



Service Data

SD-08-2414

Bendix® AD-IP® Integral Purge and AD-IP® PuraGuard® Oil Coalescing Integral Purge Air Dryers

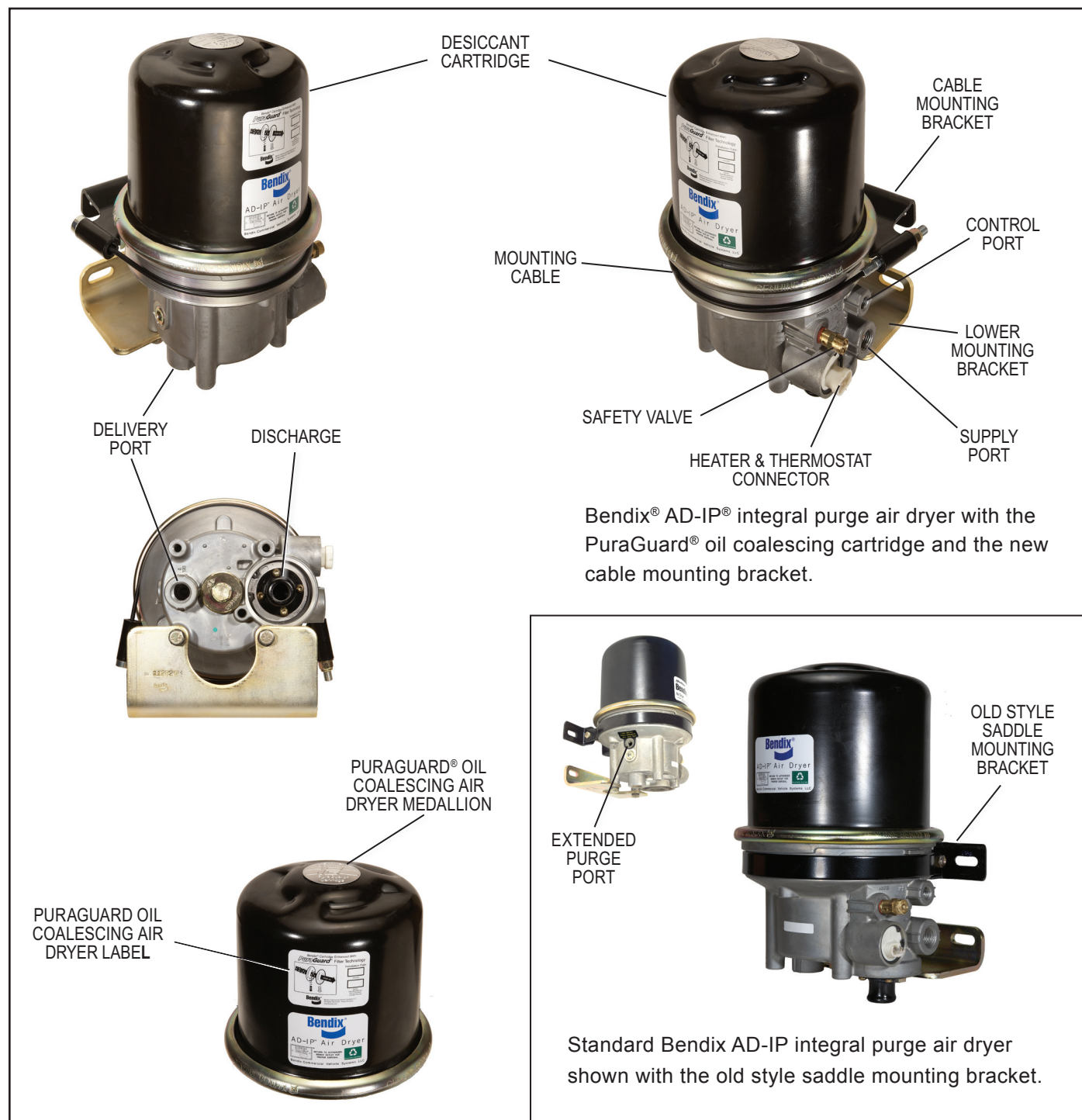


FIGURE 1 - BENDIX® AD-IP® INTEGRAL PURGE AIR DRYERS



GENERAL SAFETY GUIDELINES



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

When working on or around a vehicle, the following guidelines should be observed AT ALL TIMES:

- ▲ Park the vehicle on a level surface, apply the parking brakes and always block the wheels. Always wear personal protection equipment.
- ▲ Stop the engine and remove the 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.
- ▲ 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.
- ▲ 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 a Bendix® AD-IS® air dryer system, a Bendix® DRM™ dryer reservoir module, or a Bendix® AD-9si® air dryer, be sure to drain the purge reservoir.
- ▲ Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that safely removes all electrical power from the vehicle.
- ▲ Never exceed manufacturer's recommended pressures.
- ▲ You should consult the vehicle manufacturer's operating and service manuals, and any related literature, in conjunction with the Guidelines above.
- ▲ Never connect or disconnect a hose or line containing pressure; it may whip and/or cause hazardous airborne dust and dirt particles. Wear eye protection. Slowly open connections with care, and verify that no pressure is present. Never remove a component or plug unless you are certain all system pressure has been depleted.
- ▲ Use only genuine Bendix® brand replacement parts, components and kits. Replacement hardware, tubing, hose, fittings, wiring, etc. must be of equivalent size, type and strength as original equipment and be designed specifically for such applications and systems.
- ▲ 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.
- ▲ Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.
- ▲ For vehicles with Automatic 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.
- ▲ The power **MUST** be temporarily disconnected from the radar sensor whenever any tests **USING A DYNAMOMETER** are conducted on a vehicle equipped with a Bendix® Wingman® system.

DESCRIPTION

The function of the Bendix® AD-IP® integral purge air dryer—and the Bendix® AD-IP® integral purge air dryer with PuraGuard® oil coalescing—is to collect and remove air system contaminants in solid, liquid and aerosol form, before they enter the brake system. They provide 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 AD-IP and AD-IP PuraGuard oil coalescing air dryers consist of a desiccant cartridge secured to a die cast aluminum end cover with a single, central bolt. The end cover contains a check valve assembly, safety valve, heater and thermostat assembly, three pipe thread air connections, optional extended purge port (plugged), and the purge valve assembly. The removable purge valve assembly incorporates the purge valve mechanism and a turbo charger cut-off feature that is designed to prevent loss of engine turbo-boost pressure during the purge cycle of the air dryer. For ease of serviceability, all replaceable assemblies can be replaced without removing the air dryer from its mounting on the vehicle.

The AD-IP PuraGuard oil coalescing air dryer has an identical appearance to the standard AD-IP air dryer, but contains a coalescing media at the inlet of the desiccant bed. The coalescing media provides a higher level of oil removal over the standard AD-IP air dryer. The AD-IP PuraGuard oil coalescing air dryer has all the same functions of the standard AD-IP air dryer and is used where lower oil concentration levels are required. The AD-IP PuraGuard oil coalescing air dryer can be identified by the PuraGuard oil coalescing label shown in Figure 1 located on the air dryer cartridge.

Early Bendix AD-IP air dryers included a “Drop In” configuration for air systems that use either the Holset® (Cummins®) Type E or QE air compressor. For information pertaining to this configuration see the *Bendix AD-IP Air Dryer Troubleshooting Chart* at the end of the manual.



When servicing, note that standard Bendix AD-IP air dryers, or air dryer cartridges, may be serviced with PuraGuard® oil coalescing air dryer or cartridges, however, PuraGuard (PG) oil coalescing air dryer or cartridges must only be serviced with like replacements.

Sensitive downstream components such as automated manual transmissions, diesel exhaust emission systems, etc. can be damaged due to excessive oil levels. Therefore, always replace a PG cartridge with a Bendix PG cartridge.

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

Air Connection	Function/Connection
CON 4	Control Port (purge valve control & turbo cut-off).
SUP 11.....	Supply Port (air in).
DEL 2.....	Delivery Port (air out).
(Not Identified).....	Extended Purge Port

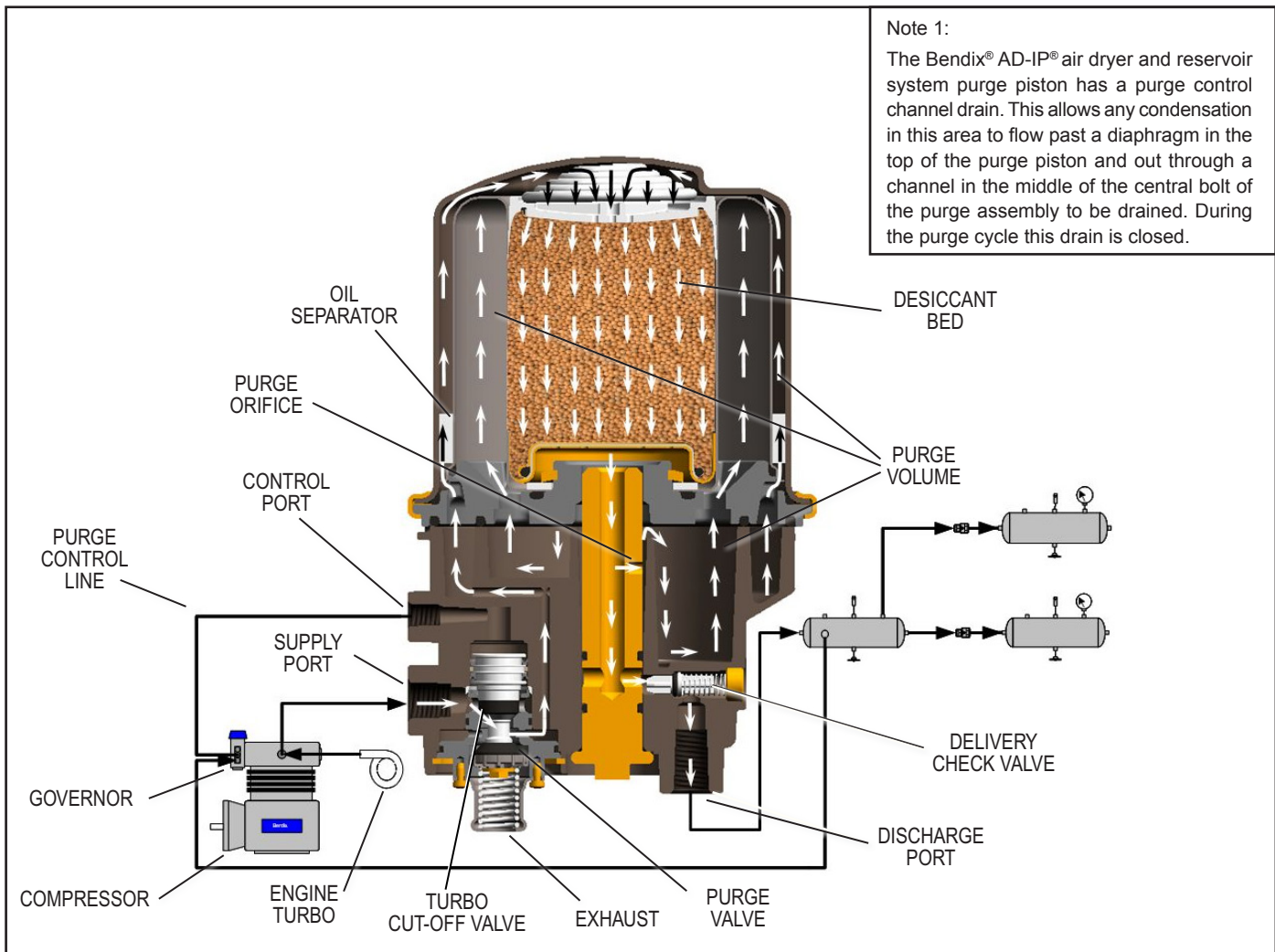


FIGURE 2 - BENDIX® AD-IP® INTEGRAL PURGE AIR DRYER CHARGE CYCLE

OPERATION

GENERAL

Note: Unless otherwise stated in this manual, the Bendix® AD-IP® air dryer refers to both the standard and Bendix® AD-IP® PuraGuard® oil coalescing air dryer. The AD-IP 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 2)

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.

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 end cover.

After exiting the end cover, the air flows into the desiccant

cartridge. Once in the desiccant cartridge the air first flows through an oil separator, located between the outer and inner shells of the cartridge. The separator removes water in liquid form as well as liquid oil and solid contaminants.

Air, along with the remaining water vapor, is further cooled as it exits the oil separator and continues to flow upward between the outer and inner shells. Upon reaching the top of the cartridge the air reverses its direction of flow and enters the desiccant drying bed. Air flowing down through the column of desiccant becomes progressively drier as water vapor adheres to the desiccant material in a process known as “ADSORPTION.” The desiccant cartridge using the adsorption process typically removes most of the water vapor from the pressurized air.

Dry air exits the bottom of the desiccant cartridge and flows through the center of the bolt used to secure the cartridge to the end cover. Air flows down the center of the desiccant cartridge bolt, through a cross drilled passage and exits the air dryer delivery port through the delivery check valve.

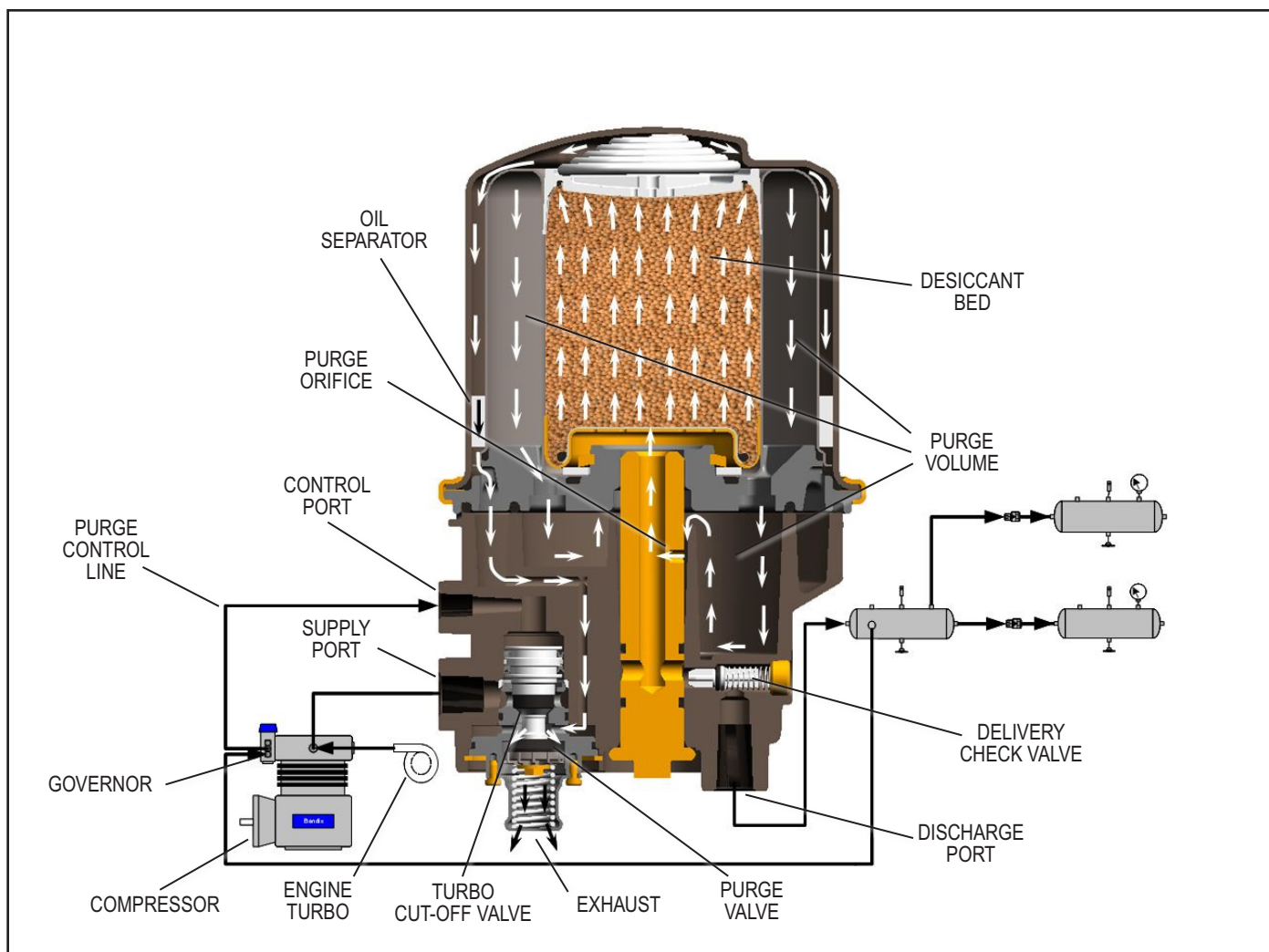


FIGURE 3 - BENDIX® AD-IP® INTEGRAL PURGE AIR DRYER PURGE CYCLE

Note: the early end cover designs incorporated a vertical delivery check valve while the newer versions have a horizontal check valve. Both have the same function, but the components are not interchangeable. See Figure 4.

A small amount of the air flowing through the center of the desiccant cartridge bolt flows out the cross drilled purge orifice and into the purge volume, for regenerating the desiccant. The air dryer will remain in the charge cycle until the air brake system pressure builds to the governor cut-out setting.

PURGE CYCLE (Refer to Figure 3)

As air brake system pressure reaches the cut-out setting of the governor, the governor unloads the compressor (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 Bendix® AD-IP® air dryer end cover control port. The purge piston

moves in response to air pressure causing the purge valve to open to the atmosphere and the turbo cut-off valve to close off the supply of air from the compressor (this will be further discussed in the *Turbo Cut-off Feature* section). Water and contaminants in the end cover sump are expelled immediately when the purge valve opens. Also, air which was flowing through the desiccant cartridge changes direction and begins to flow toward the open purge valve. Liquid oil and solid contaminants collected by the oil separator are removed by air flowing from the purge volume through the desiccant drying bed to the open purge valve.

The desiccant cartridge decompression lasts only a few seconds and is evidenced by an audible burst of air at the AD-IP air dryer exhaust. No purging of air should occur after 30 seconds.

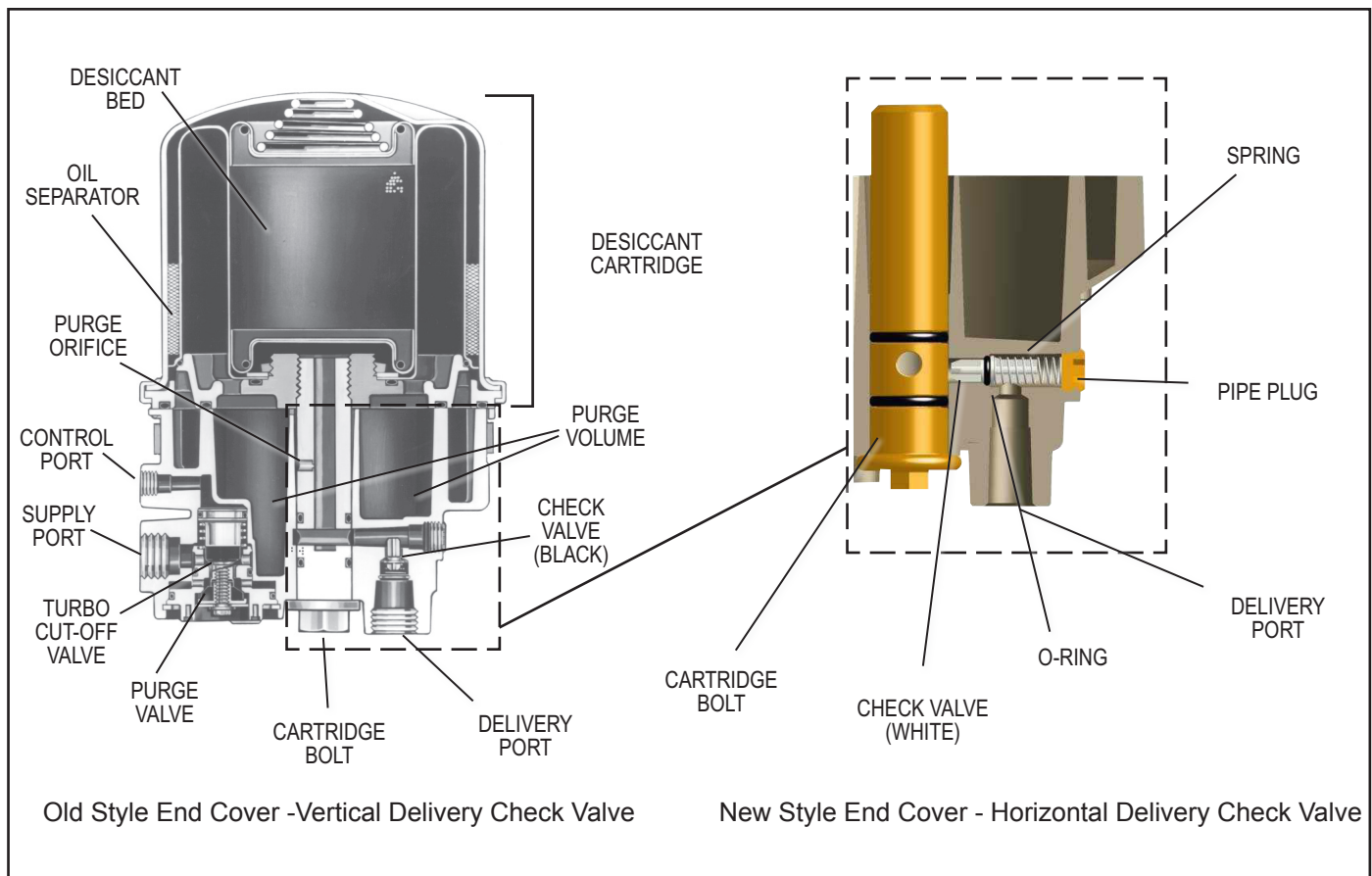


FIGURE 4 - BENDIX® AD-IP® AIR DRYER SECTIONAL VIEW

The actual reactivation of the desiccant drying bed begins as dry air flows from the purge volume through the purge orifice in the desiccant cartridge bolt, then through the center of the bolt and into the desiccant bed. Pressurized air from the purge volume expands after passing through the 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. Generally 30 seconds are required for the entire purge volume of a standard Bendix® AD-IP® air dryer to flow through the desiccant drying bed.

The delivery check valve assembly prevents air pressure in the brake system from returning to the air dryer during the purge cycle. After the 30 second purge cycle is complete the desiccant has been reactivated or dried. The air dryer is ready for the next charge cycle to begin. However the purge valve will remain open and will not close until air brake system pressure is reduced and the governor signals the compressor to charge the system.

TURBO CUT-OFF FEATURE (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-IP air dryer in systems where the compressor intake is connected to the engine turbocharger. The turbo cut-off valve also removes the “puffing” of air out the open purge exhaust when a naturally aspirated, single cylinder compressor, equipped with an inlet check valve, is in use.

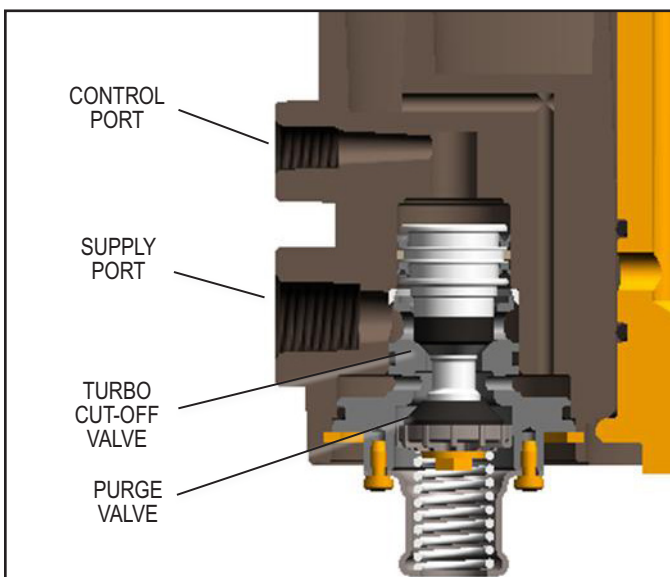


FIGURE 5 - AD-IP® INTEGRAL PURGE AIR DRYER TURBO CUT-OFF

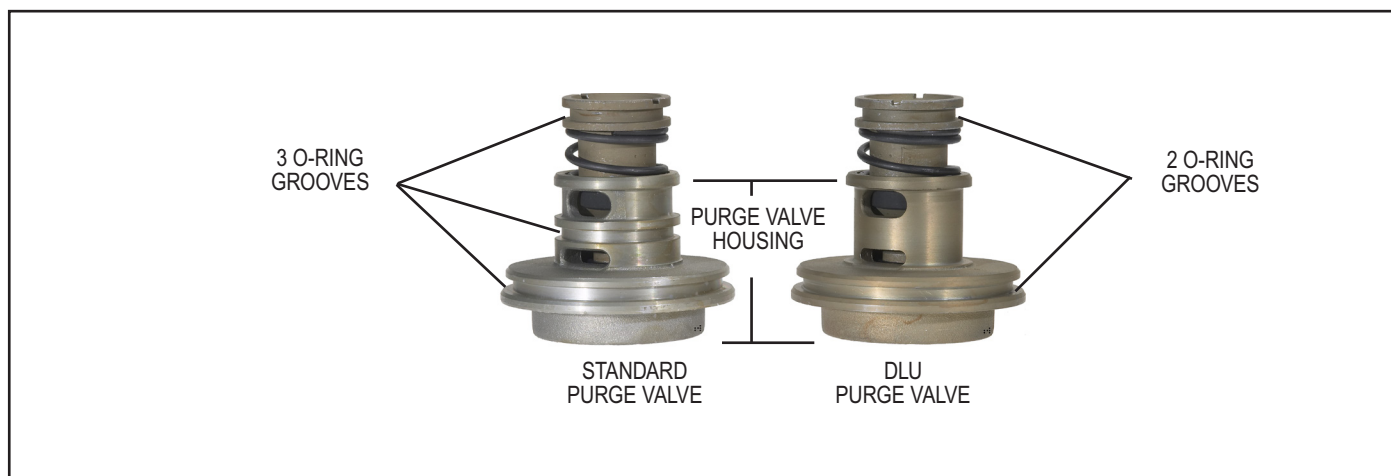


FIGURE 6 - BENDIX® AD-IP® AND AD-IP DLU AIR DRYER PURGE VALVES

At the onset of the purge cycle, the downward travel of the purge piston is stopped when the turbo cut-off valve (tapered portion of purge piston) contacts its mating metal seat in the purge valve housing. With the turbo cut-off valve seated (closed position), air in the compressor discharge line and Bendix® AD-IP® air dryer inlet port cannot enter the air dryer. In this manner the turbo cut-off effectively maintains turbocharger boost pressure to the engine.

DISCHARGE LINE UNLOADER (Refer to Figure 6)

The BendixAD-IP air dryers are available as a standard air dryer and as a Discharge Line Unloader (DLU-style). The functions of these air dryers (Standard vs. DLU) and their internal components are different. The standard air dryer cuts off the supply air from compressor to the air dryer when the compressor is in the unloaded mode, while the DLU air dryer utilizes a purge valve to bleed off the excess air instead of unloading the compressor. Externally the standard and DLU versions of each air dryer configuration are identical in appearance; however the DLU-style air dryer often has a silencer on the exhaust port.

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. Note: It is acceptable for the purge valve to be maintained as necessary, i.e., the installation of a purge valve maintenance kit, without voiding the warranty.

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.

For Bendix AD-IP air dryers: Preventive Maintenance is as easy as 1-2-3

Adhering to a preventive maintenance schedule is crucial to keeping a vehicle's air system clean and ensuring superior performance of all components that utilize system air— such as brakes, emissions equipment and automated manual transmissions. Depending on vocation, Bendix recommends a 1, 2 or 3-year air dryer cartridge replacement on vehicles equipped with a Bendix® compressor.

For severe service applications — such as residential refuse trucks or school buses — the air dryer cartridge should be replaced every year or 100,000 miles; for pick-up and delivery operations, or for double- and triple-trailer line haul trucks, every two years or 200,000 miles is the recommendation. Line-haul operations using a single trailer should swap the filter out every three (3) years or 300,000 miles. The recommended intervals for trucks equipped with non-Bendix compressors are 6 months (50,000 miles), one year (100,000 miles) and two years (200,000 miles), respectively.

More frequent intervals may be required depending on a vehicle's age, its compressor condition, use of a non-Bendix compressor, the operating environment, the vehicle's vocation, and its usage. In conjunction with these guidelines, fleets can determine the functionality of their filters by checking for moisture in the air brake system monthly. If moisture is present, the air dryer cartridge may require replacement. Reference the Bendix Service Data Sheet of the specific air dryer for additional information. (Recommended intervals for trucks equipped with non-Bendix compressors are 6 months (50,000 miles), one year (100,000 miles) and two years (200,000 miles), respectively.)

Notes:

1. Visually check for physical damage to the air dryer such as chaffed or broken air and electrical lines and broken or missing parts.
2. Check mounting bolts for tightness. Re-torque to 270–385 in-lbs.
3. Perform the *Operation & Leakage Tests* listed in this publication.



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

1. Install a pressure gauge in the #1 reservoir. Check all lines and fittings leading to and from the air dryer for leakage and integrity. Test the delivery port check valve assembly by building the air system to governor cut-out and observing a test air gauge installed in the #1 reservoir. Note the pressure on the air gauge after governor cut-out pressure is reached, a rapid loss of pressure could indicate a failed delivery port check valve. This can be confirmed by shutting the engine off, draining the air brake system pressure to a point below governor cut-in (typically < 95 psi). Make sure the dryer has completed the purge cycle (wait 30 seconds after governor cut-out) and determine if there is any air flow out of the air dryer purge valve. If air flow is detected at the purge valve, the air dryer delivery check valve should be serviced. Remove the test gauge before returning the vehicle to service.
2. 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 one (1) inch bubble in one (1) second. If the leakage exceeds the maximum specified, repair the purge valve assembly.
3. Make sure all reservoir drain cocks are closed. Build up system pressure to governor cut-out and note that Bendix® AD-IP® air dryer purges with an audible escape of air. Apply and release 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-IP air dryer purge.

4. Check the operation of the end cover heater and thermostat assembly during cold weather operation as follows:

A. Electric Power to the Dryer

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 connector with the locking latch. 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

Note: These tests are not required except in cold weather operation.

Turn off the ignition switch and cool the thermostat and heater assembly to below 35° F. Using an ohmmeter, check the resistance between the electrical pins in the air dryer connector half. The resistance should be 1.5 to 3.0 ohms for the 12 volt heater assembly and 6.0 to 9.0 ohms for the 24 volt heater assembly.

Warm the thermostat and heater assembly to over 90° F. 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.

REBUILDING THE BENDIX® AD-IP® 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 *Bendix Quick Reference Catalog (BW1114)*, available on www.bendix.com, for the latest maintenance kits and service parts.

When rebuilding or replacing components of the air dryer use only genuine Bendix® service parts.

BENDIX AD-IP AIR DRYER REMOVAL

This air dryer removal process is presented in the event it becomes necessary to replace the entire air dryer.

Normal service and parts replacement does not require removal of the air dryer from the vehicle.

1. Park the vehicle on a level surface and prevent movement by means other than the brakes.

Maintenance Kits	
Description	Piece Number
Cartridge Bolt Kit	109498
Desiccant Cartridge Service New	065624
Desiccant Cartridge Remanufactured	109493X
Bendix® PuraGuard® Coalescing Cartridge Kit - Service New	065624PG
PuraGuard Coalescing Cartridge Kit - Reman Exchange	109493PGX
Delivery Check Valve Kit	109494
Exhaust Cover Kit	5011327
Extended Purge Kit 3/8" U-Bolt; 90in ³ Reservoir	5012561N
Extended Purge Kit 3/8" U-Bolt; 288in ³ Reservoir	5008972N
Extended Purge Kit 1/2" U-Bolt; 90in ³ Reservoir	5005309N
12 Volt Heater & Thermostat Kit	109495
24 Volt Heater & Thermostat Kit	109496
Mounting Bracket Kit	5001247
Silencer Kit	K021189
Wiring Harness & Splicing Kit	109871N

Purge Valve Maintenance Kits		
Purge Valve Assembly Type	Configuration / Installation	Piece Number
Purge Valve Assembly Kit for climate conditions above -40°C (-40°F)	Bendix® AD-IP® Air Dryer	K022105
	Bendix® AD-IP® EverFlow® Air Dryer Module	K031560
	AD-IP Drop-In Air Dryer	
Arctic Purge Valve Assembly Kit for climate conditions between -40°C to -50°C (-40°F to -58°F)	AD-IP Air Dryer	K031559
	AD-IP EverFlow Air Dryer Module AD-IP Drop-In Air Dryer	K031561
Purge Valve Assembly Kit for climate conditions above -40°C (-40°F)	Bendix® AD-IP® Air Dryer Discharge Line Unloader	K031562
Arctic Purge Valve Assembly Kit for climate conditions between -40°C to -50°C (-40°F to -58°F)	AD-IP Air Dryer Discharge Line Unloader	K031563



2. Drain **all** reservoirs to 0 psi. Compressor discharge line may still contain residual pressure.
3. Identify and disconnect the three air lines from the end cover and note the position of end cover ports relative to the vehicle.

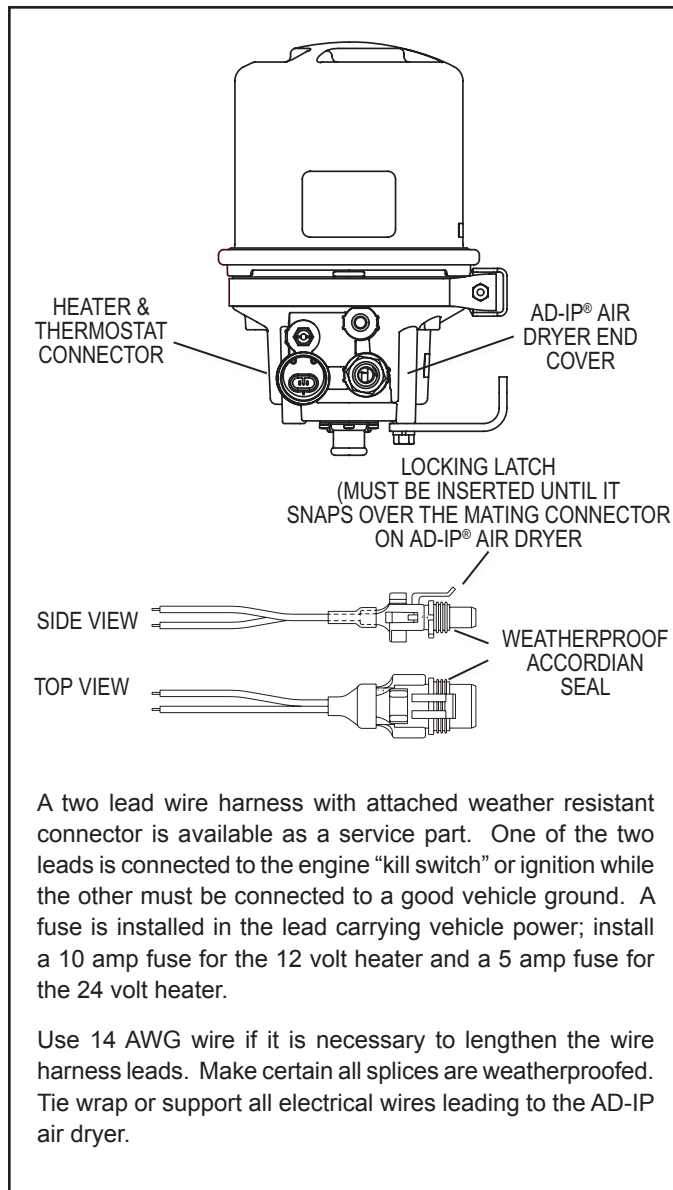
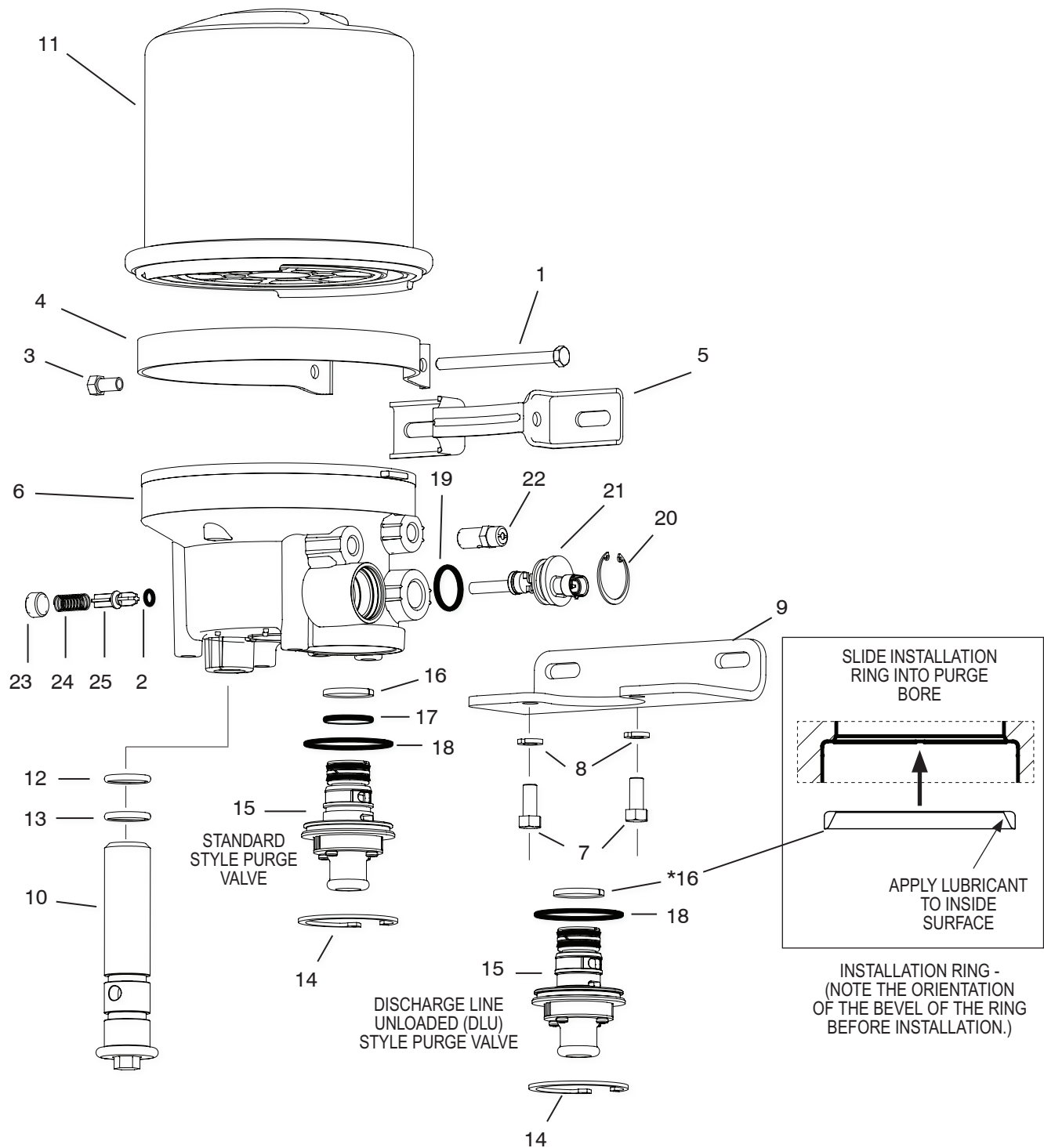


FIGURE 7 - BENDIX® AD-IP® AIR DRYER HEATER AND THERMOSTAT CONNECTOR

A two lead wire harness with attached weather resistant connector is available as a service part. One of the two leads is connected to the engine "kill switch" or ignition while the other must be connected to a good vehicle ground. A fuse is installed in the lead carrying vehicle power; install a 10 amp fuse for the 12 volt heater and a 5 amp fuse for the 24 volt heater.

Use 14 AWG wire if it is necessary to lengthen the wire harness leads. Make certain all splices are weatherproofed. Tie wrap or support all electrical wires leading to the AD-IP air dryer.

4. Unplug the vehicle wiring harness from the heater and thermostat assembly connector on the end cover assembly.
5. Remove the four bolts that secure both the upper and lower mounting brackets to the vehicle, and remove the air dryer from the vehicle.



*Most OE installed Bendix® AD-IP® air dryers manufactured after January 1, 2014 will not be equipped with a purge valve installation ring (16). The function of the installation ring has been incorporated into the air dryer lower housing. Be sure to replace the installation ring if it was removed during servicing procedures.

FIGURE 8 - BENDIX® AD-IP® AIR DRYER INTERNAL COMPONENTS – HORIZONTAL DELIVERY CHECK VALVE

Item	Description	Qty.
Reference Figure 8		
1	5/16" Cap Screw	1
2	O-ring	1
3	5/16" Sleeve Nut	1
4	Mounting Strap	1
5	Saddle Bracket	1
6	End Cover	1
7	3/8" Cap Screw	2
8	3/8" Lock Washer	2
9	Lower Mounting Bracket	1
10	Cartridge Bolt	1
11	Desiccant Cartridge	1
12	O-ring	1
13	O-ring	1
14	Retaining Ring	1
15	Purge Valve Cartridge Assembly	1
*16	Installation Ring	1
17	O-ring	1
18	O-ring	1
19	O-ring	1
20	Retaining Ring	1
21	Heater & Thermostat Assembly	1
22	Safety Valve Assembly	1
23	Delivery Check Valve Plug	1
24	Spring	1
25	Check Valve Body (white)	1
Reference Figure 9		
26	Perforated Plate	1
27	Check Ring Spring	1
28	Check Valve	1
29	O-ring	1
30	Retaining Ring	1
Reference Figure 10		
31	Upper Bracket	1
32	Cable Assembly	1
33	Isolator	2
34	Locknut	1
35	Washer	1

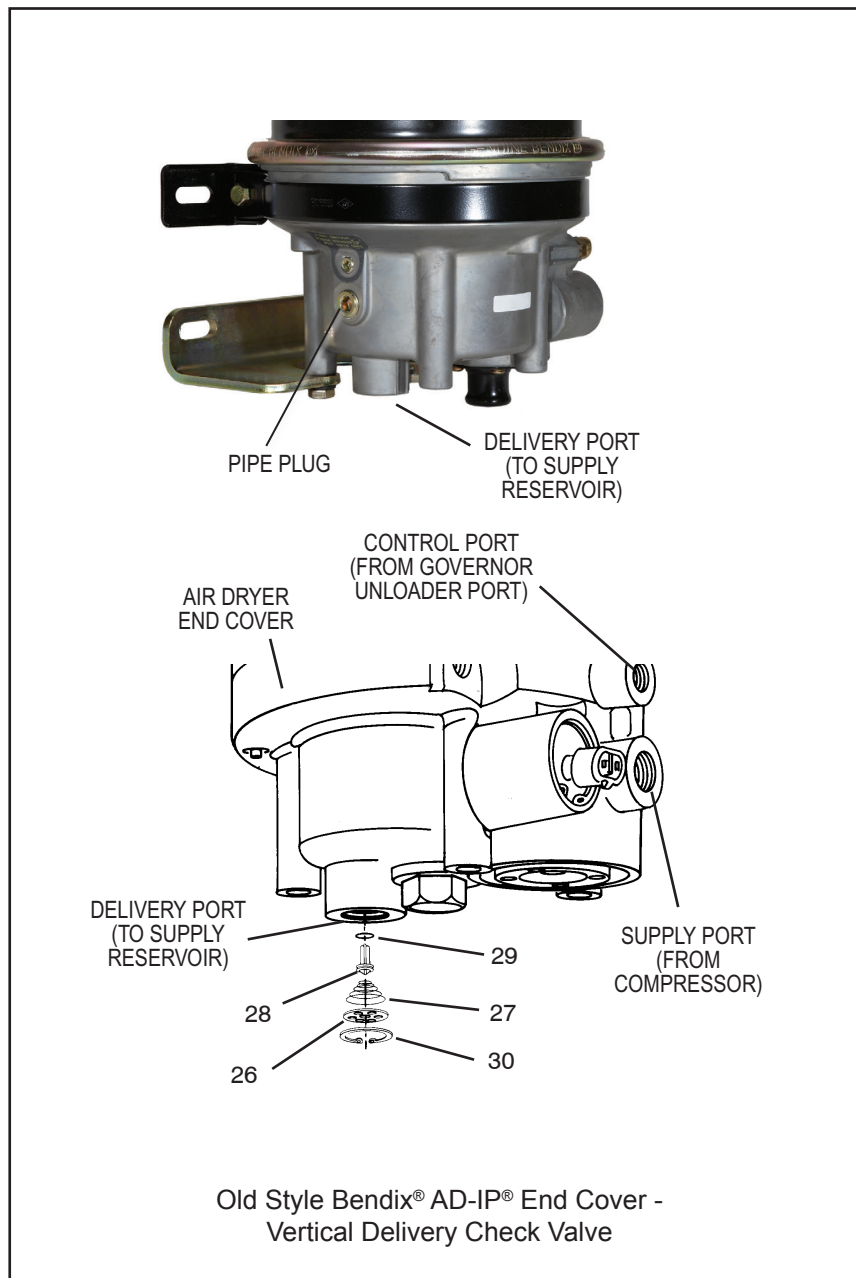


FIGURE 9 - BENDIX® AD-IP® AIR DRYER INTERNAL COMPONENTS – VERTICAL DELIVERY CHECK VALVE

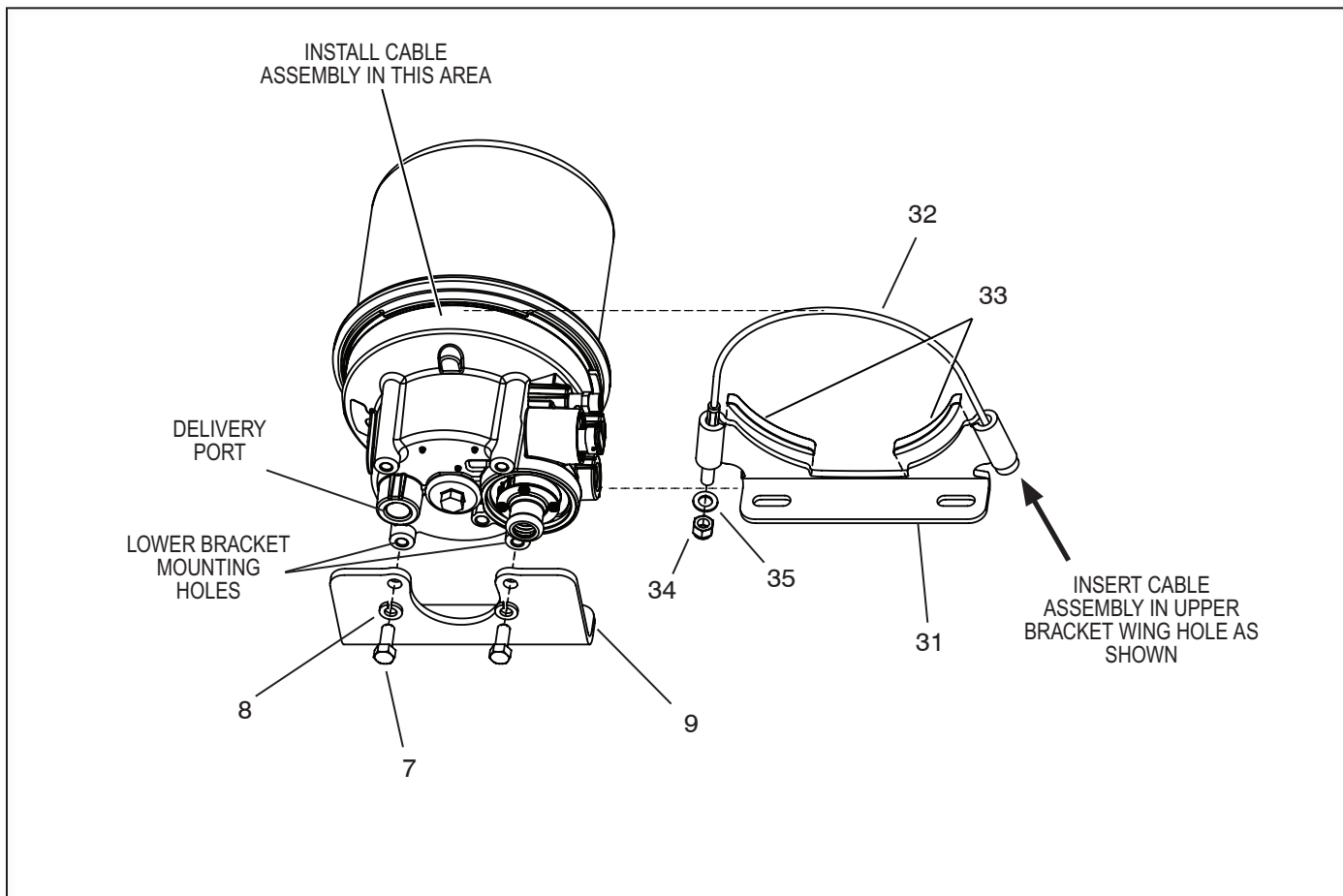


FIGURE 10 - BENDIX® AD-IP® AIR DRYER CABLE BRACKET INSTALLATION

There are two types of upper mounting brackets; saddle type (shown in Figure 8), and cable type (shown in Figure 10). Refer to the appropriate figure for the type of air dryer being serviced.

6. **Saddle Bracket:** Mark the relationship of the saddle bracket (5) to the end cover assembly (6). Remove the 5/16" cap screw (1) and sleeve nut (3) securing the upper mounting strap (4) to the saddle bracket (5). Earlier models used a washer and nut in place of the sleeve nut (3). Remove the upper mounting strap (4) from the end cover assembly (6). *Refer to Figure 8.*

Cable Bracket: Mark the relationship of the upper bracket (31) to the air dryer end cover (6). Remove the locknut (34) and washer (35) from the cable assembly. Remove the cable assembly (32) from the upper bracket. Remove the upper bracket (31) and isolators (33).

7. Mark the relationship of the lower bracket (9) to the end cover assembly (6). Remove the two 3/8" end cover cap screws (7) and two washers (8) that retain the lower mounting bracket (9) to the end cover (6).

DISASSEMBLY

The following disassembly and assembly procedure is presented for reference purposes and presupposes that a major rebuild of the Bendix® AD-IP® air dryer is being undertaken. The replacement parts and maintenance kits available generally do not require full disassembly. The instructions provided with these parts and kits should be followed in lieu of the instructions presented here. *Refer to Figures 8 and 9 during disassembly.*



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

1. Using an adjustable, or socket wrench, loosen the desiccant cartridge bolt (10), then separate the desiccant cartridge (11) from the end cover (6). Pull the desiccant cartridge bolt out of the end cover (6).



Disassembly of the desiccant cartridge assembly should not be attempted! Detail parts for the cartridge are not available and the cartridge contains a 150# spring which can not be mechanically caged.

2. Remove both o-rings (12 & 13) from the desiccant cartridge bolt.
3. Remove the retaining ring (14) that secures the purge valve assembly (15) in the end cover (6).
4. **Vertical check valve models:** Remove the retaining ring (30) that secures the delivery check valve assembly in the end cover (6). Remove and separate the perforated plate (26), spring (27), check valve body (28) and o-ring (29).
5. **Horizontal check valve models:** Remove delivery check valve plug (23) that secures the check valve assembly in the end cover (6). Remove the spring (24), check valve (25) and o-ring (2).
6. Remove the retaining ring (20) that secures the heater and thermostat assembly (21) in the end cover (6). Gently pull the heater and thermostat (21) out of the end cover (6) and remove the o-ring (19).
7. Using a 9/16" wrench, remove the safety valve assembly (22) from the end cover (6).

CLEANING & INSPECTION

1. Using mineral spirits or an equivalent solvent, clean and thoroughly dry all metal parts except the desiccant cartridge.
2. Inspect the interior and exterior of all metal parts that will be reused for severe corrosion, pitting and cracks. Superficial corrosion and/or pitting on the exterior portion of the end cover is acceptable.
3. Inspect the bores of both the end cover and the purge valve housing for deep scuffing or gouges.
4. Make certain that all purge valve housing and end cover passages are open and free of obstructions.
5. Inspect the pipe threads in the end cover. Make certain they are clean and free of thread sealant.
6. Make certain that the purge orifice in the cartridge bolt is open and free of obstructions.
7. Inspect all air line fittings for corrosion. Clean all old thread sealant from the pipe threads.
8. All o-rings removed should be discarded and replaced with new o-rings provided in appropriate kit(s).

ASSEMBLY

For purge valve assembly instructions refer to the instruction sheet included in the kit. A listing of maintenance kits is included in this document.

1. Complete the purge valve installation per the installation instructions provided in the service kit.
2. Using a 9/16" wrench, install the safety valve assembly (22) into the end cover (6).
3. **Vertical check valve models:** See *Figure 9*. Install the o-ring (29) on the check valve body (28) and push the o-ring down, over the 3 guide lands until it is in the o-ring groove of the check valve body (28). Install the check valve spring (27) on the check valve body so that the **small** coils of the spring slip over the check valve body. Install the assembled check valve body, o-ring, and spring (27, 28 & 29) in the end cover (6) so that the o-ring rests on its seat in the end cover (6) and the spring is visible. Install the perforated plate (26), in the end cover (6) and secure the check valve assembly using the retaining ring (30). Make certain the retaining ring is fully seated in its groove in the end cover (6).
4. **Horizontal check valve models:** Install o-ring (2) onto check valve (25). Place the check valve in the delivery check valve port of the end cover (6). Install the spring (24) over the delivery check valve (36) and secure with the delivery check valve plug (23).
5. Install the o-ring (19) on the heater and thermostat assembly (21). After making certain the sponge rubber cushion is positioned between the connector body and thermostat, gently push the heater and thermostat assembly (21) into the end cover (6), making certain the heating element enters the small diameter bore in the larger heater and thermostat bore in the end cover (6). Secure the heater and thermostat assembly in the body using the retaining ring (20). Make certain the retaining ring is fully seated in its groove in the end cover (6).
6. Lubricate the o-rings (12 & 13) and install them on the desiccant cartridge bolt (10) and using a twisting motion, insert the assembled desiccant cartridge bolt in the end cover (6).
7. Install the desiccant cartridge (11) on the end cover (6) making certain the cartridge is properly seated and flush on the end cover.

Note: It may be necessary to rotate the cartridge slightly until the anti-rotation lugs are properly aligned and allow the cartridge to rest flush against the end cover.



8. Using an adjustable wrench or a socket, tighten the desiccant cartridge bolt (10), to secure the desiccant cartridge (11) to the end cover (6). Torque the desiccant cartridge bolt to 65–75 ft-lbs (40 ft-lbs minimum). **Do not over torque.**

BENDIX® AD-IP® AIR DRYER INSTALLATION

1. Using the relationship marks made during step 7 of the *Bendix® AD-IP® Air Dryer Removal Procedure*, install the lower mounting bracket (9) on the end cover (6) and secure it using the two 3/8" cap screws and washers (7 & 8). Torque the cap screws to 300–360 in-lbs.
2. Using the relationship marks made during step 6 of the *AD-IP Air Dryer Removal Procedure*, install the saddle bracket (5) and mounting strap (4) on the end cover (6), and using the 5/16" cap screw (1) and sleeve nut (3) secure the strap to the saddle bracket. Tighten the 5/16" nut on the upper mounting bracket. Torque to 60-100 in-lbs.
3. Install the air dryer on the vehicle using the four bolts that secure both the upper and lower mounting brackets.
4. Reconnect the three airlines to the proper ports on the end cover (identified during step 3 of the *AD-IP Air Dryer Removal*).
5. Reconnect the vehicle wiring harness to the Bendix AD-IP air dryer heater and thermostat assembly connector by plugging it into the air dryer connector until its lock tab snaps in place.
6. Before placing vehicle back into service, perform the *Operation and Leakage Tests* stated elsewhere in this manual.

RETROFITTING THE AD-IP 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 Bendix AD-IP air dryer should be followed in lieu of those presented here.

The preceding portion of this manual deals with “in-service” repair and/or replacement of the AD-IP air dryer. The portion of the manual that follows is concerned with installing an AD-IP 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 highway vehicles in use today will meet these basic requirements however, some may not. Examples of vehicles that may not meet the requirements include, refuse trucks, city coaches, bulk trailer unloading operations and other high air consumption systems. While the Bendix AD-IP air dryer can be used on these vehicles, the standard installation procedure presented in this manual may require modification to ensure proper operation and service life. Consult your local authorized Bendix® parts outlet or sales representative for additional information.

Charge Cycle Time — The AD-IP 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 RPMs normal to 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. Consult your local authorized Bendix parts outlet or sales representative for additional information.

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 bypass system must be installed. Contact the nearest authorized Bendix parts outlet or Bendix representative for additional information. **Note:** Reservoir Volume - Total vehicle reservoir volume can impact the Charge and Purge Cycle time. The chart below can be used as a guide in determining if additional help is required.

Total Vehicle Reservoir	
Volume	Requirement
Less than 9,000 cu. in.	Standard AD-IP Air Dryer
9,000 - 12,500 cu. in.	Extended Purge AD-IP Air Dryer
Greater than 12,500 cu. in.	Contact Bendix Rep. or Bendix Engineering

Air Compressor Size — Although the AD-IP 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-IP 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.

VEHICLE PREPARATION

1. Park the vehicle on a level surface and prevent movement by means other than the brakes.
2. Drain all reservoirs to 0 psi.

LOCATING BENDIX® AD-IP® AIR DRYER ON THE VEHICLE

1. The Bendix® AD-IP® air dryer must be mounted vertically (purge exhaust toward road surface) outside the engine compartment in an area of air flow while the vehicle is in motion. The AD-IP air dryer must not be exposed to direct wheel splash. If the air dryer is located directly behind the axle, a mud flap is required.
2. Maintain a minimum clearance of 12" between the air dryer and any potential heat source (e.g. vehicle exhaust). If this is not feasible, a heat shield must be used.
3. Make certain that adequate clearance from moving components (e.g. drive shaft, suspension, pitman arm, etc.) is provided.
4. Locate the air dryer on the vehicle so that a minimum of 1/2" clearance above the air dryer is available to allow desiccant cartridge removal. A minimum of 8" clearance below the air dryer is required to allow for desiccant cartridge bolt removal.
5. When choosing the mounting location for the AD-IP 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-IP air dryer is 160 degrees Fahrenheit.

6. If possible, locate the AD-IP air dryer so that the purge exhaust does not expel contaminants on vehicle components. If this is not feasible, the purge exhaust may be redirected away from the vehicle by installing an optional special exhaust cover (piece no. 112609). The exhaust cover is available as a separate item from authorized Bendix® parts outlets. A 1" ID hose can be clamped on this special exhaust cover to allow the exhaust to be redirected.

MOUNTING THE AD-IP AIR DRYER

(Refer to Figure 8)

1. Install the lower mounting bracket (9) on the AD-IP air dryer. To accomplish this, it will be necessary to choose two, of the four available, mounting holes. To determine which two holes to utilize to attach the lower bracket, take into consideration the piping connections required to install the AD-IP air dryer and use those that will best position the unit for ease of installation. Utilizing the two cap screws (7) and washers (8), provided with the AD-IP air dryer retrofit unit, attach the lower mounting bracket and torque to 300–360 in-lbs.

Note: The bracket mounting holes in the end cover may not be pre-tapped. In this case the mounting bolt will self-tap the holes on initial installation.

2. **Saddle Bracket:** Assemble the mounting strap (4) and saddle bracket (5) as illustrated, by utilizing the 5/16" cap screw (1) and sleeve nut (3) provided. Place the upper bracket strap in the end cover channel provided for it, then install the saddle bracket and secure the strap to the saddle bracket using the cap screw (1) and sleeve nut (3) provided. Install, but do not tighten the cap screw at this time. Orient the strap and saddle bracket (5) so that it is in a flat plane with the lower bracket. Torque the 5/16" nut to 60-100 in-lbs to tighten strap onto the shell.

Cable Bracket: Press the isolators (33) onto the upper bracket (31) as shown in Figure 10. Place the air dryer onto the upper bracket (31). Insert the cable assembly (32) through the wing hole of the upper bracket (31), around the air dryer and then again through the bracket (31) on the opposite wing hole. Note: some applications may require the button end of the cable be placed on the opposite wing.

When the air dryer is installed, make sure that there isn't any interference between the cable ends and the vehicle mounting bracket. The cable assembly (32) should be placed in the end cover channel when routed around the air dryer.

Install the washer (35) and locknut (34) on the threaded end of the cable assembly (32), adjacent to the upper bracket wing hole. Tighten the locknut (34) until the washer (35) makes contact with the upper bracket (31). Do not torque the locknut (34) at this time.

Orient the cable assembly and upper bracket (31) so that it is in a flat plane with the lower bracket (9). This can be accomplished in one of two ways: either off, or on the vehicle as follows:

Off the vehicle: Place the air dryer assembly on a flat surface with the mounting brackets (1 & 9) down. Secure the brackets to the surface with C-clamps then tighten the cable locknut (34) to 140 in-lbs. Use a wrench on the hex side of the threaded end to prevent the cable from twisting.

On the vehicle: Bolt the brackets (1 & 9) to the vehicle air dryer bracket then tighten the cable locknut (34) to 140 in-lbs. Use a wrench on the hex side of the threaded end to prevent the cable from twisting.

3. Components and location used to mount the AD-IP air dryer on the vehicle must be rigid enough to minimize air dryer vibration.
4. Mount the air dryer on the vehicle using 3/8" bolts (grade 5 min.) and washers. Torque to 25 ft-lbs (300 in-lbs.)

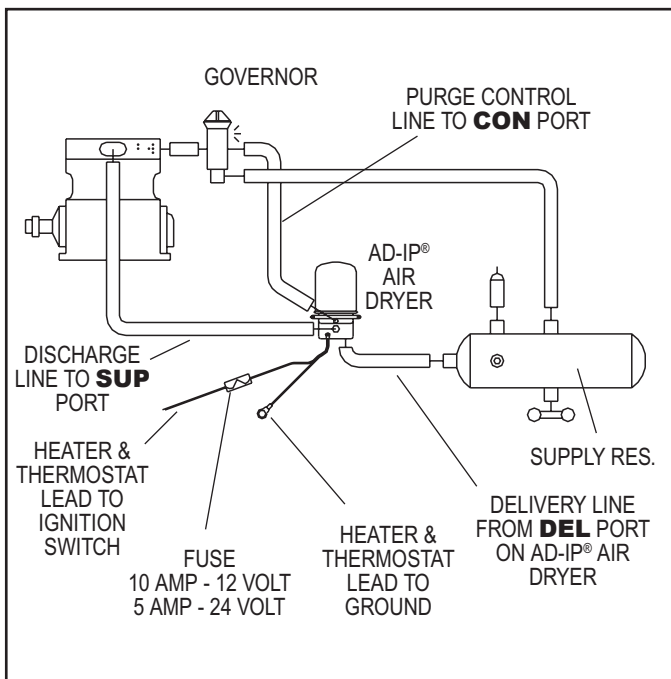


FIGURE 11 - BENDIX® AD-IP® AIR DRYER INSTALLATION

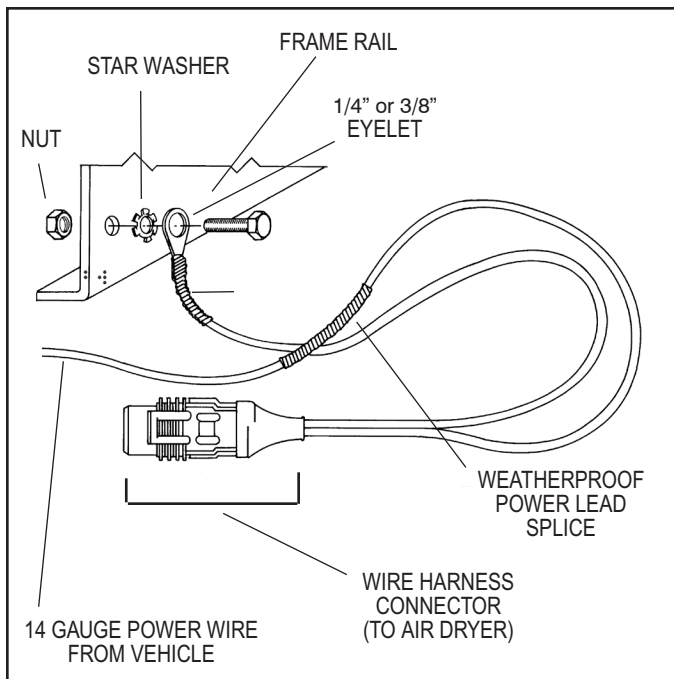


FIGURE 12 - WIRING - REMOTE POWER & LOCAL GROUND

CONNECTING THE AIR LINES

PURGE CONTROL LINE

1. Install a purge control air line having a minimum inside diameter of 3/16 inches between the Bendix® AD-IP® air dryer end cover control port and an unused unloader port on the governor. The control line must be connected directly to the governor and not in series with automatic drain valves, lubrication systems, etc.
2. The control line should slope downward to the end cover without forming sharp bends or "dips".

COMPRESSOR 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-IP air dryer discharge contaminants away from vehicle components it will be necessary to purchase a special exhaust cover for the AD-IP air dryer (Pc. No. 112609) and install on the unit. A 1 inch (25.4 mm) I.D. hose can be clamped on the special AD-IP air dryer exhaust cover.

WIRING THE HEATER & THERMOSTAT (Refer to FIGURE 7)

1. The air dryer is available with either a 12 or 24 volt heater which uses 90 watts of power. Determine the vehicle's electrical system voltage and make certain that the air dryer that is to be installed contains the same voltage heater. The air dryer's part number can be used to determine the air dryers heater voltage requirement. The heater voltage can also be identified by the color of the heater assembly connector as described in the table below.

Air Dryer Heater Voltage	Air Dryer Connector Identification
12 Volts	White (No other markings)
24 Volts	Gray, or White w/Red Dot

2. A two lead, 24 inch, wire harness with attached weather resistant connector is needed for the installation of an AD-IP air dryer. Connect one of the two leads of the wire harness to the engine kill or ignition switch. The remaining lead of the wire harness must be connected to a good vehicle ground (not to the air dryer or its mounting bracket). A fuse must be installed in the power carrying wire; install a 10 amp fuse for 12 volt heaters and a 5 amp fuse for 24 volt heaters.

3. The wire harness—available in the Wire Harness and Splice Kit from authorized Bendix® parts outlets—is not included with the service replacement air dryer. When using this kit, if it becomes necessary to lengthen the harness, use only 14 gauge wire. When splicing wires, ensure all wire splices are waterproofed.
4. Tie wrap or support all electrical wires leading to the Bendix® AD-IP® air dryer at 6–8 inch intervals.

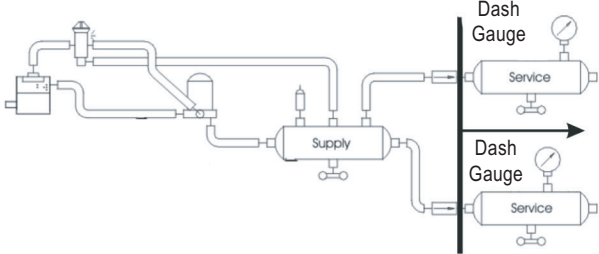
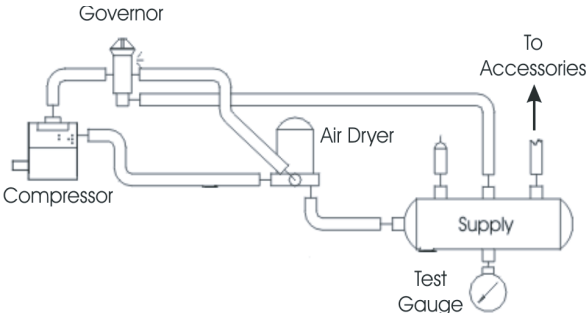
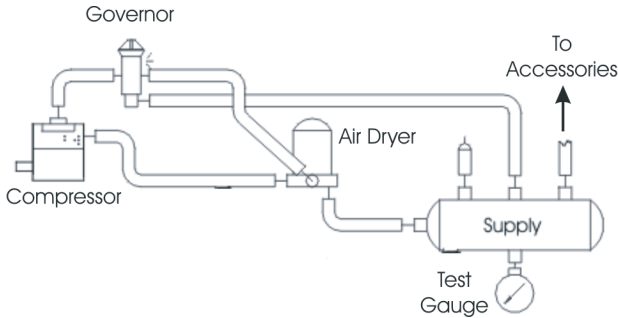
Note: Wires should have sufficient slack and not be completely taught.

TESTING THE BENDIX® AD-IP® AIR DRYER

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 and note that the air dryer purges with an audible escape of air.
3. “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-IP air dryer exhaust.
4. It is recommended that the following items be tested for leakage to ensure that the AD-IP air dryer will not cycle excessively.
 - (A) Total air system leakage (*See Bendix publication BW5057 “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.
 - (F) Delivery check valve.

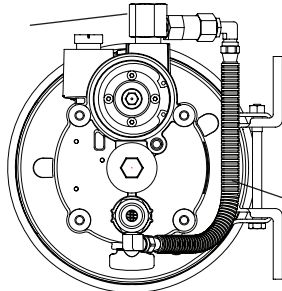
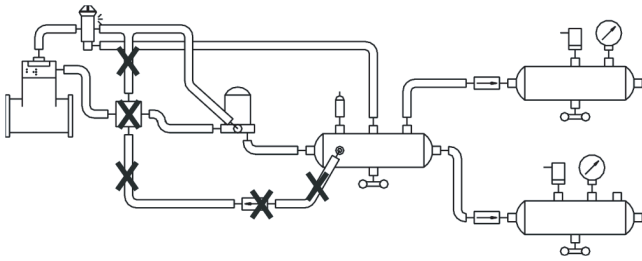
BENDIX® AD-IP® AIR DRYER TROUBLESHOOTING CHART

SYMPTOMS	CAUSE	REMEDY
<p>1. Air dryer is constantly "cycling" or purging. Air dryer purges frequently (every four (4) minutes or less while vehicle is idling).</p>	<p>A. Excessive system leakage. IMPORTANT: 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 NOT SHOWN on gauges is caused by supply system or component leakage.</p>	<p>A. If leakage IS SHOWN on the gauges, test for excessive service brake system leakage.</p> <p>Allowable leakage:</p> <p>Single vehicle - 1 psi/minute either service reservoir.</p> <p>Tractor trailer - 3 psi/minute either service reservoir.</p> <p>Repair and retest as required.</p>
	 <p>Air pressure loss shown on the dash gauges: test all components, fittings and lines in the service brake system (from this point downstream).</p>	<p>B. If leakage is NOT SHOWN on gauges test for excessive supply system leakage.</p>
		<p>Remove the drain cock, or valve, in the supply reservoir (wet tank) and install an air gauge. Build the system pressure and allow the air dryer to purge. Observe the air gauge in the supply reservoir. The pressure drop should not exceed 1 psi per minute.</p> <p>Perform tests 1 to 6 in the order presented.</p>
		

BENDIX® AD-IP® AIR DRYER TROUBLESHOOTING CHART

SYMPTOMS	CAUSE	REMEDY
1. Air dryer is constantly "cycling" or purging. Air dryer purges frequently (every four (4) minutes or less while vehicle is idling) (continued).	A. Excessive system leakage. IMPORTANT: Note whether air pressure loss is shown on dash gauge(s). Pressure loss SHOWN on the gauges is caused by service brake system or component leakage. Pressure loss NOT SHOWN on gauges is caused by supply system or component leakage. (continued)	<p>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 the gauge from the reservoir and replace drain cock or valve. If excessive leakage is detected, continue testing.</p> <p>2. Test the accessories connected to the 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 the disconnection point. Build the air system pressure until the air dryer purges and observe the supply reservoir gauge. If leakage is no longer excessive, repair or replace the leaking accessory. If excessive leakage is detected, continue testing.</p> <p>3. Test for governor leakage. Build the system pressure to the governor cut-out, turn off the engine and apply a soap solution to governor exhaust port and around the cap. Leakage should not exceed a one (1) inch bubble in five (5) seconds. Reduce the system pressure to 80 psi, or less, and re-apply the soap solution. Leakage should not exceed a one (1) inch bubble in five (5) seconds. If excessive leakage is detected in either test, repair or replace the governor.</p> <p>4. Test the compressor unloader leakage. Drain all air pressure from the 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 the air system pressure until the air dryer purges then IMMEDIATELY SHUT OFF THE ENGINE. Observe the air gauge in the supply reservoir. If the leakage is within limits, replace the compressor unloaders. Re-connect the governor to the compressor (after removing the plug installed in the governor) and retest while observing the supply reservoir gauge. If excessive leakage is detected, continue testing.</p> <p>5. Test the air dryer purge valve and outlet (delivery) check valve. Drain all air pressure from the 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 the system pressure to governor cut-out and observe the air gauge. If little or no pressure drop is observed, replace the air dryer check valve. If a pressure drop continues, apply a soap solution to the air dryer purge exhaust and purge control port (where the control line was removed). Leakage should not exceed a one (1) inch bubble in five (5) seconds. If leakage is excessive, repair or replace the purge valve assembly.</p>

BENDIX® AD-IP® AIR DRYER TROUBLESHOOTING CHART

SYMPTOMS	CAUSE	REMEDY
1. Air dryer is constantly “cycling” or purging. Air dryer purges frequently (every four (4) minutes, or less, while vehicle is idling) (continued).	A. Excessive system leakage. IMPORTANT: 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 NOT SHOWN on gauges is caused by supply system or component leakage. (continued)	6. With a gauge installed at the RES port of the governor, pressure should not drop below the “cut-in” pressure at the onset of the compressor “unloaded” cycle. If the pressure drops, check for “kinks” or restrictions in the line connected to the RES port. The line connected to the RES port on governor must be the same diameter or preferably larger than the lines connected to UNL port(s) on governor.
	B. Holset® “E” type compressor.	<p>B. Test the Holset® E Compressor unloader system with a feedback line and check valve for proper operation. Make certain the Holset ECON is not in use with the drop-in version of the air dryer, if so, remove and retest.</p> <p>When installing a Bendix® Drop-In air dryer in a system equipped with a Holset E or QE compressor, remove the Holset ECON valve along with its feedback and governor control line.</p> <div style="text-align: center;"> <p>Check Valve</p>  <p>Feedback Line</p> <p>Typical Drop-In Air Dryer End Cover</p> </div> 

BENDIX® AD-IP® AIR DRYER TROUBLESHOOTING CHART

SYMPTOMS	CAUSE	REMEDY
2. Water and/or oil in the supply or service reservoir.	A. Improper discharge line length or improper line material. The maximum air dryer inlet temperature is exceeded.	A. Refer to <i>Connecting the Air Lines</i> section as well as <i>Appendix A, Table A columns 1 & 2</i> then check line size and length.
	B. Air system charged from an outside air source (outside air not passing through air dryer).	B. If the system has an outside air fill provision, outside air should pass through the 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 the vehicle air system requirement (Improper air dryer/vehicle application). Note: <i>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.</i>	E. See <i>Appendix A, Table A, column 1</i> , for the 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: <i>The costs incurred (e.g. installing a larger capacity compressor, etc.) are not covered under the original compressor warranty.</i> <u>Charge Cycle Time</u> - The Bendix® AD-IP® 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. <u>Purge Cycle Time</u> - 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 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.

BENDIX® AD-IP® AIR DRYER TROUBLESHOOTING CHART

SYMPTOMS	CAUSE	REMEDY
2. Water and/or oil in the supply or service reservoir (continued).	E. (Continued)	<p><u>Air Compressor Size</u> - Although the Bendix® AD-IP® 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-IP 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>
	F. Air compressor discharge and/or air dryer inlet temperature too high.	<p>F. Restricted discharge line. See <i>Appendix A, Table A, column 1 & 2</i> for recommended sizes. If the 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° fitting, it may be changed to a straight or 45° fitting. For more information on how to help prevent discharge line freeze-ups, see <i>Bendix Bulletins TCH-008-021 and TCH-008-022</i>. Shorter discharge line lengths or insulation may be required in cold climates.</p> <p><u>Insufficient coolant flow through compressor</u>. Inspect coolant line. Replace as necessary (Inside Diameter (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 (not enough air to compressor)</u>. 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 (poor air quality to compressor)</u>. Check for leaking, damaged or malfunctioning compressor air inlet components (e.g. induction line, fittings, gaskets, filter bodies, etc.). Repair inlet components as needed.</p> <p>Note: <i>Dirt ingestion will damage the compressor and is not covered under the warranty.</i></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 the compressor. If still under warranty, follow the normal warranty process.</p>

BENDIX® AD-IP® AIR DRYER TROUBLESHOOTING CHART

SYMPTOMS	CAUSE	REMEDY
2. Water and/or oil in the supply or service reservoir (continued).	G. Compressor malfunction.	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 Bendix® BASIC™ cup method as described in the Bendix compressor service manual and referred to in <i>Appendix A, Table A, column 5</i> . Replace compressor. If still under warranty, follow normal warranty process.
	H. Air by-passes desiccant cartridge assembly.	H. If the vehicle uses a Holset® compressor, inspect the feedback check valve for proper installation and operation. When replacing the desiccant cartridge, make sure the desiccant cartridge assembly is properly installed and the sealing rings are in place on the mounting surface of the desiccant cartridge.
	I. Desiccant requires replacement.	I. Replace the desiccant cartridge assembly. Refer to <i>Appendix A, Table A columns 3 & 4</i> for recommended intervals.
3. Oil present at the 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 the 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 <i>Appendix A, Table A</i>). Replace the air dryer cartridge as needed and return the vehicle to service.
		B. The Bendix® AD-IP® PuraGuard® oil coalescing air dryer removes more oil from the brake system than the standard Bendix® AD-IP® air dryer.
4. Safety valve on the air dryer “popping off” or exhausting air.	A. Restriction between air dryer and supply (first) reservoir.	A. Check to determine if air is reaching the supply reservoir. Inspect for kinked tubing or hose. Check for undrilled or restricted hose or tubing fittings and repair or replace as needed.
	B. Air dryer safety valve malfunction.	B. Verify the relief pressure is at the vehicle or component manufacturer specifications. Replace if malfunctioning.
	C. Desiccant cartridge maintenance required.	C. Refer to <i>Table A and column 3</i> . Check the compressor for excessive oil passing and/or correct compressor installation. Repair or replace as necessary. Replace the desiccant cartridge.
	D. Malfunctioning discharge check valve in the end cover of the AD-IP air dryer.	D. Test to determine if air is passing through the check valve. Repair or replace.
	E. Excessive pressure pulsations from the compressor. (Typical single cylinder type.).	E. Increase the volume in the discharge line by increasing the length or diameter. Add a ping tank (small reservoir).
	F. Governor malfunction. Missing or restricted governor control line installation.	F. Test the governor operation and/or inspect the control line leading from the governor UNL (unloader) port to the air dryer control port.

BENDIX® AD-IP® AIR DRYER TROUBLESHOOTING CHART

SYMPTOMS	CAUSE	REMEDY
5. Constant exhaust of air at air dryer purge valve exhaust. (Charge mode.)	A. Air dryer purge valve is leaking excessively.	A. With the compressor loaded, apply a soap solution on the purge valve exhaust, to test for excessive leakage. Refer to <i>Technical Bulletin TCH-008-040</i> . Repair the purge valve as necessary.
	B. Compressor fails to unload (stop compressing air) and the air dryer purge exhaust makes “sputtering” or “popping” sound.	B. Confirm the failure to unload by increasing & decreasing engine RPM and noting change in the rate of leakage and intensity of accompanying leakage sound. Repair/replace compressor unloaders.
	C. Purge control line connected to reservoir or exhaust port of governor.	C. Purge control line must be connected to unloader port of governor.
	D. Purge valve frozen open - malfunctioning heater and thermostat, wiring, blown fuse.	D. Test the heater and thermostat as described in <i>Preventative Maintenance</i> Section.
	E. Excessive system leakage.	E. See Symptom #1.
	F. Purge valve stays open - supply air leaks to control side.	F. Repair the purge valve and housing.
6. Can not build system air pressure.	A. Inlet and outlet air connections reversed.	A. Connect compressor discharge to the air dryer supply port. Reconnect the lines properly.
	B. Check valve between the air dryer and first reservoir.	B. Test the check valve for proper operation. Repair or replace as necessary.
	C. Kinked or blocked (plugged) discharge line.	C. Check to determine if air passes through the discharge line. Check for kinks, bends, excessive carbon deposits, or ice blockage.
	D. Excessive bends in discharge line (water collects and freezes).	D. Discharge line should be constantly sloping from the compressor to the air dryer with as few bends as possible.
	E. Refer to Symptom 4, Causes E & F.	E. Refer to Symptom #4, Remedies E & F.
7. Air dryer does not purge or exhaust air.	A. Missing, broken, kinked, frozen, plugged or disconnected purge control line.	A. Inspect control line from the governor UNL (unloader) port to control port of air dryer. Test to determine if air flows through purge control line when compressor unloaded. Check for undrilled fittings. (See Symptom #4, Remedy C.)
	B. Faulty air dryer purge valve.	B. After determining the air reaches the purge valve (Remedy A above), repair the purge valve.
	C. See Causes, B, E, G for Symptom #4.	C. Refer to Remedies B, E, G for Symptom #4.






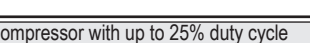
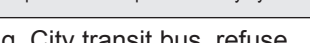





BENDIX® AD-IP® AIR DRYER TROUBLESHOOTING CHART

SYMPTOMS	CAUSE	REMEDY
<p>8. Desiccant material being expelled from the air dryer purge valve exhaust (may look like whitish liquid or paste or small beads.)</p> <p style="text-align: center;">- 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 5. See related causes for these symptoms above.	A. See <i>Causes and Remedies for Symptoms 1, 2, 3, 4 and 5.</i>
	B. Air dryer not securely mounted. (Excessive vibration.)	B. Vibration should be held to minimum. Add bracket supports or change the air dryer mounting location if necessary.
	C. Malfunctioning or saturated desiccant cartridge.	C. Replace the desiccant cartridge assembly.
	D. Compressor passing excessive oil.	D. Check for proper compressor installation; if symptoms persist, replace the compressor.
	E. Desiccant cartridge not assembled properly to the end cover. (Loose attachment.)	E. Check the torque on the desiccant cartridge to end cover attachment. Refer to the assembly section of this data sheet.
9. "Pinging" noise excessive during compressor loaded cycle.	A. Single cylinder compressor with high pulse cycles.	<p>A. A slight "pinging" sound may be heard during the 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.</p> <p>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 air dryer. IMPORTANT: Do not exceed the line lengths requirements specified in this manual.</p>
10. Constant seepage of air at air dryer purge valve exhaust (non-charging mode.)	A. Defective check valve assembly in Bendix® AD-IP® air dryer end cover.	A. Refer to <i>Remedy C, Symptom #1.</i>
	B. Leaking turbo cut-off valve.	B. Repair or replace purge valve assembly.
	C. Leaking purge valve control piston o-ring.	C. Repair or replace purge valve assembly.
11. The air dryer purge piston cycles rapidly in the compressor unloaded (non-compressing) mode.	A. Compressor fails to "unload".	A. Faulty governor installation; no air line from the governor to the compressor or the air line is kinked or restricted. Install or repair the air line.

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 ¹	Recommended Reservoir Drain Schedule ²	Acceptable Reservoir Oil Contents ³ at Regular Drain Interval	
			I.D.	Length				
Low Air Use	5 or less	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	Bendix® BASIC™ test acceptable range: 3 oil units per month.	
Compressor with less than 15% duty cycle			For oil carry-over control ⁴ suggested upgrades: 5/8 in. 9 ft.					
e.g. Line haul single trailer w/o air suspension, air over hydraulic brakes. 								
Compressor with up to 25% duty cycle	5 or less		1/2 in.	9 ft.			For the BASIC Test Kit: Order Bendix P/N 5013711	
e.g. Line haul single trailer with air suspension, RV, school bus. 			For oil carry-over control ⁴ suggested upgrades: 5/8 in. 12 ft.					
High Air Use	8 or less	Bendix® BA-921® air compressor Bendix® Tu-Flo® 750 air compressor	1/2 in.	12 ft.	Every 2 Years	Every Month	BASIC Test acceptable range: 5 oil units per month.	
Compressor with up to 25% duty cycle			For oil carry-over control ⁴ suggested upgrades: 5/8 in. 15 ft.					
e.g. Double/triple trailer, open highway coach, (most) pick-up & delivery, yard or terminal jockey, off-highway, construction, loggers, concrete mixer, dump truck, fire truck.     								
Compressor with up to 25% duty cycle	12 or less		Bendix® BA-922®, or DuraFlo 596™ air compressor	5/8 in.	12 ft.	Every Year		
e.g. City transit bus, refuse, bulk unloaders, low boys, urban region coach, central tire inflation.     				For oil carry-over control ⁴ 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 (0) 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-008-021 and TCH-008-022*, available on www.bendix.com.)
- 5 For certain vehicles/applications, where turbo-charged inlet air is used, a smaller size compressor may be permissible.

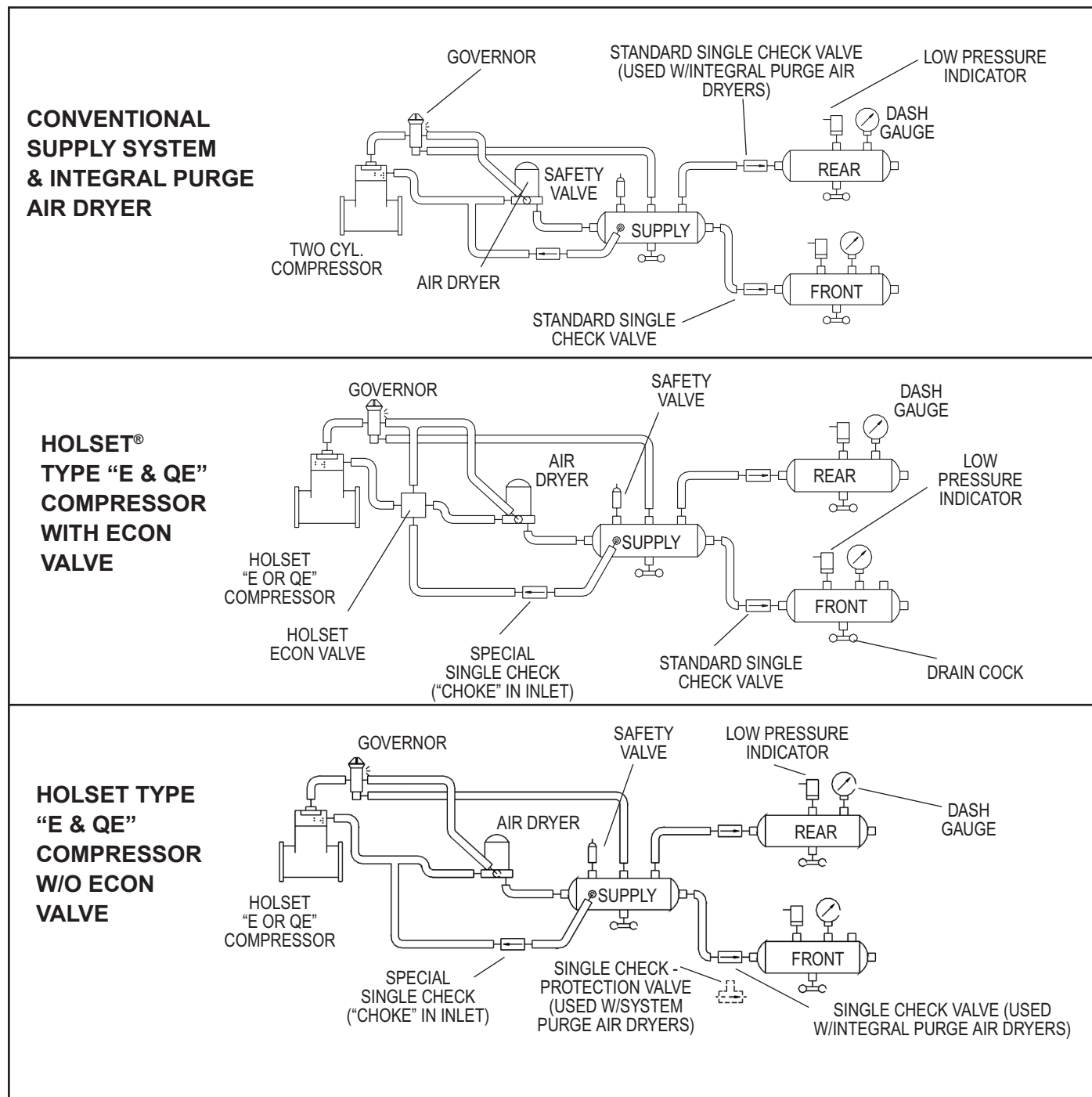
Note: Compressor and/or air dryer upgrades are recommended in cases where duty cycle is greater than the normal range (for the examples above).

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 (BW1779)*. The complete card can be ordered from the Bendix Marketing Center at www.bendix.com. 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.



COMPLAINTS COMMON TO THE CHARGING & AIR SUPPLY SYSTEM

Complaint: Can Not Build System Pressure

- Discharge line plugged or restricted: see Common Test 1.
- Air pressure trapped between the governor and compressor unloaders: see Common Test 2.
- Blow leakage at air dryer exhaust: see Common Test 3.

Complaint: Air System Builds Too Slow

- Discharge line restricted: see Common Test 1.
- Discharge line leakage: see Common Test 5.
- Air leaking at the air dryer exhaust: see Common Test 3.
- Compressor head gasket failure: apply soap solution around the cylinder head. If leakage between the head and the block is noted, repair or replace the compressor.
- Air pressure is trapped between the governor and compressor unloaders: see Common Test 2.
- Air system leakage: see Common Test 4.
- Bendix® AD-IP® PuraGuard® oil coalescing desiccant cartridge may be contaminated by excess dirt and/or carbon. Replace the AD-IP PuraGuard oil coalescing cartridge.

Complaint: Can Not Build System Pressure Above “X” psi.

- Blow leakage at the compressor unloaders: remove all the hardware from compressor inlet then remove the governor. With 120 psi shop air applied to compressor unloader port, listen for leakage at the inlet. If noted, repair the leak or replace the compressor.
- Incorrect setting on the governor: verify the safety valve operation. Drain the air from the system, remove or disconnect the governor from the compressor and install a gauge in governor unloader (UNL) port. Build system pressure and note when pressure on the dash gauge and test gauge are equal. Both should be equal at maximum setting of the governor.
- Discharge line leakage: see Common Test 5.
- Air system leakage: see Common Test 4.
- Compressor head gasket failure: apply a soap solution around the cylinder head. If leakage is found between the head and the block, repair or replace the compressor.

Complaint: Air Dryer Cycles “ON & OFF” Constantly

This complaint caused by leakage, either service system or supply system. Service system leakage is shown on dash gauges, supply system leakage is not. *Note: System purge air dryers will purge more often than those with an integral purge volume.*

Service system leakage: see Common Test 4.

Supply system component leakage: drain the system, install a gauge and a shop air hose in place of the drain cock in the supply reservoir. Fill the system to 120 psi, shut off the shop air and check for leakage on the following components in the order presented:

- Compressor unloader leakage.
- Drain the system, remove the governor from compressor and plug the governor UNL port and re-test. If the leakage is OK, repair the compressor unloader mechanism or replace compressor. If leakage is NOT OK, then continue inspection.
- Holset® ECON valve (used with Holset-type “E & QE” compressor) is missing, malfunctioning, leaking.
- Is an ECON valve required, but missing? If YES, install the valve along with special Holset check valve w/choke. If NO, and the ECON valve is present, replace the ECON valve and special check valve. If NO and the ECON valve is not required, then continue inspection.
- Air dryer leakage: Remove the line from air dryer inlet and with 120 psi in the supply reservoir and apply a soap solution to the exhaust and inlet port of air dryer. If the leakage is greater than a one (1) inch bubble in one (1) second at the exhaust port, repair or replace the check valve (on dryers with integral purge volume) or replace the body assembly on system purge air dryers. If the leakage is greater than a one (1) inch bubble in one (1) second at the inlet port, repair or replace the purge valve assembly (on air dryers with integral purge volume) or replace the turbo cut-off valve on system purge air dryers.

COMPLAINTS COMMON TO THE CHARGING & AIR SUPPLY SYSTEM

Complaint: System Pressure Goes to 150+ psi

- Drain the air system to zero (0) psi, remove/disconnect the governor from the compressor. Start the engine and note the air pressure rise on the dash gauges. Apply 120 psi of shop air to compressor unloader port. If the air pressure continues to rise, repair compressor unloaders or replace compressor. If air ceases to rise, repair or replace governor.

Complaint: Low Pressure Warning After Only 1 or 2 Applications

- Brakes out of adjustment: adjust brakes.
- Excessive system leakage on the service (application) side of system: Build the system pressure to 120 psi and turn the engine off. With the park brakes released, make a full service application and note the dash gauges for two (2) minutes. A pressure drop on either gauge should not exceed 4 psi. (two (2) psi per min.) If the pressure drop is excessive, find the leakage in service system, if OK, then proceed to next complaint.
- Incorrect low pressure switch in use or setting incorrect: Build the system pressure to 120 psi, with the engine OFF and the ignition ON, slowly drain the air pressure from one service reservoir. Low pressure warning on at minimum 60 psi, maximum 10–15 psi less than governor cut-in pressure.

TESTS COMMON TO MORE THAN ONE COMPLAINT

1. Discharge plugged or restricted

- Connect a temporary discharge line from the compressor discharge port to the supply reservoir and re-check the build-up. If the system build-up is OK then replace the plugged discharge line. If the build-up is NOT OK, go to next cause.

2. Air pressure trapped between the governor and the compressor

- Verify the safety valve operation, then remove or disconnect the governor from the compressor and check build-up.
- If the build-up is OK, repair or replace the governor or the line between the governor and the compressor.
- If the build-up is NOT OK, repair or replace the compressor.

3. Blow Leakage at the Air Dryer Exhaust

- Drain all air from the supply reservoir then remove the control air line from the air dryer, plug the line and plug the control port in the air dryer. Re-check build-up.
- If the build-up is OK, repair or replace the governor or the line between the governor and the air dryer.
- If the build-up is NOT OK, and the temperature is below 32° F, turn the ignition ON and allow the heater to warm the air dryer then check the system build-up. If NOT OK, remove the wire (connector or terminal) from the air dryer. Using a test light, check the wire end, or terminal, for battery voltage with the vehicle ignition ON. If the voltage is OK, repair or replace the air dryer heater and thermostat. If the voltage is NOT OK, repair or replace the vehicle wire connected to the air dryer. Retest build-up.
- If build-up is still NOT OK, or if the temperature is above 32° F, replace the air dryer purge valve assembly.

4. Air system leakage

- Build the system pressure to governor cut-out, wait two (2) minutes for the air dryer purge completion. Note the pressure on the dash gauges then watch the dash gauges for two (2) minutes. The leakage is not to exceed 2 psi in two (2) minutes for truck bus or tractor (no trailer).
- If the leakage is NOT OK on the gauges, find the leak(s) in service and park system and repair. Retest and if the system purge air dryer is in use and still not OK, repair or replace the dryer.
- If the leakage is OK on the gauges, drain the air from the supply reservoir, remove the drain cock and install an air gauge. Build the system air in the supply reservoir and note the leakage. If OK, continue checking. If NOT OK, find the leaks and repair.

5. Discharge line leakage

- Apply a soap solution to the cover on the flexible discharge line, if leakage is noted, replace the line.
- Soap fittings to check for leakage and tighten as needed.

IMPORTANT: The Complaints, Causes and Remedies presented here should not be considered as the only situations possible. They are only meant to represent the most commonly encountered situations. It may be necessary to perform additional troubleshooting using the more detailed information presented in service manuals for the specific components.



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