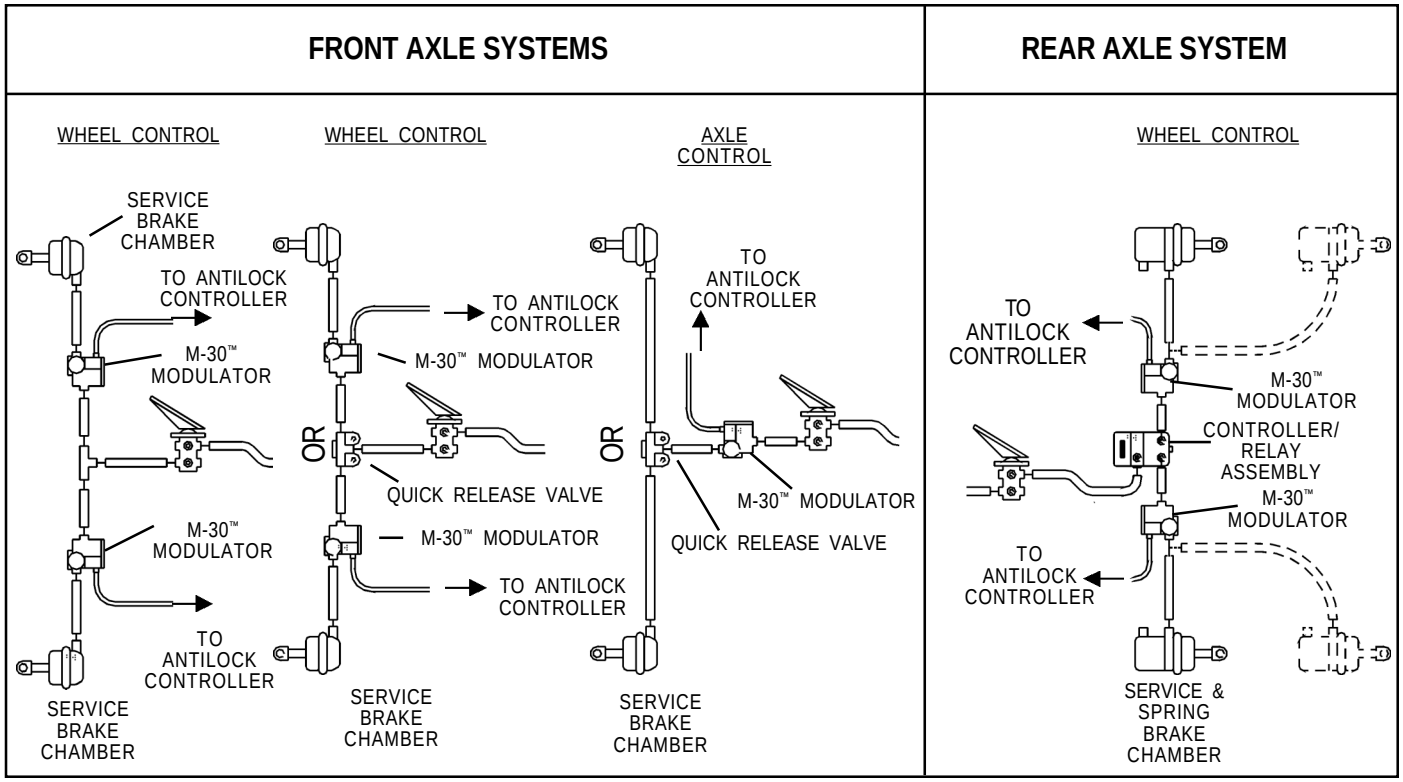

FIGURE 4: ***TYPICAL WHEEL AND AXLE CONTROL SYSTEMS***

NOTE: USE OF A QUICK RELEASE VALVE IS NOT TYPICALLY REQUIRED WITH THE M-30™ MODULATOR. REFER TO VEHICLE SPECIFICATIONS FOR RECOMMENDED CONFIGURATION.

The Supply, Delivery and Exhaust ports on the M-30™ modulator are identified with a cast, embossed numeral for positive identification.

Identification	Air Line Connection
1, SUP	Supply
	(incoming air from foot, relay or quick release valve)
2, DEL	Delivery
	(air delivery to service actuators)
3, EXH	Exhaust

FUNCTIONAL CHECK

A wiring harness connects the vehicle modulators to the controller. The ABS controller is able to simultaneously and independently control the individual modulators. When vehicle power is supplied to the ABS ECU, a modulator "chuff" test is performed. When the brake pedal is depressed and the ignition turned on, the modulator "chuff" test can be heard. This test will verify if the modulator is functioning pneumatically correct. The modulators will exhaust air in the sequence of right front, left front, right rear, left rear. If they do not follow this sequence, proceed with modulator troubleshooting.

OPERATION

NON ANTILOCK APPLICATION (FIGURE 5)

During normal, non antilock braking, both solenoids are de-energized (no electrical power). Brake application air enters the Supply port of the modulator and flows to the exhaust diaphragm. Air pressure, along with spring force, seats the exhaust diaphragm on the exhaust passage, thus preventing the escape of service air. Simultaneously, application air flows to the supply diaphragm and forces it away from its seat. Air flows past the open supply port and out the modulator delivery port to the service brake chambers.

NON ANTILOCK HOLD (FIGURE 6)

When the desired air pressure is attained in the service brake chambers, the brake system is in the Holding position. In the Holding position, both solenoids in the modulator remain de-energized and the balance of the internal components remain in the same position as they assumed during application.

NON ANTILOCK EXHAUST

The manner in which air exhausts through the modulator differs, depending upon how rapidly the brake application is released by the driver.

Normal Exhaust *(Figure 7)* - During a normal, relatively "slow" brake release, air moves back through the modulator in the reverse direction as it flowed during application. The internal components of the modulator will remain in the same position as they assumed during application until air pressure decreases to approximately one half psi, at which time the supply diaphragm will seat on the supply passage. A relatively small amount of air will generally be expelled from the modulator exhaust port during "slow" brake release.

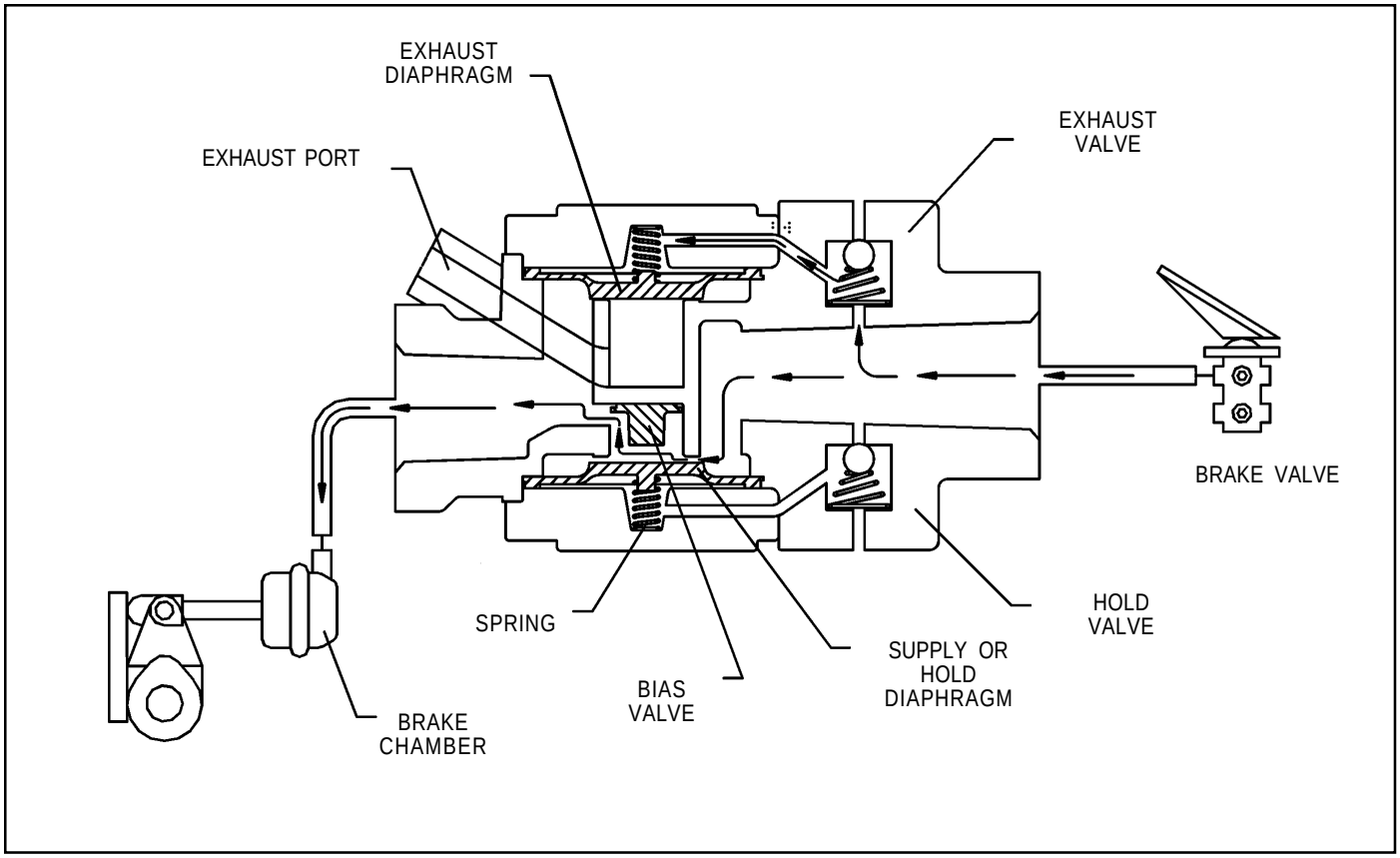

FIGURE 5: ***M-30™ MODULATOR NON ANTILOCK APPLICATION OF SERVICE BRAKES***

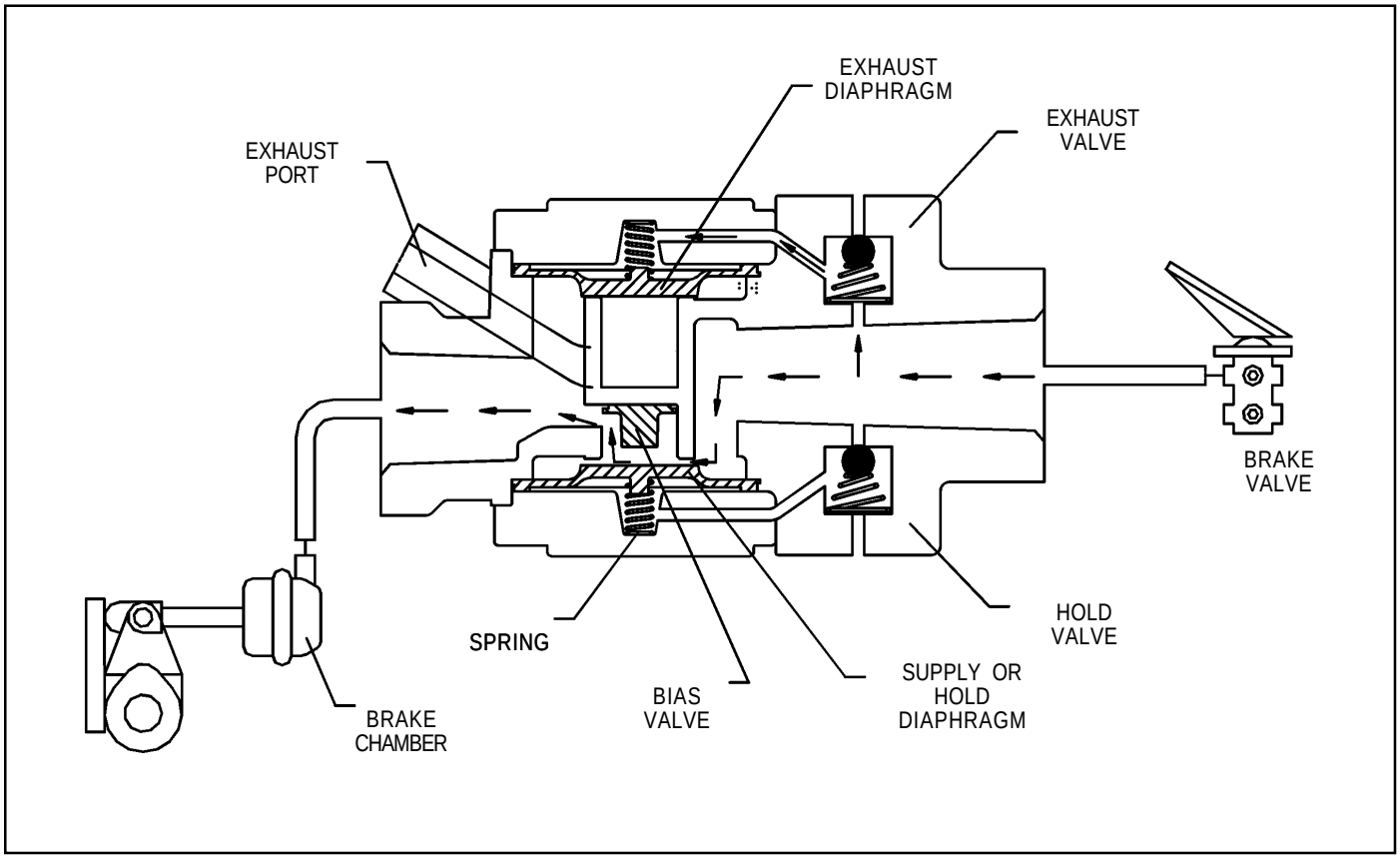

FIGURE 6: ***M-30™ MODULATOR NON ANTILOCK APPLICATION HELD POSITION***

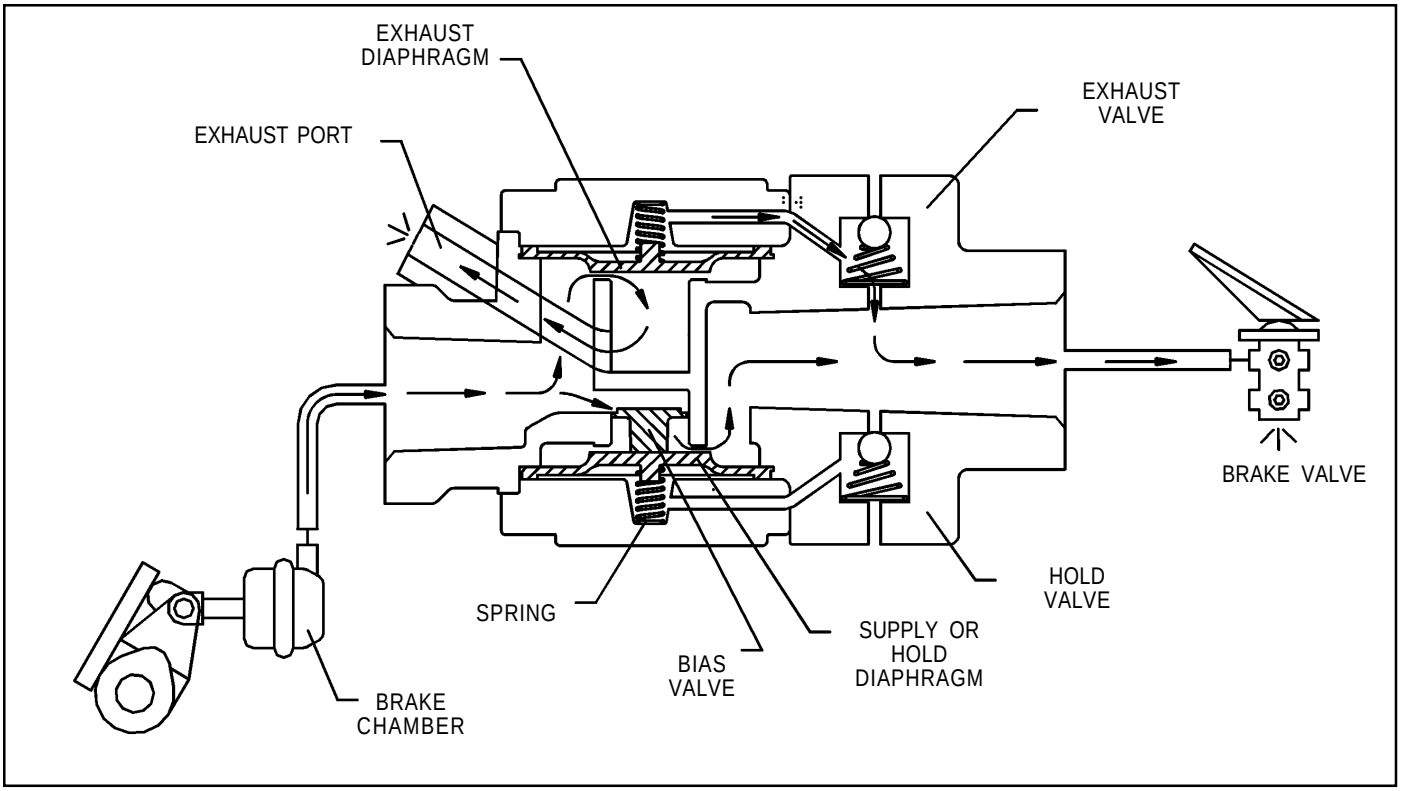

FIGURE 7: ***M-30™ MODULATOR NON ANTILOCK EXHAUST OF SERVICE BRAKES (NORMAL)***

Rapid Exhaust *(Figure 8)* - The Rapid Exhaust operation described in the following text occurs when the modulator is controlling service chamber(s). During a very rapid brake release the modulator will exhaust air in a different manner. An example of this would be the case if the driver made a severe brake application then lifted his foot from the foot valve. During a rapid brake release, the rapid return of air from the brake chamber to the supply port lifts the bias valve from its normal position. The bias valve orifices the return air which induces differential pressure across the exhaust diaphragm. This differential pressure lifts the exhaust diaphragm from its seat. Returning air flows past the open exhaust and out the modulator exhaust port.

ANTILOCK OPERATION

GENERAL

If a service brake application is made and the antilock system detects an impending wheel lockup, the antilock controller will immediately begin modification of the brake application using the modulator.

In order to modify the brake application, the coils of the two solenoid valves contained in the modulator are energized or de-energized in a preprogrammed sequence by the antilock controller. When a solenoid coil is energized, and depending whether the exhaust or hold solenoid is energized, it either opens or closes, thereby causing the exhaust or reapplication of air pressure to the brake actuator. The solenoids in the modulator are controlled independently by the antilock controller. By opening and closing the solenoid valves in the modulator, the antilock controller is able to simulate what the driver does when he pumps the brakes. It must be remembered, however, that unlike the driver the antilock controller is able to cycle each modulator, along with the brakes connected to it, independently and with far greater speed and accuracy.

ANTILOCK EXHAUST (FIGURE 9)

When wheel lock is detected or imminent, the antilock controller simultaneously energizes both the supply and exhaust solenoids in the modulator. Energizing the supply solenoid causes its exhaust to close and its inlet to open. With the inlet of the supply solenoid open, application air is permitted to flow to the control side of the supply diaphragm. Air pressure acting on the supply diaphragm causes it to close the supply and prevent further delivery of air to the brake chamber.

Energizing the exhaust solenoid closes its inlet and opens its exhaust. By closing the exhaust solenoid inlet, application air is prevented from flowing to the control side of the exhaust diaphragm. Air pressure which was present on the control side of the exhaust diaphragm flows out the exhaust port of the modulator. With control air pressure removed from the exhaust diaphragm, brake application air forces the exhaust diaphragm to unseat, allowing it to flow out the modulator exhaust port. The modulator will remain in the antilock exhaust mode until the antilock controller senses that wheel speed has increased. The modulator can enter the antilock hold or reapply mode from the antilock exhaust mode.

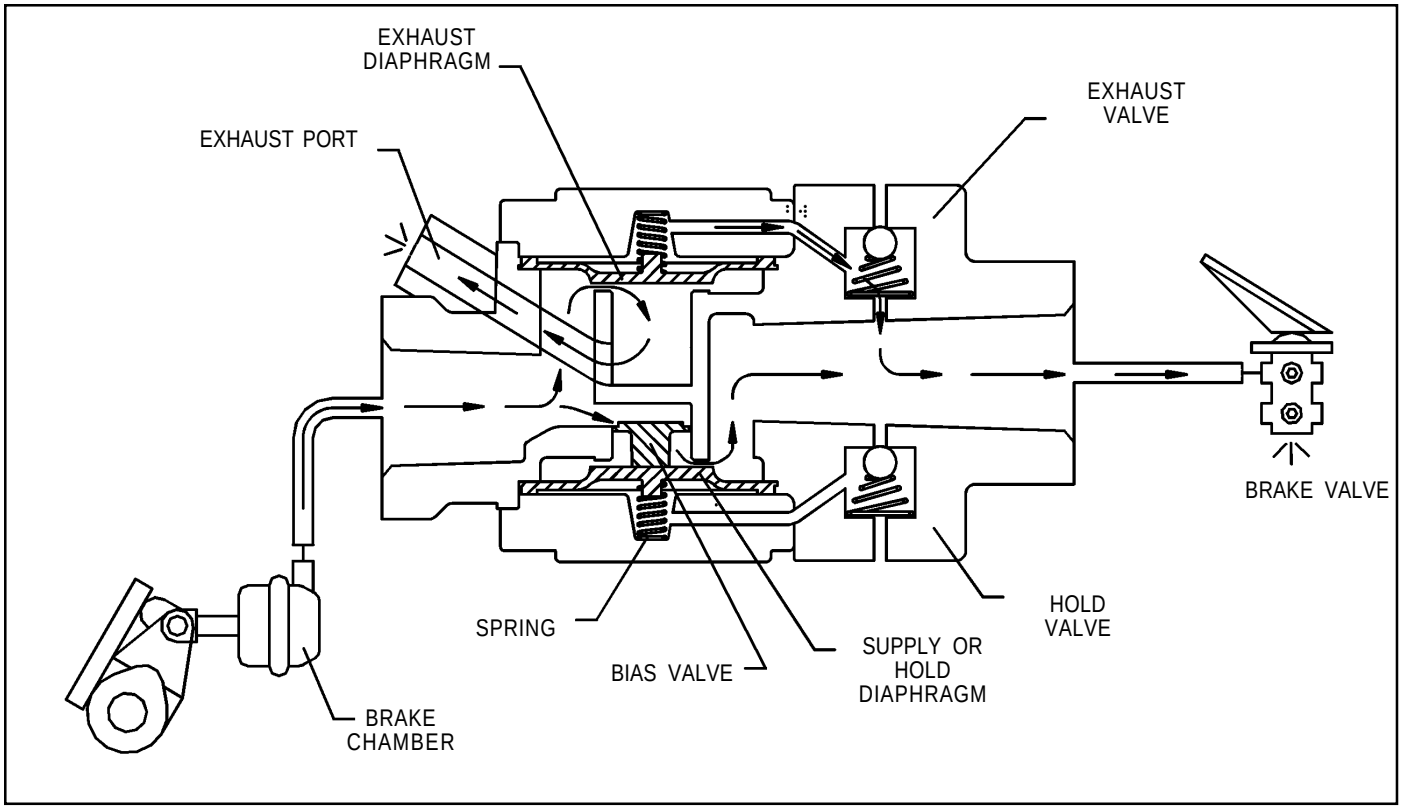

FIGURE 8: ***M-30™ MODULATOR NON ANTILOCK EXHAUST OF SERVICE BRAKES (RAPID)***

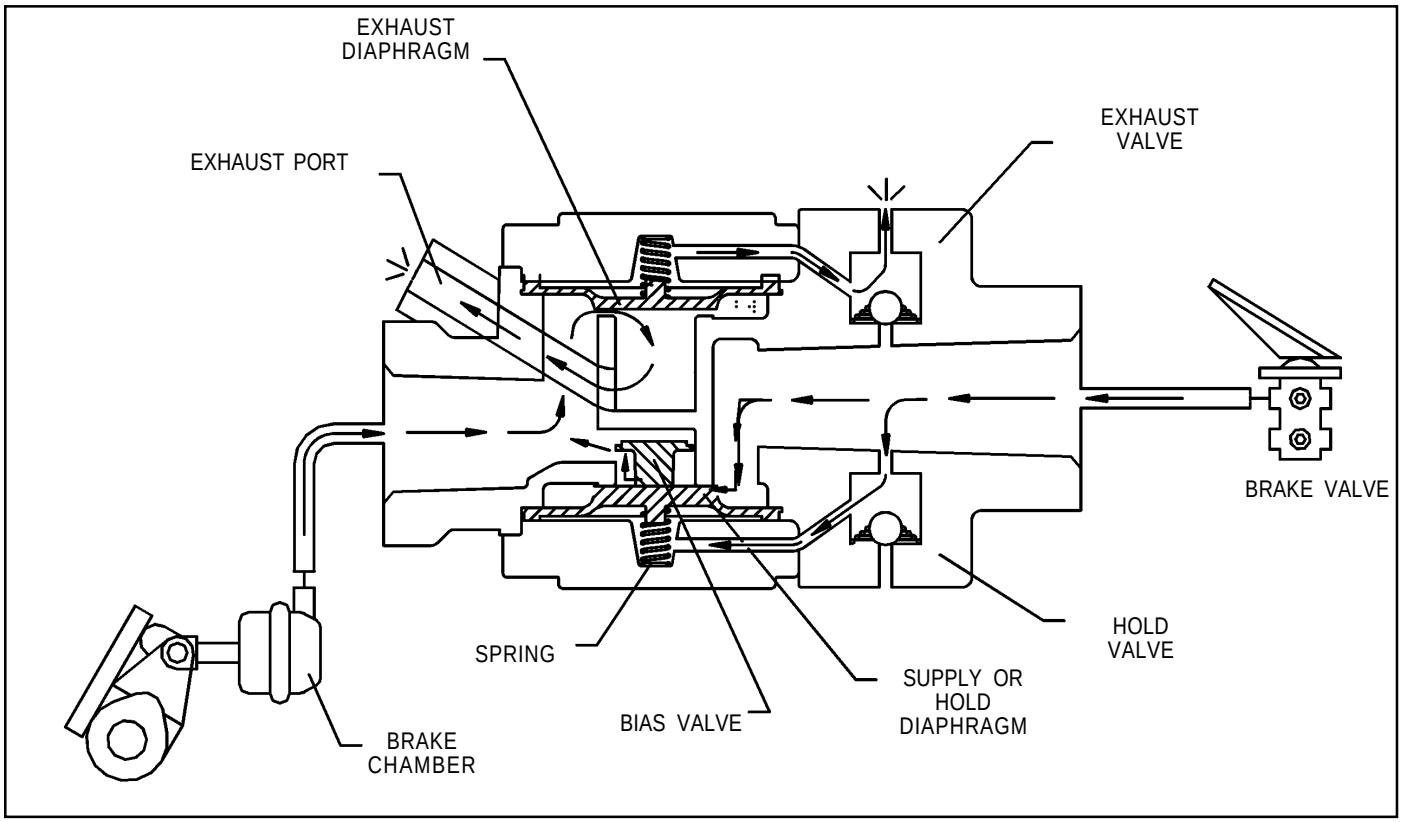

FIGURE 9: ***M-30™ MODULATOR ANTILOCK EXHAUST OF BRAKES***

ANTILOCK HOLD (FIGURE 10)

The antilock controller will place the modulator in the hold position when it senses that the correct wheel speed (braking force) has been attained. The antilock controller will also place the modulator in the hold position, prior to entering the reapply, when it detects recovery from a locked wheel condition. In this mode of operation, the modulator supply/hold solenoid remains energized while the exhaust solenoid is de-energized. De-energizing the exhaust solenoid allows

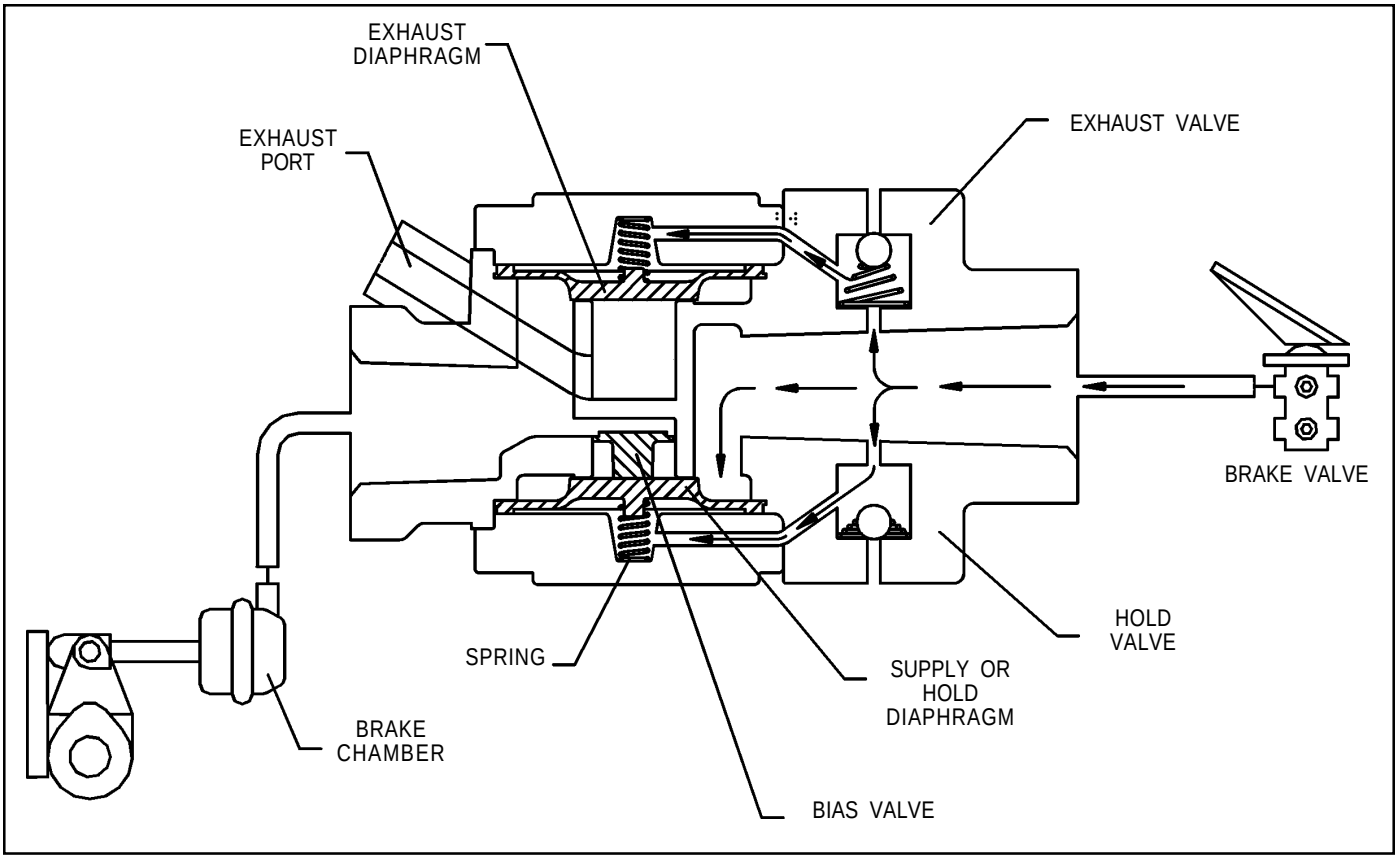

FIGURE 10: ***M-30™ ANTILOCK APPLICATION HELD POSITION***

application air to flow to the control side of the exhaust diaphragm, which then seals the exhaust passage. With the exhaust diaphragm seated, further exhaust of brake chamber air pressure is prevented. Because the supply solenoid remains energized, the supply diaphragm remains seated, thus preventing application air from flowing to the delivery port and out to the brake chamber. The modulator can enter the antilock exhaust or reapply mode from the antilock hold mode.

ANTILOCK REAPPLY

If the antilock controller senses that wheel speed has increased sufficiently enough to require re-application of braking pressure, it deenergizes the supply and exhaust solenoids. With both solenoids de-energized, the modulator re-applies air to the brakes in the same manner it did during a non-antilock event.

VEHICLE PREPARATION

WARNING! PLEASE READ AND FOLLOW THESE INSTRUCTIONS TO AVOID PERSONAL INJURY OR DEATH:

When working on or around a vehicle, the following general precautions should be observed at all times.

1. **Park the vehicle on a level surface, apply the parking brakes, and always block the wheels. Always wear safety glasses.**
2. **Stop the engine and remove ignition key when working under or around the vehicle. When working in the engine compartment, the engine should be shut off and the ignition key should be removed. Where circumstances require that the engine be in operation, EXTREME CAUTION should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated or electrically charged components.**
3. **Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.**
4. **If the work is being performed on the vehicle's air brake system, or any auxiliary pressurized air systems, make certain to drain the air pressure from all reservoirs before beginning ANY work on the vehicle. If the vehicle is equipped with an AD-IS™ air dryer system or a dryer reservoir module, be sure to drain the purge reservoir.**
5. **Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that safely removes all electrical power from the vehicle.**
6. **Never exceed manufacturer's recommended pressures.**
7. **Never connect or disconnect a hose or line containing pressure; it may whip. Never remove a component or plug unless you are certain all system pressure has been depleted.**

8. **Use only genuine Bendix® replacement parts, components and kits. Replacement hardware, tubing, hose, fittings, etc. must be of equivalent size, type and strength as original equipment and be designed specifically for such applications and systems.**
9. **Components with stripped threads or damaged parts should be replaced rather than repaired. Do not attempt repairs requiring machining or welding unless specifically stated and approved by the vehicle and component manufacturer.**
10. **Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.**
11. **For vehicles with Antilock Traction Control (ATC), the ATC function must be disabled (ATC indicator lamp should be ON) prior to performing any vehicle maintenance where one or more wheels on a drive axle are lifted off the ground and moving.**

PREVENTIVE MAINTENANCE

GENERAL

Perform the tests and inspections presented at the prescribed intervals. If the modulator fails to function as described, or leakage is excessive, it should be replaced with a new Bendix unit, available at any authorized parts outlet.

EVERY MONTH, 10,000 MILES OR 350 OPERATING HOURS

1. Remove any accumulated contaminates and visually inspect the exterior for excessive corrosion and physical damage.
2. Inspect all air lines and wire harnesses connected to the modulator for signs of wear or physical damage. Replace as necessary.
3. Test air line fittings for leakage and tighten or replace as necessary.
4. Perform the ROUTINE OPERATION AND LEAKAGE TESTING described in this manual.

OPERATION & LEAKAGE TESTS

LEAKAGE TESTING

1. Park the vehicle on a level surface and block or chock the wheels. Release the parking brakes and build the air system to full pressure.
2. Turn the engine OFF and make 4 or 5 brake applications and note that the service brakes apply and release promptly.
3. Build system pressure to governor cut-out and turn the engine OFF.
4. After determining the pressure loss with the brakes released (2 PSI/minute allowed), make and hold a full service brake application. Allow the pressure to stabilize for one minute.
5. Begin timing pressure loss for two minutes while watching the dash gauges for a pressure drop. The leakage rate for the service reservoirs should not exceed 3 PSI/minute.
6. If either circuit exceeds the recommended two PSI/minute, apply soap solution to the exhaust port of the modular and any other components in the respective circuit.
7. The leakage at the exhaust port of most Bendix components, including M-30™ modulators, should not exceed a one-inch bubble in three seconds. If leakage at the modulator is determined to exceed the maximum limits, replace the modulator.

OPERATION TESTING

To properly test the function of the modulator will require two (2) service technicians.

1. Park the vehicle on a level surface and block or chock the wheels. Release the parking brakes and build the air system to governor cut out.
2. Turn the engine ignition key to the OFF position then make and hold a full brake application.
3. With the brake application held and one (1) service technician posted at one (1) of the modulators, turn the vehicle ignition key to the ON position. ONE OR TWO SHORT bursts of air pressure should be noted at the modulator exhaust. Repeat the test for each modulator on the vehicle. If at least a single burst of exhaust is not noted or the exhaust of air is prolonged and not short, sharp and well defined, perform the Electrical Tests.

ELECTRICAL TESTS

1. Before testing the solenoid assembly of a suspect modulator, its location on the vehicle should be confirmed using the Troubleshooting or Start Up procedure for the specific antilock controller in use. (See the Service Data Sheet for the antilock controller for this procedure.)

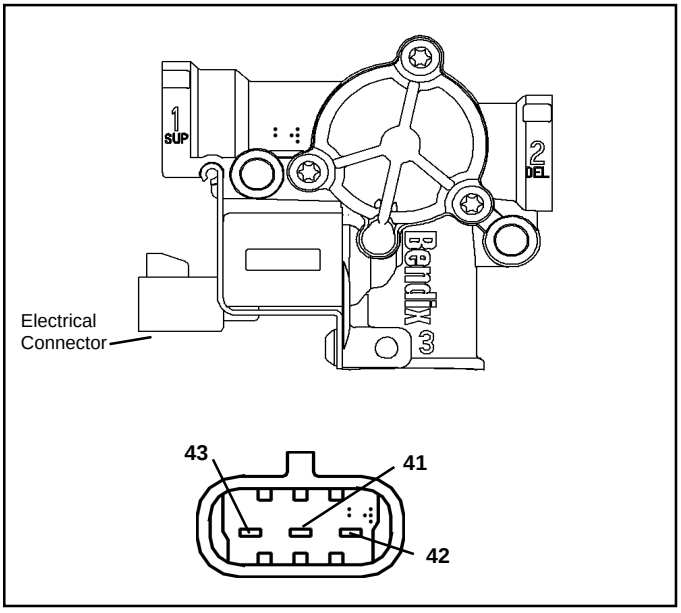

*FIGURE 11 - **M-30™ MODULATOR CONNECTOR VIEWS***

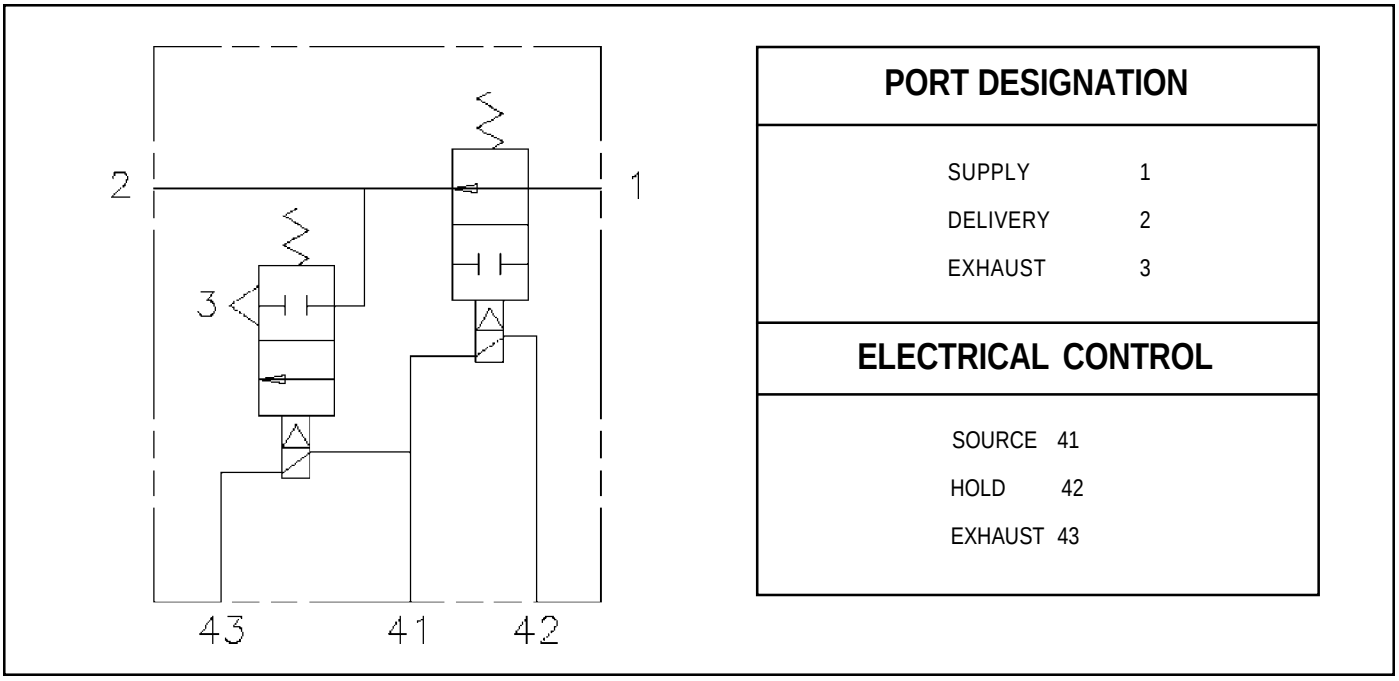

FIGURE 12: ***M-30™ MODULATOR DIN SYMBOL***

2. Proceed to the modulator in question and inspect its wiring connector. Disconnect the connector and test the resistance between the pins ON THE MODULATOR. Refer to figures 11 and 12.

A. HOLD TO SOURCE **(41-42)**: Read 3.5 to 5 OHMS

B. EXHAUST TO SOURCE **(43-41)**: Read 3.5 to 5 OHMS

C. EXHAUST TO HOLD **(43-42)**: Read 7 to 10 OHMS

D. Individually test the resistance of each pin to vehicle ground and note there is NO CONTINUITY.

If the resistance readings are as shown, the wire harness leading to the modulator may require repair or replacement. Before attempting repair or replacement of the wire harness, refer to the test procedures specified for the antilock controller in use for possible further testing that may be required to substantiate the wire harness problem. If the resistance values are NOT AS STATED, replace the modulator.

MODULATOR REMOVAL

1. Locate the modulator that will be replaced and clean the exterior.
2. Identify and mark or label all air lines and their respective connections on the valve to facilitate ease of installation.
3. Disconnect both air lines and the electrical connector.
4. Remove the modulator from the vehicle.
5. Remove all air line fittings and plugs. **These fittings will be re-used in the replacement modulator.**

MODULATOR INSTALLATION

1. Install all air line fittings and plugs, making certain thread sealing material does not enter the valve.
2. Install the assembled valve on the vehicle.
3. Reconnect both air lines to the valve using the identification made during VALVE REMOVAL step 5.
4. Reconnect the electrical connector to the modulator.
5. After installing the valve, test all air fittings for excessive leakage and tighten as needed.

TECHNICAL INFORMATION

Porting 1 Supply Port (from brake, relay or quick release valve) - 1/2" NPT

1 Delivery Port (brake actuator) - 1/2" NPT

Optional:

Push-to-connect for 1/2" tubing

Solenoid Voltage : 12 Volts DC Nominal

Weight: 1.7 pounds

Maximum Operating Pressure: 150 psi Gauge

Operating Temperature Range: -40 to 185 degrees Fahrenheit

Pressure Differential: 1 psi maximum (supply to delivery)

Mounting Hole Sizes 0.33" diameter thru body