



# Service Data

SD-08-2415

## Bendix® AD-SP™ System Purge Air Dryer & SC-PR™ Single Check Protection Valve

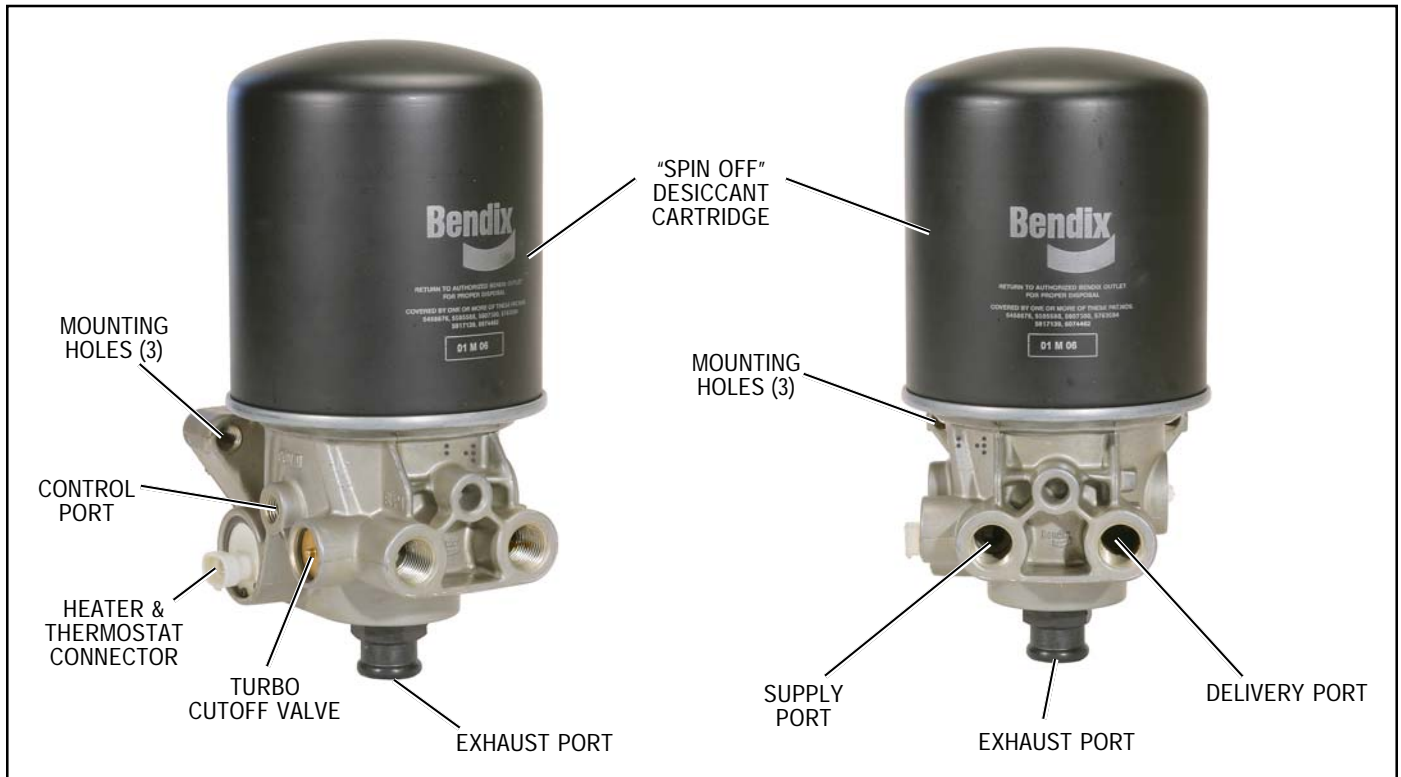


FIGURE 1 - AD-SP™ SYSTEM PURGE AIR DRYER

### DESCRIPTION

The function of the AD-SP™ System Purge Air Dryer is to collect and remove air system contaminants in solid, liquid and vapor form before they enter the brake system. It provides clean, dry air to the components of the brake system which increases the life of the system and reduces maintenance costs. Daily manual draining of the reservoirs is eliminated.

The system purge designation is used because the AD-SP™ air dryer uses a small portion of system air pressure from the supply and front axle service reservoirs to perform the purge or regenerative function. An SC-PR™ single check protection valve or a valve that performs the same function is always used in conjunction with the AD-SP™ air dryer to protect the service system.

The AD-SP™ air dryer consists of two major component groups, a spin off desiccant cartridge assembly and a die cast aluminum body assembly. The desiccant cartridge is self contained and serviced as a complete assembly. The

AD-SP™ air dryer aluminum body contains the following serviceable components or assemblies; the turbocharger cut-off valve, heater and thermostat assembly, delivery check valve assembly and combined purge and relief valve assembly. In addition, the non-serviceable purge control valve is located in the body. All service and replacement can be accomplished from the exterior of the dryer without removal from the vehicle. The spin-on desiccant cartridge is removed and installed using a “strap wrench.”

The AD-SP™ air dryer has three female pipe thread air connections identified as follows:

Air Connection Port ID	Function/Connection
CON 4	Control Port (purge valve control & turbo cut-off).
SUP 11	Supply Port (air in).
DEL 2	Delivery Port (air out).

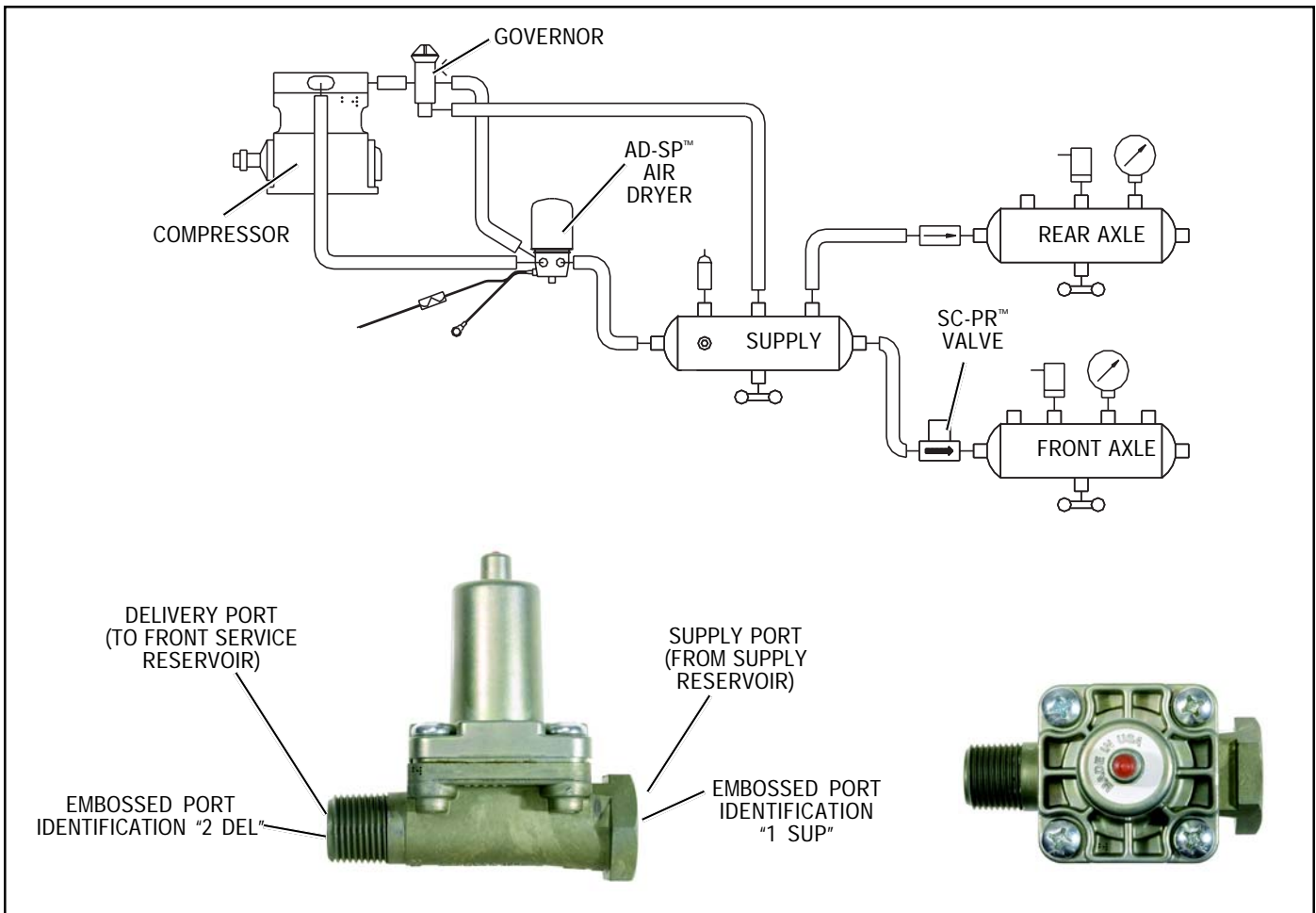


FIGURE 2 - AD-SP™ AIR DRYER SYSTEM DRAWING WITH EXTERIOR AND TOP VIEW OF SC-PR™ VALVE.

## OPERATION

### GENERAL

The AD-SP™ air dryer alternates between two operational modes or “cycles” during operation: the *Charge Cycle* and the *Purge Cycle*. The following description of operation is separated into these “cycles” of operation.

### CHARGE CYCLE (refer to Figure 3)

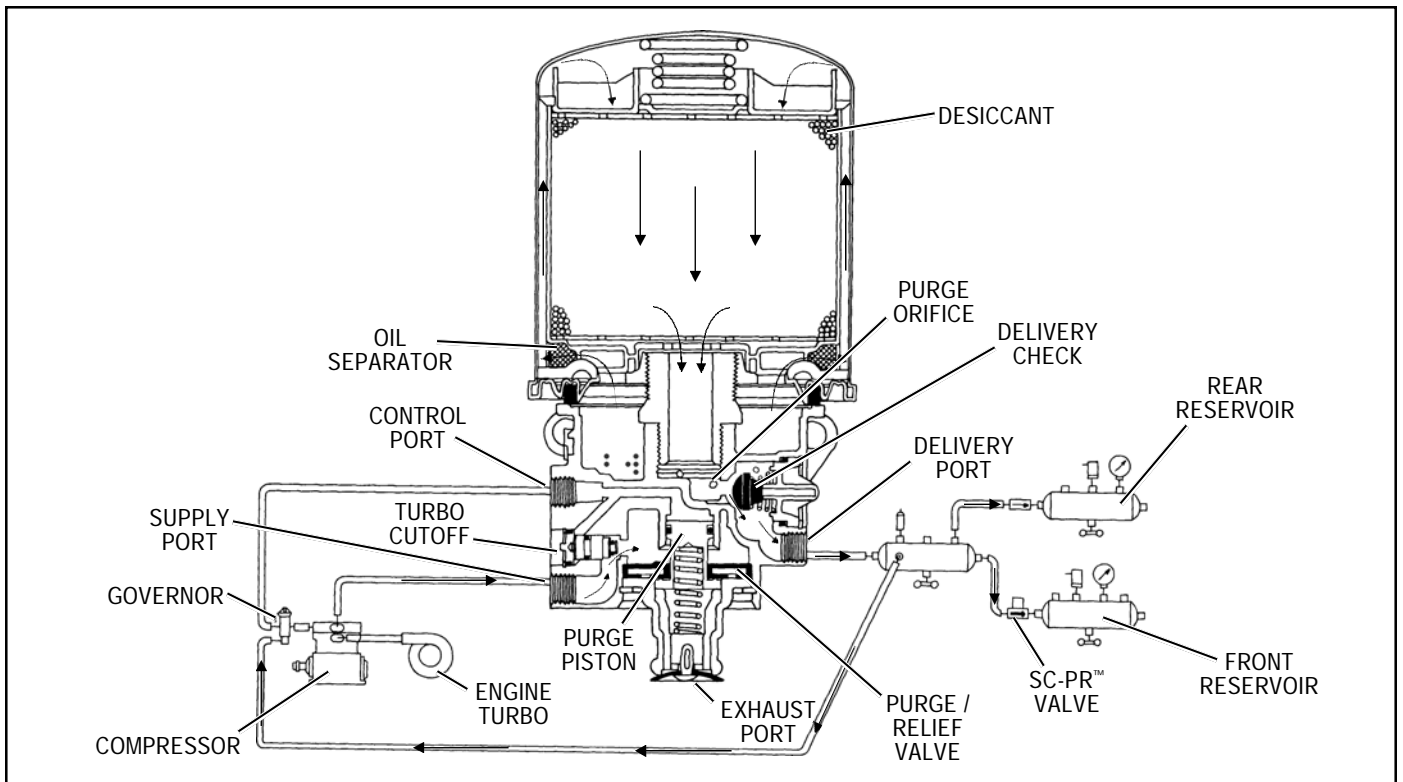
When the compressor is loaded (compressing air) compressed air, along with oil, oil vapor, water and water vapor flows through the compressor discharge line to the supply port of the air dryer body.

Air entering the supply port immediately encounters the “turbo cut-off” valve. With no air pressure in the control port, the turbo cut-off piston moves the valve away from its seat in the body allowing the supply air to enter the body. As air travels through the end cover assembly, its direction of flow changes several times, reducing the temperature, causing contaminants to condense and drop to the bottom or sump of the air dryer body.

After exiting the end cover, the air flows into the desiccant cartridge where an oil separator, located between the outer and inner shells of the cartridge, removes water in liquid form as well as liquid oil and solid contaminants.

After exiting the oil separator, air enters the space between the desiccant drying bed and the outer cartridge shell and flows down through the column of desiccant. Flowing through the desiccant column, air becomes progressively dryer as water vapor adheres to the desiccant material in a process known as “ADSORPTION.” Using the adsorption process, the desiccant cartridge typically removes 95% of the water vapor from the pressurized air.

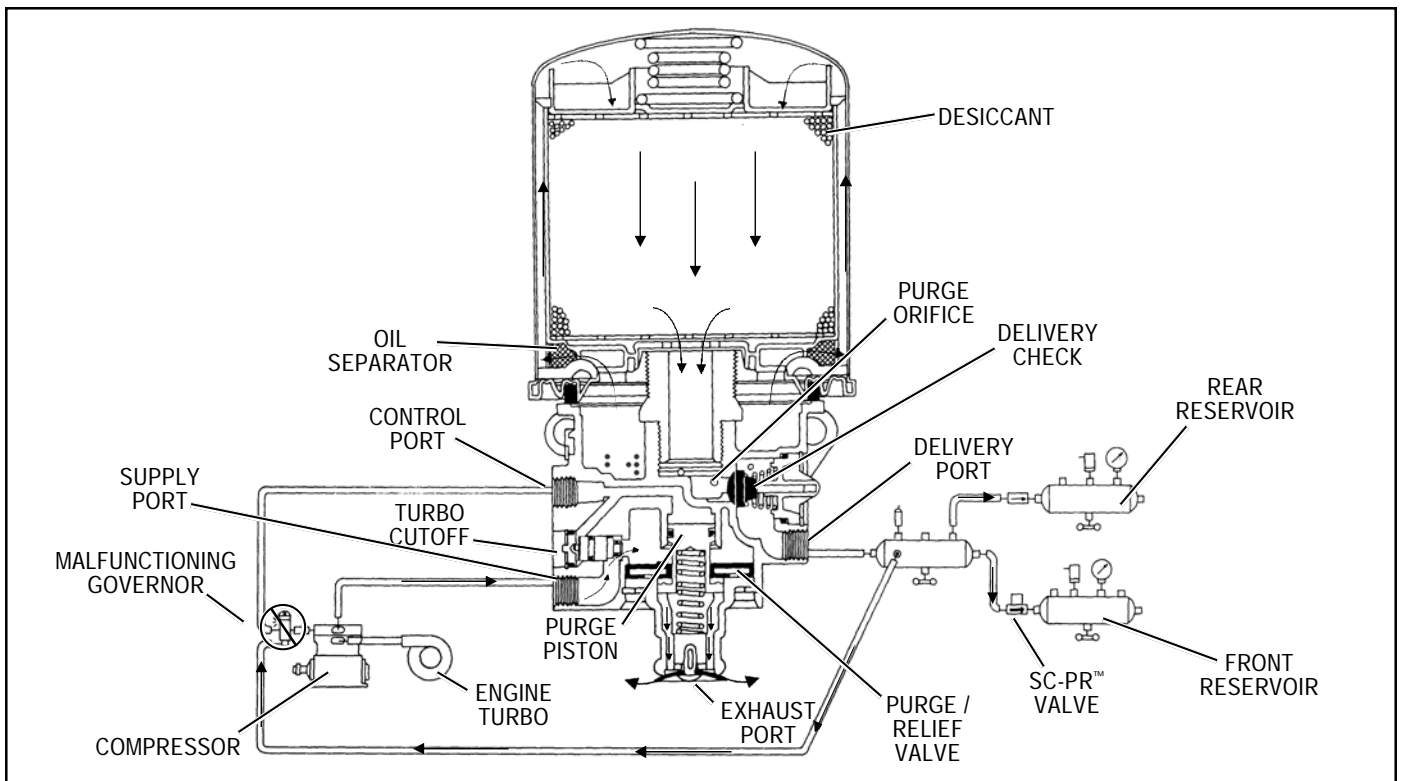
Dry air exits the bottom of the desiccant cartridge through its center opening and returns to the air dryer body assembly. As air flows through the supply cavity it is also conducted, via internal passages, to the non-serviceable purge control mechanism contained in the body. The purge control mechanism (not shown) is able to monitor supply air pressure. The air then flows through the delivery check valve assembly and out the delivery port to the first (supply) reservoir of the air system. As air moves past the delivery check valve, on its way to the delivery port, it is also conducted to the purge control mechanism. The purge control mechanism is able to monitor air brake system pressure as well as supply air pressure.



**FIGURE 3 - AD-SP™ AIR DRYER CHARGE CYCLE**

The air dryer will remain in the charge cycle until the air brake system pressure builds to the governor cutout setting. To protect against over pressurization of the AD-SP™ air dryer, the purge valve incorporates an integral relief valve feature. In the event that the compressor unloader

mechanism or governor malfunctions, at approximately 200 psi supply air pressure the AD-SP™ air dryer purge valve will open (without control pressure), and vent excess air pressure to atmosphere (refer to Figure 4).



**FIGURE 4 - AD-SP™ AIR DRYER RELIEF VALVE OPERATION**

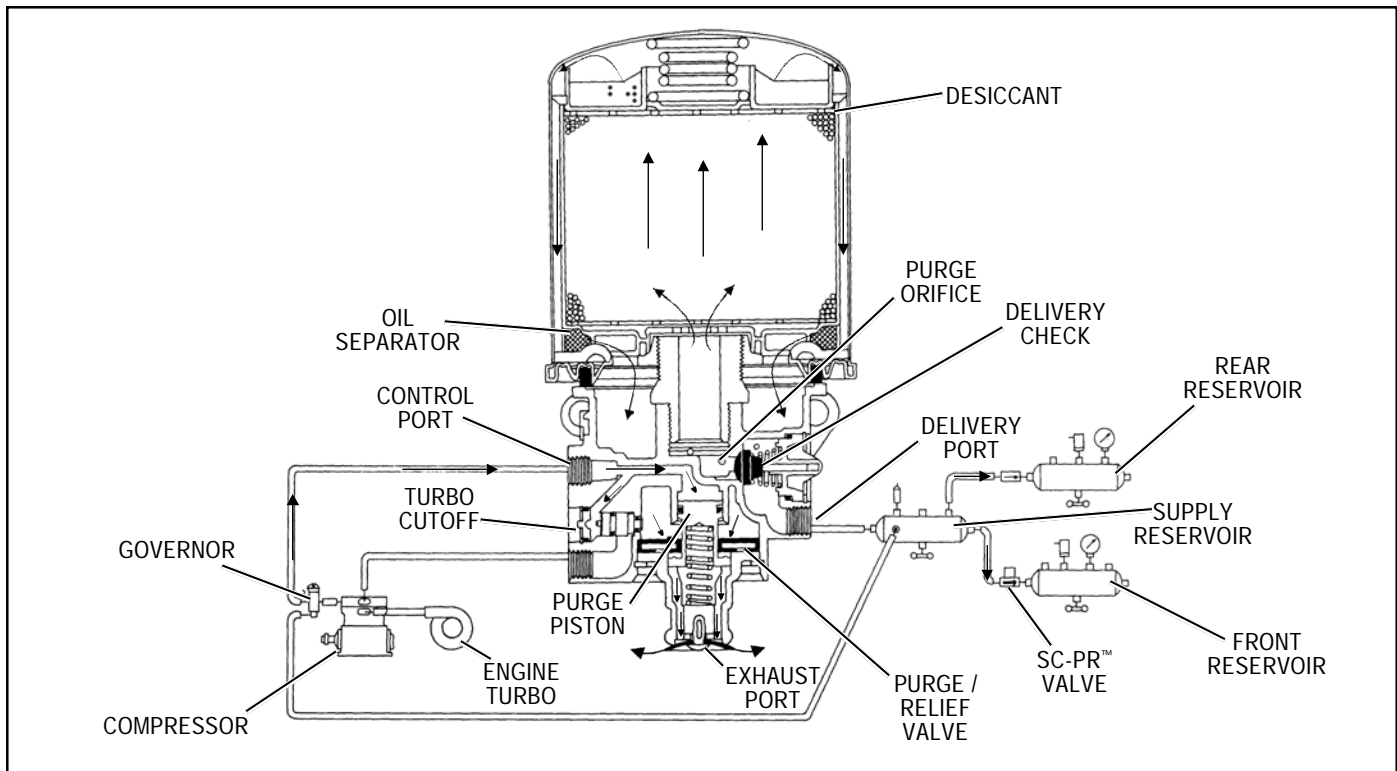


FIGURE 5 - AD-SP™ AIR DRYER PURGE CYCLE

### PURGE CYCLE (refer to Figure 5)

When air brake system pressure reaches the cutout setting of the governor, typically 120 psi, the compressor unloads (air compression is stopped) and the purge cycle of the air dryer begins. When the governor unloads the compressor, it pressurizes the compressor unloader mechanism and the line connecting the governor unloader port to the control port of the AD-SP™ air dryer body. Air entering the control port is simultaneously directed to the turbo cut-off valve and the purge valve control piston.

The initial purge cycle consists of two simultaneous occurrences; the closing of the turbo cut-off valve and the opening of the purge valve. Each is discussed below under a separate subheading.

### TURBO CUT-OFF VALVE (refer to Figure 5)

The primary function of the turbo cut-off valve is to prevent loss of engine turbocharger air pressure through the AD-SP™ air dryer in systems where the compressor intake is connected to the engine turbocharger. The turbo cut-off valve also eliminates the “puffing” of air out the open air dryer exhaust when a naturally aspirated, single cylinder compressor is equipped with an inlet check valve.

Governor unloader pressure causes the turbo cut-off valve piston to move and close. With the turbo cut-off valve piston seated (closed position), air in the discharge line and AD-SP™ air dryer inlet port is prevented from entering the air dryer.

### PURGE PISTON

The AD-SP™ air dryer purge piston also moves in response to governor unloader pressure, causing the purge valve to open to atmosphere. Contaminants in the body sump are instantly expelled when the purge valve opens. Air which was flowing through the desiccant cartridge immediately changes direction and begins to flow back toward the open purge valve. Oil and solid contaminants collected by the oil separator are removed by air flowing from the desiccant drying bed to the open purge valve.

### DESICCANT RE-ACTIVATION (DRYING THE DESICCANT)

The initial decompression of the air dryer assembly lasts only a few seconds and is evidenced by an audible burst of air at the AD-SP™ air dryer exhaust. The initial decompression of the air dryer assembly is “sensed” by the purge control mechanism and is used by the purge mechanism as a signal that desiccant re-activation should begin. The purge control mechanism “remembers” the highest pressure attained in the air system, the cutout pressure of the governor.

The actual re-activation of the desiccant drying bed begins as the purge mechanism allows dry air to flow from the delivery port (air brake system) back into the AD-SP™ air dryer body and through the desiccant cartridge. The delivery check valve assembly prevents air pressure in the brake system from returning to the air dryer and flowing out the open purge valve. The delivery check valve forces system

air to flow through the purge mechanism. Dry air for the brake system enters the purge control mechanism through an air channel located in the delivery port, before the delivery single check valve. It flows through the mechanism and exits a purge orifice; its pressure is lowered and its volume increased. The flow of dry air through the drying bed reactivates the desiccant material by removing the water vapor adhering to it.

Dry, brake system air will continue to flow through the desiccant bed until the purge mechanism senses that the brake system pressure has dropped between 8 - 14 psi below what it "remembered" as being high (governor cut out). For example: If governor cutout pressure was 120 psi the purge mechanism will use air from the supply and front axle reservoirs until it detects that pressure has dropped to between 112 - 106 psi. System pressure will be reduced in the supply and secondary (front axle) reservoirs only. The primary or rear axle service reservoir will retain governor cutout pressure (in the example, 120 psi). The purge cycle and re-activation of the desiccant drying bed along with the resulting pressure reduction takes place in approximately 15 - 20 seconds.

Once the purge cycle is complete, the purge control mechanism closes and no further reduction of system pressure should occur. The air dryer is ready for the next charge cycle to begin.

The purge valve will remain open and the turbo cut-off valve closed after the purge cycle is complete and neither will change position until air brake system pressure is reduced to governor cut-in pressure and the Charge Cycle begins.

### SC-PR™ VALVE DESCRIPTION

The SC-PR™ single check protection valve, combines a single check valve and a pressure protection valve in a single assembly. Its primary use is in conjunction with the Bendix® AD-SP™ air dryer and is installed in the front axle (secondary) service reservoir **in place of** a standard single check valve.

The SC-PR™ valve allows the AD-SP™ air dryer to draw air pressure from the front axle service reservoir during the purge cycle. It also protects the air pressure in the front axle service reservoir, in the event of a compressor, supply, or rear axle reservoir failure, or malfunction of the AD-SP™ air dryer purge control mechanism.

The SC-PR™ valve is intended for direct mounting to the service reservoir. Both SC-PR™ valve air connections are 1/2 inch pipe thread and each is identified with cast, embossed letters for ease of identification and installation. The letter identifications and connections to the air system are shown below for reference.

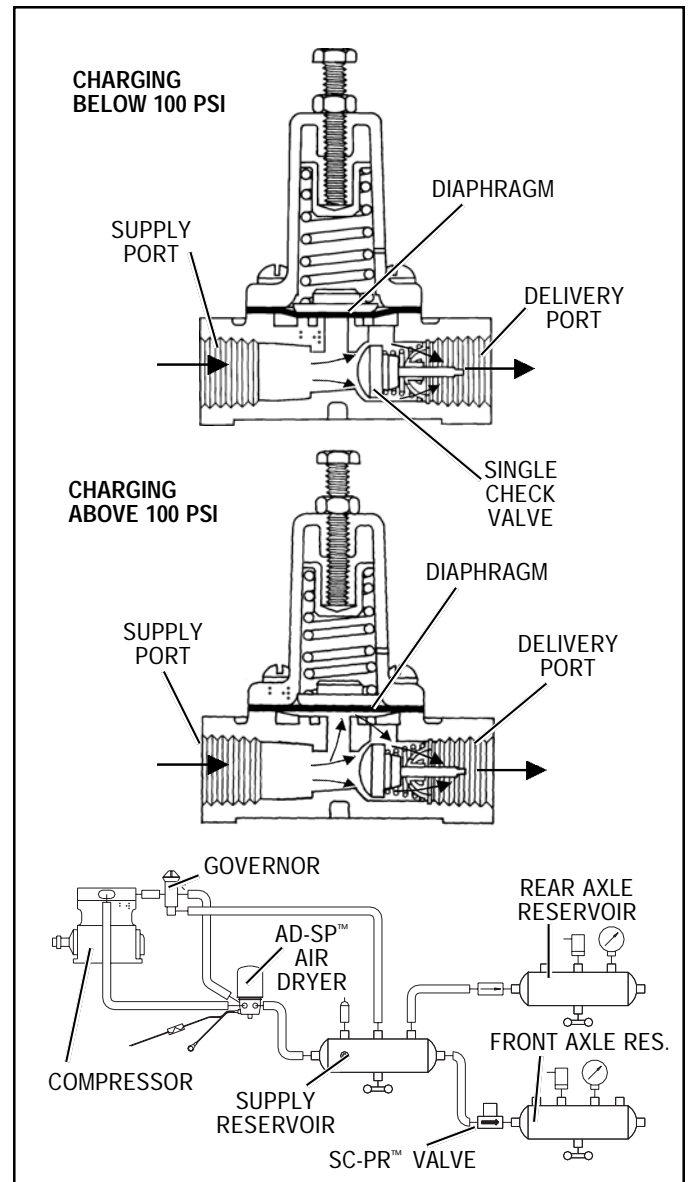


FIGURE 6 - SC-PR™ VALVE CHARGE POSITION\*

Air Connection	Identification	System Connection
Supply .....	1 SUP .....	Connected to Supply (wet) Reservoir
Delivery .....	2 DEL .....	Nipple Mounted to Front Axle Service Reservoir

### SC-PR™ VALVE OPERATION

#### CHARGING

During initial air system build up, air flows from the supply reservoir to the supply port of the SC-PR™ valve. Air entering the SC-PR™ valve supply port is present beneath the pressure protection diaphragm and simultaneously flows through the single check valve portion into the front axle service reservoir. With supply air pressure less than 100 psi, the pressure protection diaphragm, which functions as a valve, remains seated on its inlet due to spring force above.

\*Cutaway views are functionally correct, but do not represent current form of SC-PR™ valve.

When supply pressure reaches 100 psi, the diaphragm moves away from its seat and air entering the supply port flows through the pressure protection valve portion, as well as the single check valve portion, and into the front axle service reservoir.

The pressure protection valve remains open as long as supply pressure remains above 95 psi.

## PURGING

When the AD-SP™ air dryer begins its purge cycle, air from the supply and front axle service reservoirs flows back to the air dryer to re-activate the desiccant. Air flowing from the front axle service reservoir to the supply reservoir must pass through the SC-PR™ pressure protection valve because the single check valve portion is closed to flow in that direction.

Since an AD-SP™ air dryer purge cycle begins at governor cutout (120 psi minimum) and only reduces reservoir air pressure 8 - 14 psi, the SC-PR™ pressure protection valve will normally remain open. If a malfunction occurs that causes the supply reservoir to lose pressure, air from the front axle service reservoir will flow back to the supply reservoir until the pressure beneath the SC-PR™ pressure protection valve diaphragm falls to approximately 95 psi. With 95 psi or less beneath the diaphragm, spring force moves the diaphragm into contact with the inlet seat and air flow to the supply reservoir ceases. The supply reservoir will continue to lose pressure, however 95 psi will be retained in the front axle service reservoir for braking.

Any malfunction occurring between the compressor and SC-PR™ valve that causes pressure to drop below 95 psi will result in the SC-PR™ pressure protection valve closing and protecting the front axle service reservoir.

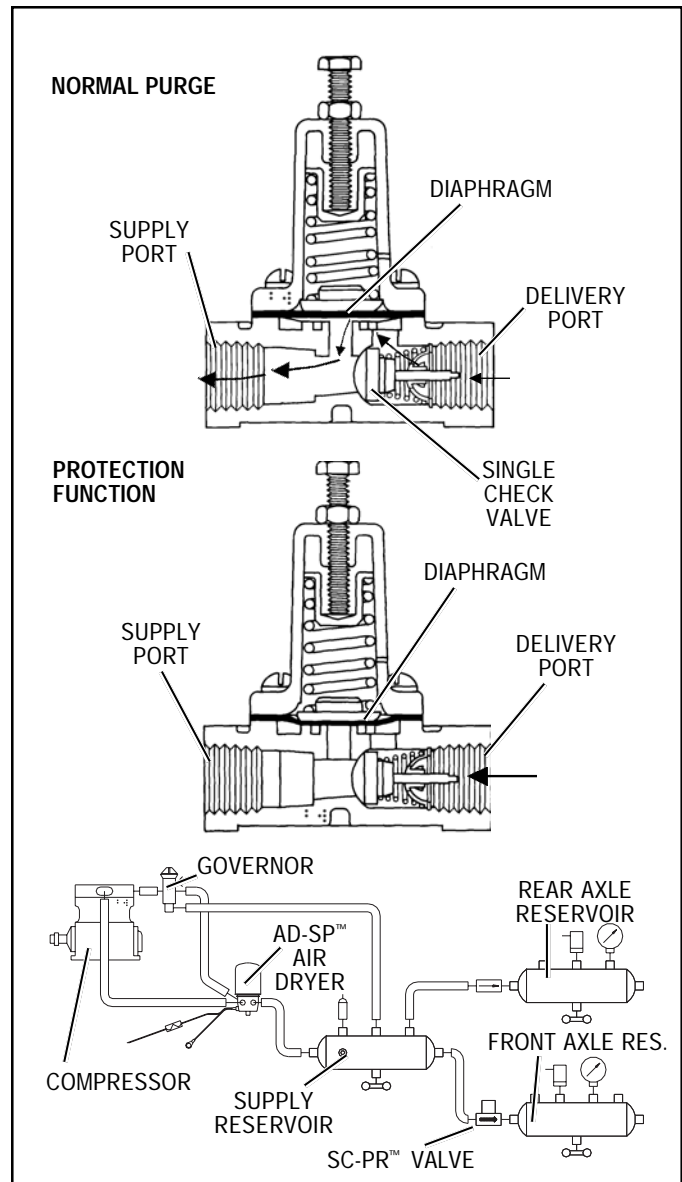
## PREVENTIVE MAINTENANCE

**Important:** Review the warranty policy before performing any intrusive maintenance procedures. An extended warranty may be voided if intrusive maintenance is performed during this period.

Because no two vehicles operate under identical conditions, maintenance and maintenance intervals will vary. Experience is a valuable guide in determining the best maintenance interval for any one particular operation.

### Every 900 operating hours, or 25,000 miles or three (3) months:

1. Check for moisture in the air brake system by opening reservoirs, drain cocks, or drain valves and checking for presence of water. If moisture is present, the desiccant cartridge may require replacement; however, the following conditions can also cause water accumulation and should be considered before replacing the desiccant:



**FIGURE 7 - SC-PR™ SINGLE CHECK PROTECTION VALVE PURGE POSITION\***

- A. An outside air source has been used to charge the system. This air does not pass through the drying bed.
- B. Air usage is exceptionally high and not normal for a highway vehicle.  
This may be due to accessory air demands or some unusual air requirement that does not allow the compressor to load and unload (compressing and non-compressing cycle) in a normal fashion. Check for high air system leakage. If the vehicle vocation has changed it may be necessary to upgrade the compressor size. Refer to Appendix A, Table A and the column entitled Vehicle Vocation.
- C. The air dryer has been installed in a system that has been previously used without an air dryer. The system will be saturated with moisture and several weeks of operation may be required to dry it out.

- D. A single check valve, or a device with a check valve feature, may have been installed to the inlet port of the supply tank or in the delivery line between the air dryer and the supply tank. This will prevent re-generation of the air dryer desiccant cartridge and lead to moisture accumulation in the air reservoirs.
- E. Location of the air dryer is too close to the air compressor. Refer to *Locating AD-SP™ Air Dryer On Vehicle* section and Appendix A, Table A, column 2 for discharge line length.
- F. In areas where more than a 30 degree range of temperature occurs in one day, small amounts of water can temporarily accumulate in the air brake system due to condensation. Under these conditions, the presence of small amounts of moisture is normal and should not be considered as an indication that the dryer is not performing properly.

**Note:** A small amount of oil in the system is normal and should not be considered as a reason to replace the desiccant cartridge; oil-stained desiccant can function adequately.

- 2. Visually check for physical damage to the AD-SP™ air dryer such as dented desiccant cartridge, chaffed or broken air and electrical lines and broken or missing parts. Check the SC-PR™ valve also.
- 3. Check mounting bolts for tightness. Re-torque to 50 ft. pounds.
- 4. Perform the *Operation & Leakage Tests* listed in this publication.

**Every 3600 operating hours, or 100,000 miles or twelve (12) months:**

- 1. Test the AD-SP™ air dryer turbo cut-off and purge valves for leakage. Disconnect the supply, control and delivery lines from the AD-SP™ air dryer. Perform the tests below in the order they are presented.
  - A. Apply 120 psi shop air pressure to the control port and a soap solution to the supply port. If leakage exceeds a 1" bubble in 5 seconds, repair the turbo cut-off piston and valve before proceeding to step 2.
  - B. With 120 psi shop air pressure applied to the control port, apply a soap solution to the purge exhaust port. If leakage exceeds a 1" bubble in 5 seconds, repair the purge piston and valve before proceeding to step 2.
  - C. With 120 psi shop air pressure applied to the control and supply port, apply a soap solution to the purge exhaust port. If leakage exceeds a 1" bubble in 5 seconds, repair the turbo cut-off piston and valve before proceeding to step 2.

- D. With a plug installed in the delivery port, 0 psi in the control port, and 120 psi applied to the supply port, apply a soap solution to the purge exhaust port. If leakage exceeds a 1" bubble in 5 seconds, repair the purge piston and valve before proceeding to step 2.
- 2. Perform the *Operation & Leakage Tests* shown in this publication.

**Every 10,800 hours; or 350,000 miles or 36 months:**

- 1. Replace the air dryer desiccant cartridge.

**Note:** The desiccant change interval may vary from vehicle to vehicle. Although typical desiccant cartridge life is three years, many will perform adequately for a longer period of time. In order to take maximum advantage of desiccant life and assure that replacement occurs only when necessary, it is important that *Operation & Leakage Tests* be performed.

- 2. Perform the *Operation & Leakage Tests* shown in this publication.

**WARNING!**

**This air dryer is intended to remove moisture and other contaminants normally found in the air brake system. Do not inject alcohol, anti-freeze, or other de-icing substances into or upstream of the air dryer. Alcohol is removed by the dryer, but reduces the effectiveness of the device to dry air. Use of other substances can damage the air dryer and may void the warranty.**

**OPERATION & LEAKAGE TESTS (ALSO SEE VIDEO BW2327)**

- 1. Check for excessive leakage around the purge valve. With the compressor in loaded mode (compressing air), apply a soap solution to the purge valve exhaust port and observe that leakage does not exceed a 1" bubble in 5 second. If the leakage exceeds the maximum specified, service the purge valve assembly.
- 2. Check for leakage around the desiccant cartridge. With the compressor in loaded mode (compressing air), apply a soap solution around the desiccant cartridge seal and observe that no leakage occurs. If leakage is noted, tighten the cartridge using a strap wrench and re-test for leakage.
- 3. While observing the dash gauge(s), build up system pressure at approximately 1,800 engine/compressor rpm to governor cut-out. Note the pressure on the dash gauge(s) at the moment governor cutout occurs and that the AD-SP™ air dryer purges with an audible escape of air. Observe the dash gauge(s) pressure for two minutes after the purge cycle begins. The front axle service (secondary) reservoir pressure should not drop more than 8-14 psi below the governor cutout pressure noted and the rear axle (primary) reservoir pressure should not drop more than 2 psi. Perform this test 3 times to positively confirm the values.

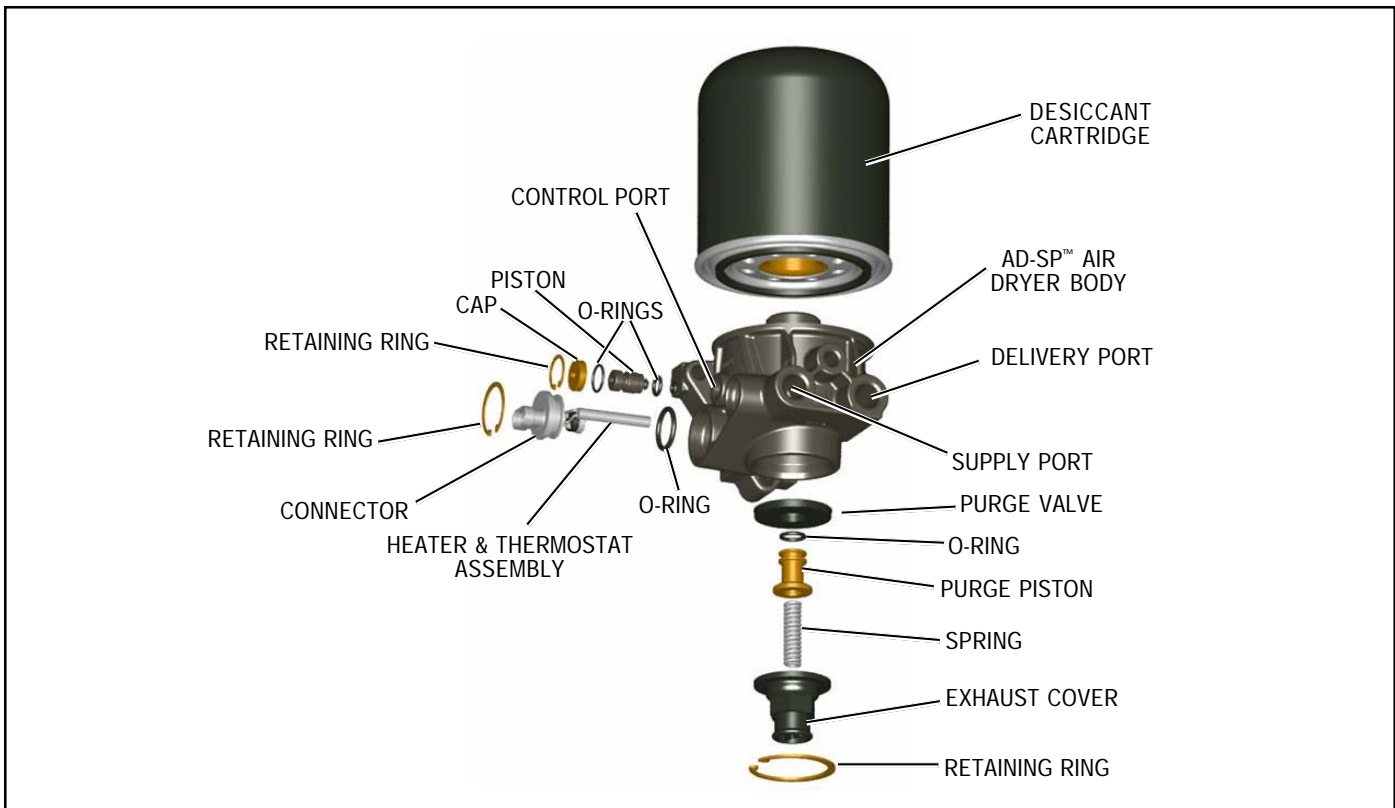


FIGURE 8 - AD-SP™ SYSTEM PURGE AIR DRYER EXPLODED VIEW

- A. If the pressure drop in the front axle reservoir exceeds 8-14 psi, check the air brake system for excessive leakage and repair and re-test. If the excessive pressure drop persists, replace the AD-SP™ air dryer.
  - B. If the pressure drop in the rear axle reservoir exceeds 2 psi, check the air brake system for excessive leakage and repair.
- Build up system pressure to governor cut-out, wait 30 seconds for completion of the purge cycle, then "Fan" the service brakes to reduce system air pressure to governor cut-in. Note that the system once again builds to full pressure and is followed by an AD-SP™ air dryer purge.
- 4. Check the operation of the SC-PR™ single check protection valve. Build system pressure to governor cutout, wait 30 seconds for completion of the purge cycle, then drain all air pressure from the supply reservoir while observing the front axle reservoir dash gauge. Reservoir pressure should decrease to approximately 95 psi and stop. If front axle reservoir pressure continues to drop replace the SC-PR™ valve. **Do not attempt to adjust the SC-PR™ valve.** This valve is factory preset and mix-adjustment can result in insufficient air pressure in the front axle reservoir in the event of a line or component failure. The rear axle reservoir pressure should remain constant.

- 5. Check the operation of the heater and thermostat assembly in the body during cold weather operation (if possible) as follows:

A. Electric Power to the Heater and Thermostat

With the ignition or engine kill switch in the ON position, check for voltage to the heater and thermostat assembly using a voltmeter or test light. Unplug the electrical connector at the air dryer and place the test leads on each of the pins of the male connector. If there is no voltage, look for a blown fuse, broken wires, or corrosion in the vehicle wiring harness. Check to see if a good ground path exists.

B. Thermostat and Heater Operation

Turn off the ignition switch and cool the body assembly to below 40 degrees Fahrenheit.

**Note:** If this test is performed in warm weather (above 30 deg. F) it may be necessary to remove the heater and thermostat assembly and cool it in a freezer.

Using an ohmmeter, check the resistance between the electrical pins in the connector. The resistance should be 1.5 to 1.7 ohms for the 12 volt heater assembly and 6.0 to 6.9 ohms for the 24 volt heater assembly. If the resistance is higher than the maximum stated, replace the heater and thermostat assembly.

Warm the heater and thermostat assembly to over 90 degrees Fahrenheit and again check the resistance. The resistance should exceed 1000 ohms. If the resistance values obtained are within the stated limits, the thermostat and heater assembly is operating properly. If the resistance values obtained are outside the stated limits, replace the heater and thermostat assembly.



## REPAIRING THE AD-SP™ AIR DRYER GENERAL

If, after completing the routine operation and leakage tests, it has been determined that one or more components of the air dryer requires replacement or maintenance, refer to the following list to find the appropriate kit(s). When repairing or replacing components of the air dryer use only genuine Bendix parts.

### MAINTENANCE KITS AVAILABLE:

109495 ... 12 VOLT REPLACEMENT HEATER AND THERMOSTAT ASSEMBLY KIT

109496 ... 24 VOLT REPLACEMENT HEATER AND THERMOSTAT ASSEMBLY KIT

109993 ... TURBO CUT-OFF MAINTENANCE KIT

5008414 . DESICCANT CARTRIDGE REPLACEMENT

109995 ... PURGE & RELIEF VALVE MAINTENANCE KIT

65677 ... The SC-PR™ single check protection valve is non-serviceable. Replace as an assembly.

### **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.

## AD-SP™ AIR DRYER REMOVAL

1. Park the vehicle on a level surface and prevent movement by means other than the brakes.
2. Drain **ALL** reservoirs to 0 p.s.i. (0 kPa). - **Caution: Compressor discharge line may still contain residual pressure.**
3. Identify, mark and disconnect the supply, delivery and control port air lines. Disconnect the wiring harness connector from the heater and thermostat assembly connector on the body assembly.
4. If so equipped, disconnect, remove and save the exhaust line from the exhaust port of the air dryer.
5. Remove the three mounting bolts that secure the air dryer to the vehicle and remove the air dryer.  
**Note:** It is important to retain the three mounting bolts since their length is specific to mounting the air dryer without damage. If these bolts must be replaced, the **same length must be used.**
6. Remove the AD-SP™ air dryer from its mounting brackets on the vehicle.

## DISASSEMBLY FOR PART REPLACEMENT AND KIT INSTALLATION

1. The following disassembly and assembly procedures are presented for reference purposes and assumes that the appropriate AD-SP™ air dryer kits are on hand. The instructions provided with these parts and kits should be followed instead of the instructions presented here.
2. The replacement parts and maintenance kits that are available do not require full disassembly and in most cases do not require the removal of the AD-SP™ air dryer from the vehicle.
3. If removal of the air dryer is necessary adhere to the following caution:

**Caution:** While performing service on the AD-SP™ air dryer, it is **not** recommended that a clamping device (vise, C-clamp, etc.) be used to hold any die cast aluminum component as damage may result. To hold the body, install a pipe nipple in the supply port and clamp the nipple into a vise.

### DISASSEMBLY - TURBO CUT-OFF VALVE

1. Loosen the supply port line and allow any residual air in the discharge line to drain.
2. Remove the retaining ring from the body assembly, then remove the turbo cut-off cap from the body. Remove the turbo cut-off cap o-ring.
3. Remove the turbo cut-off piston from the body.
4. Remove the large and small diameter o-rings from the piston.

### DISASSEMBLY - PURGE/RELIEF VALVE

1. If so equipped, disconnect, remove and save the exhaust line from the exhaust port of the air dryer.
2. Remove the retaining ring from the body assembly, then remove the non-metallic exhaust cover and spring from the body. **Note:** The spring exerts a 30 pound force against the exhaust cover.
3. Carefully remove the purge piston from the body and remove the o-ring from the purge piston.
4. The purge valve has two different sides. Note which side is visible **before** removing the valve. Remove the valve from the body.

### DISASSEMBLY - HEATER AND THERMOSTAT

1. Disconnect the vehicle wiring harness connector that mates with the heater and thermostat connector on the body. Pry the lock tabs out, on the vehicle wiring harness connector, before removal from the air dryer connector. Make sure connector seal is present on the vehicle wiring harness connector.
2. Remove the retaining ring that secures the heater and thermostat in the body.
3. Carefully pull the heater and thermostat assembly straight out of the body.
4. Remove the o-ring from the heater connector.

### DISASSEMBLY - DESICCANT CARTRIDGE

1. Place a strap wrench or equivalent tool on the desiccant cartridge next to the lip low on the cartridge and rotate counter clockwise to remove the desiccant cartridge.

### CLEANING, INSPECTION AND ASSEMBLY PREPARATION

1. Clean the exterior of the body.
2. Using a clean rag, wipe the body bores clean.

3. Inspect for physical damage to the body casting, broken and or missing parts.
4. Inspect the interior and exterior of the body for severe corrosion, pitting and cracks. Superficial corrosion and or pitting on the exterior portion is acceptable.
5. Inspect the bores, valve seating and o-ring contact areas for deep scuffing or gouges or nicks that would not permit an air tight seal.
6. Inspect the pipe threads in the body. Make certain they are clean and free of thread sealant.
7. Inspect the purge valve piston seat for nicks and excessive wear.
8. Inspect all air line fittings for corrosion. Clean all old thread sealant from the pipe threads.
9. All o-rings removed should be discarded and replaced with new o-rings provided in appropriate kit(s).
10. Lubricate the body bores and o-ring grooves, in the body and components, with a silicone grease only such as those packaged with Bendix maintenance kits.
11. Lubricate all o-rings with a silicone grease only, such as those packaged with Bendix maintenance kits.

Any component exhibiting a condition described in step 3 to 8 should be replaced.

### ASSEMBLY - TURBO CUT-OFF VALVE

1. Lubricate all o-rings with a silicone grease only, such as those packaged with Bendix maintenance kits.
2. Install the large and small diameter o-rings on the piston.
3. Install the turbo cut-off piston assembly in the body.
4. Install the o-ring on the turbo cut-off cap then install the cap in the body.
5. Install the retaining ring in the body, making certain that it is fully seated in its groove.
6. Before placing vehicle back into service, perform the *Operation & Leakage Tests* stated elsewhere in this manual.

### ASSEMBLY - PURGE/RELIEF VALVE

1. Lubricate the piston o-ring with a silicone grease only, such as those packaged with Bendix maintenance kits. Also lubricate completely around the outside edge of the purge valve.
2. Install the purge valve in the body making certain that it is firmly and squarely seated in the body with the correct side visible. **Note:** The three "bumps" on the purge valve should not be visible. If the 3 "bumps" are visible after the purge valve is installed, the valve must be removed and re-installed.

3. Install the o-ring on the purge piston, then install the piston in the body taking care not to cut the piston o-ring.
4. Install the non-metallic exhaust cover and spring in the body.
5. Install the retaining ring in the ring in the body, **making certain that it is fully seated in its groove.**
6. If so equipped, reconnect the exhaust line from the exhaust port of the air
7. Before placing vehicle back into service, perform the *Operation & Leakage Tests* stated elsewhere in this manual.

### ASSEMBLY - HEATER AND THERMOSTAT

1. Lubricate the connector o-ring with a silicone grease only, such as those packaged with Bendix maintenance kits.
2. Install the o-ring on the connector, then slide the heater and thermostat assembly into the body making certain not to cut the o-ring. Note that the "tab" on the assembly fits into the corresponding slot in the body.
3. Install the retaining ring in the ring in the body, **making certain that it is fully seated in its groove.**
4. Apply a dielectric grease on the heater and thermostat connector contacts (both the heater and thermostat and vehicle wiring harness connector halves).
5. After making certain the accordion seal is in place on the vehicle wire harness connector, connect the wire harness to the heater and thermostat assembly on the dryer until its lock tab snaps ("clicks") into place.
6. Before placing vehicle back into service, perform the *Operation & Leakage Tests* stated elsewhere in this manual.

### ASSEMBLY- DESICCANT CARTRIDGE

1. Lubricate the desiccant cartridge sealing ring with a silicone grease only, such as those packaged with Bendix maintenance kits and replacement parts.
2. Screw the desiccant cartridge on to the body, by hand, until the seal makes contact with the body and rotate clockwise **approximately one full turn**. If necessary, place a strap wrench or equivalent tool on the desiccant cartridge next to the lip low on the cartridge.
3. Before placing vehicle back into service, perform the *Operation & Leakage Tests* stated elsewhere in this manual.

### INSTALLATION

1. Install the assembled AD-SP™ air dryer back onto the vehicle using the same three mounting bolts retained during removal. Tighten, then torque the three cap screws to 50 lb. ft.

2. Reconnect the three air lines to the proper ports on the body (identified during disassembly). If the fittings were removed from the body, use a thread sealant making certain none enters the body during re-installation
3. Apply a dielectric grease on the heater and thermostat connector contacts (both the heater and thermostat and vehicle wiring harness connector halves).
4. After making certain the accordion seal is in place on the vehicle wire harness connector, connect the wire harness to the heater and thermostat assembly on the dryer by plugging it into the air dryer connector until its lock tab snaps ("clicks") into place.
5. If so equipped, reconnect the exhaust line to the exhaust port of the air dryer.
6. Before placing vehicle back into service, perform the *Operation & Leakage Tests* stated elsewhere in this manual.

## RETROFITTING THE AD-SP™ AIR DRYER

### GENERAL

The following retrofit instructions are presented for reference purposes only since Bendix aftermarket retrofit and replacement air dryers are packaged with the most up-to-date installation instructions. The instructions packaged with the AD-SP™ air dryer should be followed instead of those presented here.

The preceding portion of this manual deals with "in-service" repair and or replacement of the AD-SP™ air dryer. The portion of the manual that follows is concerned with installing an AD-SP™ air dryer on a vehicle not previously equipped with one.

### VEHICLE APPLICATION REQUIREMENTS

The basic application requirements presented here apply to a standard air dryer installation. The majority of vehicles in use today will meet these basic requirements however, some may not.

The following are examples of vehicles where the AD-SP™ air dryer should not be used: bulk trailer unloading operations, city transit coaches, trash compactors and other high air consumption or continuous flow systems. When vehicles of this type are encountered other Bendix air dryer models must be used. Consult your local authorized Bendix parts outlet or sales representative for additional information.

1. Charge Cycle Time - The AD-SP™ air dryer is designed to provide clean, dry air for the brake system. When a vehicle's air system is used to operate non-brake air accessories it is necessary to determine that during normal, daily operation the compressor should recover from governor "cut-in" to governor "cut-out" (usually 100 psi to 120 psi) in 90 seconds or less at engine rpm's commensurate with the vehicle vocation. **Important Note:** *The AD-SP™ air dryer must be used in conjunction*

with governors which have a 120 to 130 psi nominal cut-out pressure. If a governor is used that is not within this limitation contact your Bendix parts outlet or sales representative for additional information. If the recovery time consistently exceeds this limit, it may be necessary to "by-pass" the air accessory responsible for the high air usage. Consult your local authorized Bendix parts outlet or sales representative for additional information.

2. Purge Cycle Time - During normal vehicle operation, the air compressor must remain unloaded for a minimum of 30 seconds. This minimum purge time is required to ensure complete regeneration of the desiccant material. If the purge time is occasionally shorter than the times specified, no permanent ill effect should be expected, however, if the purge time is consistently less than the minimum, an accessory by-pass system must be installed.
3. European Air Brake Systems - The AD-SP™ air dryer must not be installed in brake systems that incorporate compressors without integral unloading mechanisms and/or utilize a compressor discharge line unloader valve. When vehicles of this type are encountered other Bendix air dryer models must be used. Consult your local authorized Bendix parts outlet or sales representative for additional information.
4. Air Compressor Size - The AD-SP™ air dryer was designed primarily for use with compressors rated up to 30 CFM. It is recommended that when using the AD-SP™ air dryer with a compressor which has a rated displacement exceeding 30 CFM that an authorized Bendix parts outlet or Bendix marketing representative be contacted for assistance.
5. Holset "E or QE" Type Air Compressors - The AD-SP™ air dryer can be installed with the Holset Type "E or QE" compressor. When the AD-SP™ air dryer is used in this installation, the Holset ECON valve should be removed and the special orifice check valve in the "make-up" line should be removed and replaced with a conventional single check valve. This is most easily done using a special 45 deg. supply port fitting, 112864, and single check valve 109710.
6. Use the following guidelines to determine the vehicle application suitable for the AD-SP™ air dryer:

Total Vehicle Res. Volume (Cu. In.)	Air Dryer Model
Less than 9,000 .....	AD-SP™ Air Dryer
Less than 9,000 w/several air accessories or high air usage (e.g. transit coaches & refuse haulers)	AD-9™ Extended Purge Volume Air Dryer
Greater than 9,000 .....	AD-9™ Extended Purge Volume Air Dryer or Contact Bendix Commercial Vehicle Systems LLC

## VEHICLE PREPARATION

1. Park the vehicle on a level surface and prevent movement by means other than the brakes.
2. Locate the front axle service (secondary) reservoir in preparation for installing the SC-PR™ single check protection valve included with AD-SP™ air dryer retro-fit kits.
  - A. With full system pressure in all reservoirs, drain any single reservoir and observe the reaction of the dash gauges. If the supply reservoir was drained, no reaction will be noted on the dash gauges. Drain air from another reservoir. When the front axle service reservoir gauge displays a pressure loss mark the reservoir that was drained. Confirm that the front axle service (secondary) reservoir has been found by building system pressure to governor cut-out and draining the marked reservoir. After the reservoir is completely drained make a service brake application and have an assistant observe the front axle service brakes. The front axle brakes should be inoperative.
  - B. Some vehicles may be equipped with multi-compartment reservoirs. This type of reservoir is easily identified by the presence of more than one drain cock in the reservoir shell. The most common is a two compartment reservoir with a "built-in" single check valve between the two compartments. In most instances when this type of reservoir is in use, one of the two compartments (usually the smallest) will be the supply reservoir and the second compartment will be either the front or rear service reservoir. Drain air from either of the two compartments and observe the dash gauges. If the supply reservoir compartment was drained, no reaction will be noted on the dash gauges. If one dash gauge displays pressure loss note whether it is the front axle (secondary) or rear axle (primary) reservoir. Mark the front axle service (secondary) reservoir or compartment. Confirm that the correct reservoir has been found in the same manner described in 2A.
3. Locate the supply reservoir ("wet tank") and note if a single check valve is installed in the discharge line connected to the reservoir. If a single check valve is found it should be removed before proceeding with the installation.
4. Locate and mark the single check valve that is used to protect and isolate the front axle service reservoir.
5. Drain all reservoirs to 0 p.s.i. (0 kPa).

## LOCATING AD-SP™ AIR DRYER ON VEHICLE

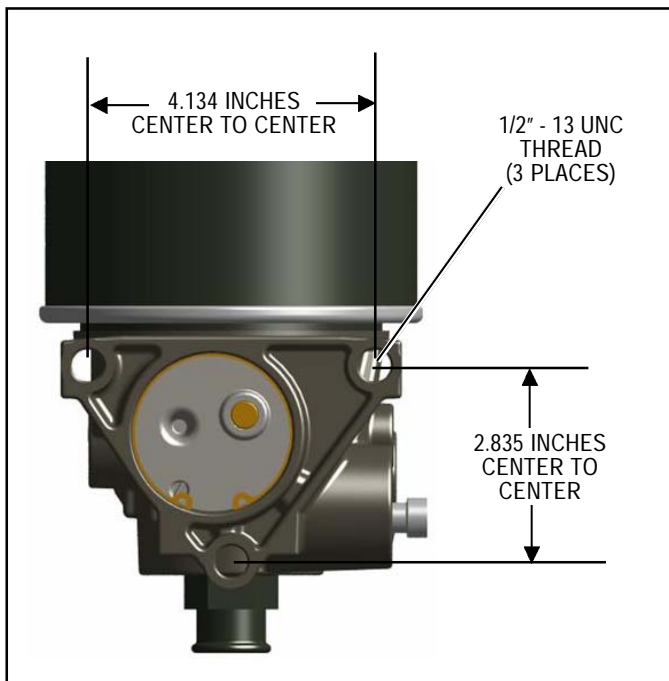
1. The AD-SP™ air dryer must be mounted vertically (purge exhaust port toward road surface) outside the engine compartment in an area of air flow while the vehicle is in motion. The AD-SP™ air dryer must not be exposed to direct wheel splash (located behind axle mud flap is acceptable).
2. Locate the AD-SP™ air dryer as close to the first (supply) reservoir as possible.

- Do not locate the AD-SP™ air dryer near heat producing components such as the vehicle exhaust and make certain adequate clearance from moving components (e.g. drive shaft, suspension, pitman arm, etc.) is provided.
- Locate the AD-SP™ air dryer on vehicle so that a minimum of 1" clearance above the cartridge is available to allow cartridge servicing. Additionally, provide access to the bracket bolts so the unit may be removed when necessary.
- When choosing the mounting location for the AD-SP™ air dryer, note the discharge line length requirements stated under the heading *Connecting the Air Lines*, elsewhere in this manual.

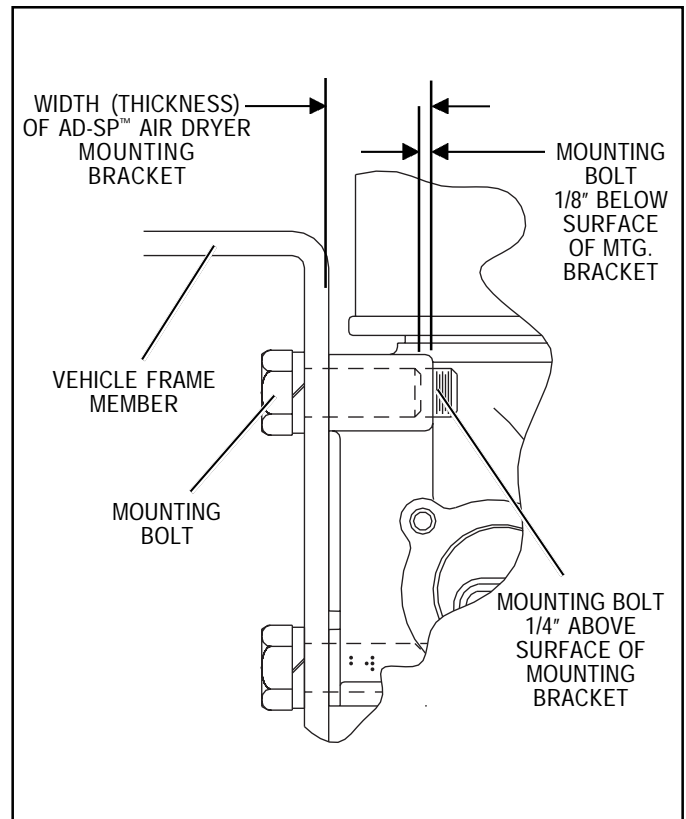
**Important Note:** Under normal operating conditions, the maximum inlet air temperature for the AD-SP™ air dryer is 150 degrees Fahrenheit.

### MOUNTING THE AD-SP™ AIR DRYER

- Install the AD-SP™ air dryer by referring to Figure 2 and drilling the triangular mounting hole pattern in a mounting plate and then mounting the plate on the vehicle or by drilling the mounting hole pattern in the area of the vehicle chosen for mounting. **Note:** Check the vehicle manual before drilling a frame member.
- Important:** The length of the three mounting bolts used to attach the AD-SP™ air dryer to the mounting plate is very important. Refer to Figure 3. The threaded end of the 1/2" - 13 UNC bolt must be between 1/8" below to 1/4" above the surface of the AD-SP™ air dryer mounting bracket surface when **fully installed and tightened to 50 pound feet**. Damage to the dryer body will result if the bolt warning is ignored.



**FIGURE 9 - AD-SP™ SYSTEM PURGE AIR DRYER MOUNTING BRACKET DIMENSIONS**



**FIGURE 10 - AD-SP™ SYSTEM PURGE AIR DRYER MOUNTING BRACKET BOLT LENGTHS**

Measure the thickness of all materials that the three mounting bolts must pass through. Small adjustments can be made using flat washers under the bolt heads. Do not use more than 3 flat washers.

- Mount the AD-SP™ air dryer on the vehicle using three 1/2" bolts (grade 5 min.) of the proper length and washers. Torque to 50 lb. ft.

### INSTALLING THE SC-PR™ VALVE

- Refer to steps 2A and 2B under *Vehicle Preparation*. If the front axle (secondary) reservoir is:
  - A single reservoir and not part of a multiple compartment, proceed to step 2.
  - One compartment in a multiple compartment, proceed to step 3.
- Locate the single check valve that protects and isolates the front axle reservoir and remove it. Remove the air line fitting from the single check valve and install the same fitting in the SC-PR™ valve. Install the SC-PR™ valve and fitting in the reservoir port that was formerly occupied by the single check valve. Reconnect the air line to the SC-PR™ valve. Refer to Figure 12.

3. Locate an unused port in both the supply compartment and front axle compartment of the multiple compartment reservoir. Install the SC-PR™ valve in the front axle reservoir (or compartment). Connect the supply port of the SC-PR™ valve to either an unused port in the supply compartment of the reservoir OR Tee into the line between the AD-SP™ air dryer and the supply compartment of the reservoir. **Note:** Use 3/8" air brake tubing. Refer to Figure 13.

## CONNECTING THE AIR LINES

### Important General Instructions

The instructions that follow apply to all installations of the AD-SP™ air dryer regardless of whether the AD-SP™ air dryer is replacing an existing air dryer or is being installed on a vehicle that never had one installed.

If the vehicle is currently equipped with an air dryer some additional considerations apply.

- A. If the AD-SP™ air dryer is replacing an integral purge air dryer, such as the Bendix® AD-9™ air dryer, on a vehicle equipped with any compressor except the Cummins-Holset type E & QE, all that is necessary is that the air dryer be removed and the existing air lines be correctly connected to the AD-SP™ air dryer.

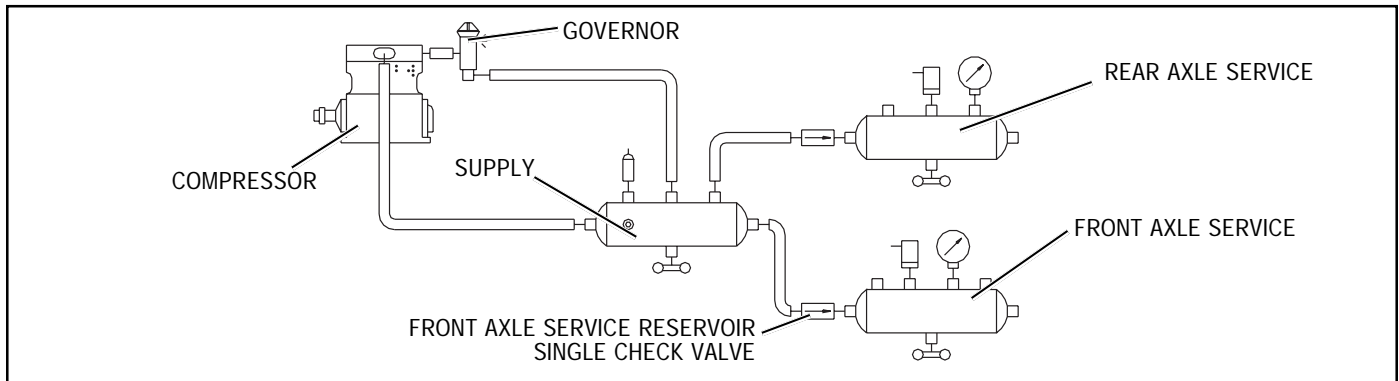


FIGURE 11 - AIR SYSTEM WITHOUT AD-SP™ SYSTEM PURGE AIR DRYER

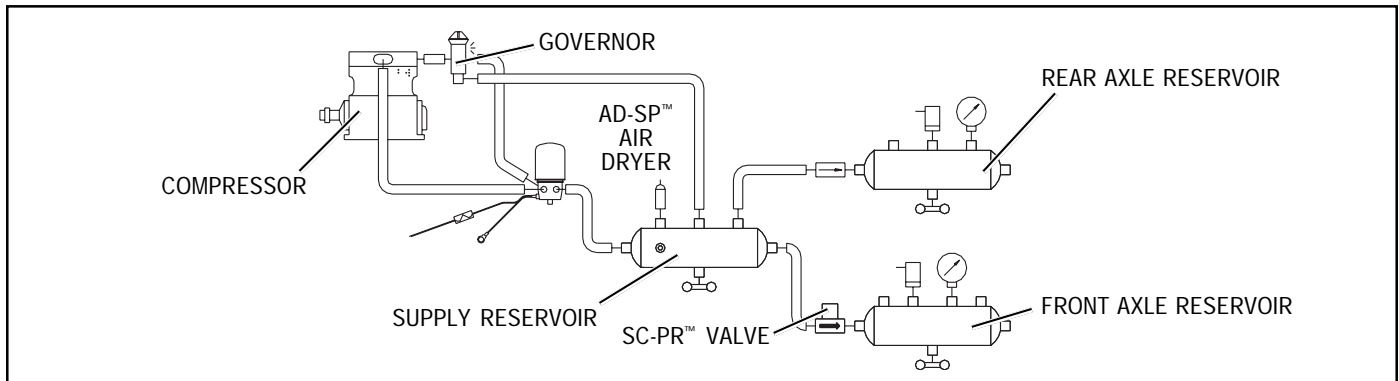


FIGURE 12 - AIR SYSTEM WITH AD-SP™ SYSTEM PURGE AIR DRYER

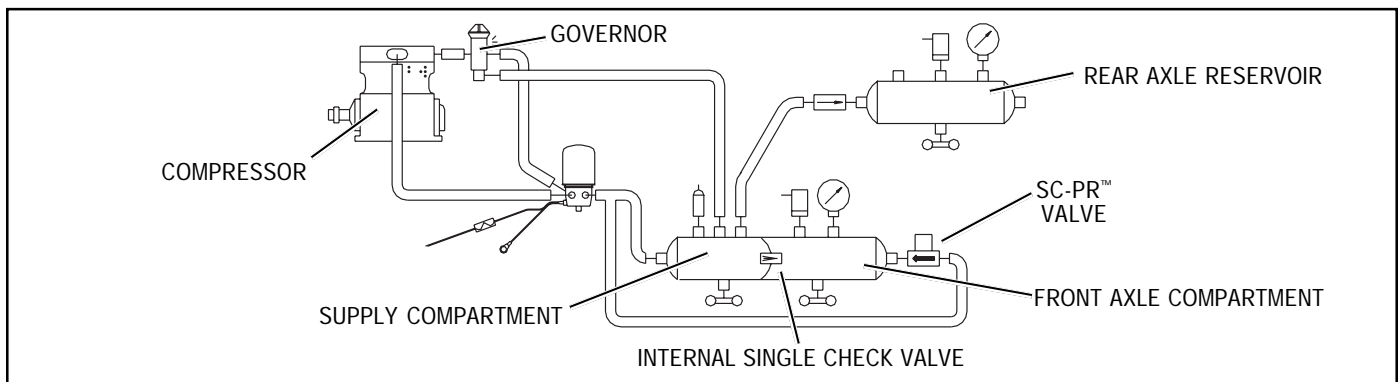


FIGURE 13 - SC-PR™ SINGLE CHECK PROTECTION VALVE INSTALLED IN MULTI-COMPARTMENT RESERVOIR

- B. If the AD-SP™ air dryer is replacing an integral purge air dryer such as the Bendix® AD-4™ or AD-9™ air dryer, on a vehicle equipped with a Cummins-Holset type E or QE compressor, in addition to removing the existing air dryer and correctly connecting the existing air lines to the AD-SP™ air dryer, it will be necessary to remove and discard the Holset ECON and special orifice check valve. See Figure 8.

### PURGE CONTROL LINE

1. Install a purge control air line having a minimum inside diameter of 3/16 inches between the AD-SP™ air dryer control port and an unused unloader port on the governor. The control line must be plumbed direct to the governor and not in series with automatic drain valves, lubrication systems, etc.
2. The control line should slope downward to the AD-SP™ air dryer without forming potential water traps.

### DISCHARGE LINE

#### General:

Refer to Appendix A, Table A for recommended discharge line lengths and sizes for various vehicle applications and vocations.

### PURGE EXHAUST LINE

1. If it is necessary to direct AD-SP™ air dryer discharge contaminates away from vehicle components a 1" (25.4 mm) I.D. hose can be clamped on the AD-SP™ air dryer exhaust

### WIRING THE HEATER/THERMOSTAT

1. Determine the vehicle's electrical system voltage and make certain that the AD-SP™ air dryer that is to be installed contains the same voltage heater. Confirm the proper voltage by noting the color of the heater and thermostat connector.

Heater & Thermostat Voltage	Connector Color
12 Volts .....	White, (No other markings)
24 Volts .....	Gray, or White w/Red Dot

The AD-SP™ air dryer is available with either a 12 or 24 volt heater and each uses 90 watts of power.

2. A separate wire harness and splice kit is with all AD-SP™ air dryer replacements and retro-fit kits. Refer to the instructions contained in that kit for the proper wiring procedure.

### TESTING THE AD-SP™ AIR DRYER

#### GENERAL OPERATIONAL STATEMENT

The AD-SP™ system purge air dryer, operates differently than integral purge air dryers such as the AD-9™ air dryer. The "System Purge", designation is used because this air

dryer uses a small portion of the supply and front axle (secondary) reservoir air pressure to purge or dry the desiccant material. During the Purge cycle, an approximately 8 - 14 psi drop in air pressure will be noted on the front axle (secondary) service reservoir dash gauge. The drop in pressure is the result of using a small amount of air from the reservoir to purge the AD-SP™ air dryer desiccant.

The SC-PR™ valve protects the air pressure in the front axle (secondary) service reservoir, in the event of a compressor, supply or rear axle reservoir failure or malfunction of the AD-SP™ air dryer purge control valving.

### TESTING

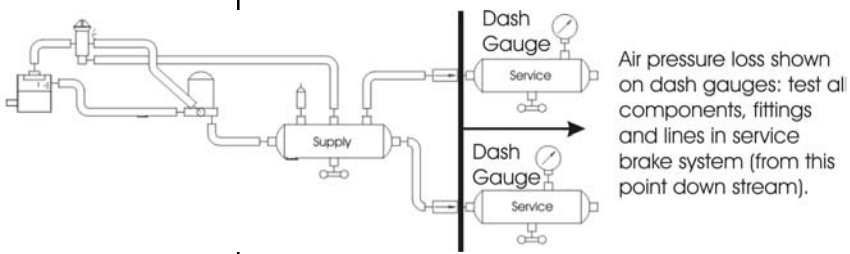
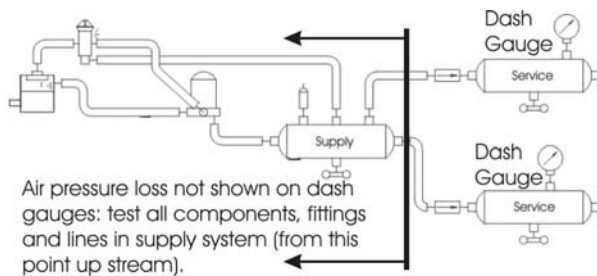
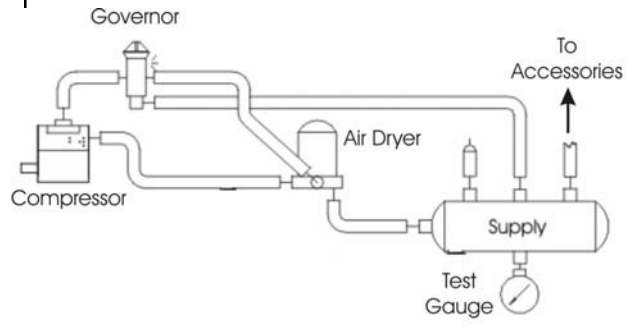
Before placing the vehicle in service, perform the following tests:

1. Close all reservoir drain cocks.
2. Build up system pressure to governor cut-out while observing that both the front axle (secondary) and rear axle service reservoir dash gauges rise equally in pressure from 0 psi to governor cut-out. **Note:** When building up brake system pressure to governor cutout during testing, the engine/compressor should be run at approximately 1,800 rpm to simulate normal operation of the vehicle.

If either gauge fails to display this condition, stop testing and check the installation of the SC-PR™ valve. Note that the AD-SP™ air dryer purges with an audible escape of air when governor cut-out pressure is reached.

3. Note that the front axle (secondary) service reservoir pressure drops approximately 8 - 14 psi and that the rear axle service reservoir loses no air pressure.
4. "Fan" the service brakes to reduce system air pressure to governor cut-in. Note that the system once again builds to full pressure and is followed by a purge at the AD-SP™ air dryer exhaust.
5. Test the operation of the SC-PR™ valve. Build system air pressure to governor cut-out and turn the ignition off. Drain the supply reservoir and note that pressure in the front axle (secondary) service reservoir does not drop below 90 psi.
6. It is recommended that the following items be tested for leakage to assure that the AD-SP™ air dryer will not cycle excessively:
  - (A) Total air system leakage (See Bendix publication BW-5057 "Air Brake Handbook").
  - (B) Compressor unloader mechanism.
  - (C) Governor.
  - (D) Drain cock and safety valve in first (supply) reservoir.
  - (E) All air connections leading to and from the first (supply) reservoir.

# AD-SP™ AIR DRYER TROUBLESHOOTING CHART

SYMPTOMS	CAUSE	REMEDY
<p>1. Dryer is constantly “cycling” or purging. Dryer purges frequently (every 4 minutes or less while vehicle is idling).</p>	<p>A. Excessive system leakage.</p> <p><b>IMPORTANT:</b> Note whether air pressure loss is shown on dash gauge(s). Pressure loss shown on gauges is caused by service brake system or component leakage. Pressure loss <b>NOT SHOWN</b> on gauges is caused by supply system or component leakage.</p>	<p>A. If leakage <b>IS SHOWN</b> on gauges test for excessive service brake system leakage. Allowable leakage:</p> <p>Single vehicle - 1 psi/minute either service reservoir.</p> <p>Tractor trailer - 3 psi/minute either service reservoir. Repair and retest as required.</p> <div style="text-align: center; margin-top: 20px;">  </div> <p>B. If leakage is <b>NOT SHOWN</b> on gauges test for excessive supply system leakage.</p> <div style="text-align: center; margin-top: 20px;">  </div> <p style="margin-top: 20px;">Remove drain cock or valve in supply reservoir (wet tank) and install air gauge. Build system pressure, allow air dryer to purge and observe air gauge in supply reservoir. Pressure drop should not exceed 1 psi per minute. <b>Perform tests 1 to 5 in the order presented.</b></p> <div style="text-align: center; margin-top: 20px;">  </div>



## AD-SP™ AIR DRYER TROUBLESHOOTING CHART (Continued)

SYMPTOMS	CAUSE	REMEDY
		<ol style="list-style-type: none"> <li>1. Test fittings, hoses, lines and connections. Apply soap solution to detect excessive leakage. Tighten or replace as needed then repeat the air dryer charge-purge cycle and observe the gauge installed in the supply reservoir. If leakage is within limits remove gauge from reservoir and replace drain cock or valve. If excessive leakage is detected, continue testing.</li> <li>2. Test accessories connected to supply reservoir. Drain all air pressure from system, disconnect all air lines leading to accessories (fan clutch, wipers, air seats, etc.) and plug the reservoir at disconnection point. Build air system pressure until air dryer purges and observe supply reservoir gauge. If leakage is no longer excessive, repair or replace leaking accessory. If excessive leakage is detected, continue testing.</li> <li>3. Test governor leakage. Build system pressure to governor cut-out, turn off engine and apply soap solution to governor exhaust port and around cap. Leakage should not exceed a 1" bubble in 5 seconds. Reduce system pressure to 80 psi or less, and re-apply soap solution. Leakage should not exceed a 1" bubble in 5 seconds. If excessive leakage is detected in either test, repair or replace governor.</li> <li>4. Test compressor unloader leakage. Drain all air pressure from system and remove the governor from the compressor. Temporarily plug the governor unloader port or air line that mated with, or connected to, the compressor. Build air system pressure until air dryer purges then <b>IMMEDIATELY SHUT OFF THE ENGINE</b>. Observe the air gauge in the supply reservoir. If leakage is within limits, replace the compressor unloaders. Re-connect the governor to the compressor (after removing plug installed in governor) and retest while observing supply reservoir gauge. If excessive leakage is detected, continue testing.</li> <li>5. Test air dryer purge valve and outlet (delivery) check valve. Drain all air pressure from system, remove the control line connection at the air dryer and plug the end of the air line leading to the governor (not the air dryer control port). Build system pressure to governor cut-out and observe air gauge. If little or no pressure drop is observed replace the air dryer check valve. If pressure drop continues, apply soap solution to air dryer purge exhaust and purge control port (where the control line was removed). Leakage should not exceed a 1" bubble in 5 seconds. If leakage is excessive repair or replace purge valve assembly.</li> </ol>

## AD-SP™ AIR DRYER TROUBLESHOOTING CHART (Continued)

SYMPTOMS	CAUSE	REMEDY
	B. Leaking (internal or external) SC-PR™ single check protection valve.	B. Locate the SC-PR™ valve on the front axle service (secondary) reservoir and replace.
	C. Incorrect governor setting or malfunctioning governor.	C. Minimum setting required for AD-SP™ air dryer installation 100 cut in and 120 cut out. Test operation of governor. Repair or replace as necessary.
	D. Rapid cycling of the governor due to air starvation at the RES port of the governor.	D. With gauge installed at RES port of governor, pressure should not drop below "Cut In" pressure at the onset of the compressor "Unloaded" cycle. If pressure drops, check for "kinks" or restrictions in line connected to RES port. Line connected to RES port on governor must be same diameter, or preferably larger than, lines connected to UNL port(s) on governor.
	E. Leaking purge control mechanism or delivery check valve in AD-SP™ air dryer.	E. Eliminate all leakage possibilities in 1A - Replace AD-SP™ air dryer.
	F. High air usage - Vehicle application.	F. Refer to the "Vehicle Application Requirements" section of this manual and verify application.
2. Water and/or Oil in Supply or Service Reservoir.	A. Improper discharge line length or improper line material. Maximum air dryer inlet temperature is exceeded.	A. Refer to section entitled <i>Connecting the Air Lines</i> as well as Appendix A, Table A columns 1 & 2 then and check line size and length.
	B. Air system charged from outside air source (outside air not passing through air dryer).	B. If system must have outside air fill provision, outside air should pass through air dryer. This practice should be minimized.
	C. Air dryer not purging (see Symptom #5).	C. See Symptom #5.
	D. Purge (air exhaust) time insufficient due to excessive system leakage (see causes for Symptom #1).	D. Check causes and remedies for Symptom #1.
	E. Excessive air usage, duty cycle too high - Air dryer not compatible with vehicle air system requirement (Improper air dryer/vehicle application).	E. See Appendix A, Table A, column 1, for recommended compressor sizes. If the compressor is "too small" for the vehicle vocation (for example, where a vehicle's vocation has changed or service conditions exceed the original vehicle or engine OE spec's) then upgrade the compressor. Note: The costs incurred (e.g. installing a larger capacity compressor, etc.) are not covered under original compressor warranty.

## AD-SP™ AIR DRYER TROUBLESHOOTING CHART (Continued)

SYMPTOMS	CAUSE	REMEDY
	<p>NOTE: Duty Cycle is the ratio of time the compressor spends building air to total engine running time. Air compressors are designed to build air (run "loaded") up to 25% of the time. Higher duty cycles cause conditions that affect air brake charging system performance which may require additional maintenance. Factors that add to the duty cycle are: air suspension, additional air accessories, use of an undersized compressor, frequent stops, excessive leakage from fittings, connections, lines, chambers or valves, etc.</p>	<p><u>Charge Cycle Time</u> - The AD-SP™ air dryer is designed to provide clean, dry air for the brake system. When a vehicle's air system is used to operate non-brake air accessories it is necessary to determine that; during normal, daily operation the compressor should recover from governor "cut-in" to governor "cut-out" (usually 100 psi to 120 psi) in 90 seconds or less at engine RPM's commensurate with the vehicle vocation. If the recovery time consistently exceeds this limit, it may be necessary to "bypass" the air accessory responsible for the high air usage. An example of where a by-pass system would be required is when the compressor is used to pressurize a tank trailer for purposes of off-loading product. Consult your local authorized Bendix parts outlet or sales representative for additional information.</p> <p><u>Purge Cycle Time</u> - During normal vehicle operation, the air compressor <b>must remain unloaded for a minimum of 30 seconds</b>. This minimum purge time is required to ensure complete regeneration of the desiccant material. If the purge time is consistently less than the minimum, an accessory by-pass system must be installed. Consult your local authorized Bendix parts outlet or sales representative for additional information.</p> <p><u>Air Compressor Size</u> - Although the AD-SP™ air dryer can be used in conjunction with larger compressors, it was designed primarily for units rated for up to 30 CFM. It is recommended that when using the AD-SP™ air dryer with a compressor which has a rated displacement exceeding 30 CFM that an authorized Bendix parts outlet or Bendix marketing representative be contacted for assistance.</p>
	<p>F. Air compressor discharge and/or air dryer inlet temperature too high.</p>	<p>F. <u>Restricted discharge line</u>. See Appendix A, Table A, column 1 &amp; 2 for recommended sizes. If discharge line is restricted or more than 1/16" carbon build up is found, replace the discharge line. Replace as necessary.</p> <p><u>Discharge Line Freeze-Up</u>: The discharge line must maintain a constant slope down from the compressor to the air dryer inlet fitting to avoid low points where ice may form and block the flow. If, instead, ice blockages occur at the air dryer inlet, insulation may be added here, or if the inlet fitting is a typical 90 degree fitting, it may be changed to a straight or 45 degree fitting. For more information on how to help prevent discharge line freeze-ups, see Bendix Bulletins TCH-08-21 and TCH-08-22. Shorter discharge line lengths or insulation may be required in cold climates.</p>

## AD-SP™ AIR DRYER TROUBLESHOOTING CHART (Continued)

SYMPTOMS	CAUSE	REMEDY
		<p><u>Insufficient coolant flow through compressor.</u> Inspect coolant line. Replace as necessary (I.D. is 1/2" min.). Inspect the coolant lines for kinks and restrictions and fittings for restrictions. Replace as necessary. Verify coolant lines go from engine block to compressor and back to the water pump. Repair as necessary.</p> <p><u>Restricted air inlet</u> (not enough air to compressor). Check compressor air inlet line for restrictions, brittleness, soft or sagging hose conditions etc. Repair as necessary. Inlet line size is 3/4 ID. Maximum restriction requirement for compressors is 25 inches of water. Check the engine air filter and service if necessary (if possible, check the air filter usage indicator).</p> <p><u>Poorly filtered inlet air</u> (poor air quality to compressor). Check for leaking, damaged or malfunctioning compressor air inlet components (e.g. induction line, fittings, gaskets, filter bodies, etc.). Repair inlet components as needed. Note: Dirt ingestion will damage compressor and is not covered under warranty.</p> <p>If you found excessive oil present in the service reservoir and you did not find any issues above, the compressor may be passing oil.</p> <p>Replace compressor. If still under warranty, follow normal warranty process.</p>
	G. Compressor malfunction.	<p>G. If you found excessive oil present in the service reservoir and you did not find any issues above, the compressor may be passing oil. Test the compressor using the BASIC cup method as described in the Bendix compressor service manual and referred to in Appendix A, Table A, column 5.</p> <p>Replace compressor. If still under warranty, follow normal warranty process.</p>
	H. Air by-passes desiccant cartridge assembly.	<p>H. When replacing the desiccant cartridge, make sure desiccant cartridge assembly is properly installed and sealing rings are in place on mounting surface of desiccant cartridge.</p>
	I. Desiccant requires replacement.	<p>I. Replace desiccant cartridge assembly. Refer to Appendix A, Table A columns 3 &amp; 4 for recommended intervals.</p>

## AD-SP™ AIR DRYER TROUBLESHOOTING CHART (Continued)

SYMPTOMS	CAUSE	REMEDY
3. Oil present at air dryer purge exhaust or cartridge during maintenance.	A. Air brake charging system is functioning normally.	A. Air dryers remove water and oil from the air brake charging system. A small amount of oil is normal. Check that regular maintenance is being performed and that the amount of oil in the air tanks (reservoirs) is within the acceptable range shown on the BASIC cup (see also column 5 of Appendix A, Table A). Replace the air dryer cartridge as needed and return the vehicle to service.
4. Air is escaping from air dryer exhaust <b>during Charge Cycle</b> but able to build system air pressure. (Compressor pumping.)	A. Air dryer purge valve leaking.	A. Repair or replace air dryer purge valve.
	B. Compressor unloader mechanism malfunction.	B. One or both dash air gauges should show higher than normal air pressure. Test compressor unloader mechanism for proper operation. Repair or replace unloaders as necessary.
	C. Governor malfunction.	C. One or both dash air gauges may show higher than normal air pressure. Test governor for proper operation. Repair or replace as necessary.
	D. Air flow to the supply reservoir restricted.	D. <u>Kinked, plugged, damaged hose tubing or fittings:</u> Check to determine if air is reaching first reservoir. Inspect for kinked tubing or hose. Check for un-drilled or restricted hose or tubing fittings. Repair or replace as necessary.  <u>Desiccant cartridge plugged:</u> Check compressor for excessive oil passing and/or correct compressor installation. Repair or replace as necessary. Replace desiccant cartridge.
	E. Excessive pressure pulsations from compressor. (Typical single cylinder type.)	E. Increase volume in discharge line by added length or size of line, or add a ping tank.
5. Air escaping from air dryer exhaust port during entire purge cycle. (Compressor not running.)	A. Leaking turbo cutoff valve in AD-SP™ air dryer.	A. Note dash gauges to verify Purge Cycle has ended. Perform Air Dryer "Operation & Leakage Tests" specified in this manual. Repair or replace as necessary.
	B. Leaking purge piston o-ring in AD-SP™ air dryer.	B. Perform Air Dryer "Operation & Leakage Tests" specified in this manual. Repair or replace as necessary.
	C. Leaking or malfunctioning purge control mechanism.	C. Replace AD-SP™ air dryer.
	D. Leaking delivery check valve.	D. Perform Air Dryer "Operation & Leakage Tests" specified in this manual. Repair or replace as necessary.

## AD-SP™ AIR DRYER TROUBLESHOOTING CHART (Continued)

SYMPTOMS	CAUSE	REMEDY
6. Unable to build air system pressure. Air <b>not</b> escaping from AD-SP™ air dryer exhaust (not exhibiting Symptom #4 plus this symptom.)	A. Frozen discharge line.	A. Inspect discharge line installation for water traps that could freeze. Refer to “Connecting The Air Lines” section in manual. Repair or replace as necessary.
	B. Compressor unloader mechanism malfunction.	B. Test compressor unloader mechanism for proper operation. Repair or replace as necessary.
	C. Governor malfunction.	C. Test governor for proper operation. Repair or replace as necessary.
	D. Air flow to service brake system restricted or plugged. Air pressure on one dash gauge normal with no, or low pressure on other gauge.	D. Kinked, plugged, damaged hose tubing or fittings in line between supply reservoir and low pressure service reservoir
7. Unable to build air system pressure.	A. AD-SP™ air dryer purge control line incorrectly connected to governor.	A. Check that purge control of AD-SP™ air dryer is connected to governor UNL (unloader) port on governor.
	B. Air trapped in purge control line (between governor and AD-SP™ air dryer.)	B. Inspect for kinked, plugged, damaged hose tubing or fittings. Check for undrilled or restricted hose or tubing fittings. Repair or replace as necessary.
	C. Governor malfunction.	C. Test governor operation. Repair or replace as necessary.
	D. Compressor unloader mechanism malfunction.	D. Test compressor unloader mechanism for proper operation. Repair or replace as necessary.
	E. AD-SP™ air dryer purge valve piston frozen open.	E. Check operation of AD-SP™ air dryer heater and thermostat. Repair or replace as necessary.
	F. AD-SP™ air dryer purge valve piston stuck.	F. Check operation and repair or replace as necessary.
8. Air dryer does not purge or exhaust air. Note: this symptom often precedes Symptom #9 if desiccant cartridge is not replaced.	A. Air not reaching AD-SP™ air dryer purge control port.	A. Test to determine air flows through purge control line to purge control port on AD-SP™ air dryer when compressor unloaded. Check for undrilled fittings. Purge control line broken, not connected, mis-connected, frozen, damaged. Inspect, repair or replace as necessary. Replace desiccant cartridge.
	B. AD-SP™ air dryer purge valve or piston frozen closed.	B. Check operation of AD-SP™ air dryer heater and thermostat. Repair or replace as necessary. Replace desiccant cartridge.
	C. Extremely high air usage requirements on vehicle.	C. Refer to the <i>Vehicle Application Requirements</i> section of this manual and verify application.

## AD-SP™ AIR DRYER TROUBLESHOOTING CHART (Continued)





SYMPTOMS	CAUSE	REMEDY
<p>9. Desiccant material being expelled from air dryer purge valve exhaust (may look like whitish liquid or paste or small beads).</p> <p>-OR-</p> <p>Unsatisfactory desiccant life.</p>	A. This symptom is almost always accompanied by one or more of Symptoms 1, 2, 3, 4, and 6. See related causes for these Symptoms above.	A. See related Remedies for Causes under Symptoms 1, 2, 3, 4 and 6*.
	B. Air dryer not securely mounted. (Excessive vibration.)	B. Vibration should be held to minimum. Add bracket supports or change air dryer mounting location if necessary*.
	C. Defective desiccant cartridge.	C. Replace*.
	D. Compressor passing excessive oil.	D. Check for proper compressor installation; if symptoms persist, replace compressor*.
	E. Air dryer has not purged for an extended period.	E. Refer to Symptom #7 Causes and Remedies*.
<p>10. "Pinging" noise excessive during compressor loaded cycle.</p>	A. A single cylinder compressor with high pulse cycles.	A. A slight "pinging" sound may be heard during system build up when a single cylinder compressor is used. If this sound is deemed objectionable, it can be reduced substantially by increasing the discharge line volume. This can be accomplished by adding an additional four feet of discharge line or adding a 90 cubic inch reservoir between the compressor and the AD-SP™ air dryer.
<p>11. The air dryer purge piston cycles rapidly in the compressor unloaded (non-compressing) mode.</p>	A. Compressor fails to "unload."	A. Faulty governor installation: no air line from governor to compressor or line is "kinked" or restricted. Install or repair air line.

\*If desiccant material is being expelled, cartridge and purge valve must be removed from air dryer and desiccant material must be removed from interior of dryer. Clean the interior surfaces of dryer and install a new cartridge. Clean and inspect the purge valve before re-installation, or replace with a new purge valve.

# Appendix A

## Table A: Maintenance Schedule and Usage Guidelines

Regularly scheduled maintenance is the single most important factor in maintaining the air brake charging system.

Vehicle Used for:	No. of Axles	Column 1	Column 2		Column 3	Column 4	Column 5
		Typical Compressors Spec'd	Discharge Line		Recommended Air Dryer Cartridge Replacement <sup>1</sup>	Recommended Reservoir Drain Schedule <sup>2</sup>	Acceptable Reservoir Oil Contents <sup>3</sup> at Regular Drain Interval
			I.D.	Length			
<b>Low Air Use</b>		Bendix® BA-921™ air compressor Bendix® Tu-Flo® 550 air compressor	1/2 in.	6 ft.	Every 3 Years	Recommended Every Month - Max of every 90 days	BASIC test acceptable range: 3 oil units per month. See appendix A.
Compressor with less than 15% duty cycle e.g. Line haul single trailer w/o air suspension, air over hydraulic brakes. 	5 or less		For oil carry-over control <sup>4</sup> suggested upgrades: 5/8 in. 9 ft.				
Compressor with up to 25% duty cycle e.g. Line haul single trailer with air suspension, school bus. 	5 or less		1/2 in.	9 ft.			For the BASIC Test Kit: Order Bendix P/N 5013711
<b>High Air Use</b>		Bendix® BA-921™ air compressor Bendix® Tu-Flo® 750 air compressor Bendix® Tu-Flo® 596 air	1/2 in.	12 ft.	Every 2 Years	Every Month	
Compressor with up to 25% duty cycle e.g. Double/triple trailer, open highway coach/RV, (most) pick-up & delivery, yard or terminal jockey, off-highway, construction, loggers, concrete mixer, dump truck, fire truck. 	8 or less		For oil carry-over control <sup>4</sup> suggested upgrades: 5/8 in. 15 ft.				
Compressor with up to 25% duty cycle e.g. City transit bus, refuse, bulk unloaders, low boys, urban region coach, central tire inflation. 	12 or less	Bendix® BA-922™, or DuraFlo™	5/8 in.	12 ft.	Every Year		
			For oil carry-over control <sup>4</sup> suggested upgrades: 3/4 in. 15 ft.				

**Footnotes:**

- 1 With increased air demand the air dryer cartridge needs to be replaced more often.
- 2 Use the drain valves to slowly drain all reservoirs to zero psi.
- 3 Allow the oil/water mixture to fully settle before measuring oil quantity.
- 4 To counter above normal temperatures at the air dryer inlet, (and resultant oil-vapor passing upstream in the air system) replace the discharge line with one of a larger diameter and/or longer length. This helps reduce the air's temperature. If sufficient cooling occurs, the oil-vapor condenses and can be removed by the air dryer. Discharge line upgrades are not covered under warranty. Note: To help prevent discharge line freeze-ups, shorter discharge line lengths or insulation may be required in cold climates. (See Bendix Bulletins TCH-08-21 and TCH-08-22, included in Appendix B, for more information.)
- 5 For certain vehicles/applications, where turbo-charged inlet air is used, a smaller size compressor may be permissible.

Note: Compressor and/or air dryer upgrades are recommended in cases where duty cycle is greater than the normal range (for the examples above).

For Bendix® Tu-Flo® 550 and 750 compressors, unloader service is recommended every 250,000 miles.



# Appendix B

## Additional Troubleshooting Information

The troubleshooting procedure presented on the following pages has been excerpted from a laminated card entitled: Troubleshooting Charging and Air Supply Systems. The complete card can be obtained from authorized Bendix parts outlets under literature number BW1779. It is presented here because of the air dryers connection to the supply air system and for convenience. The procedure is not all inclusive but rather represents the most commonly encountered complaints.

