Technical Bulletin

Bulletin No: TCH-001-045 **Effective Date: 5/1/98** **Cancels: PRO-01-32 dated 8/1/88**

Subject: **Troubleshooting Compressor Oil Passing**

General Comments

Some oil carryover from the air compressor into the air brake system occurs as a normal part of all air compressor operation. Compressors require oil carry over to lubricate the compressor's valves and rings. It is typical to find some presence of oil at the inlet and discharge ports of the air compressor. Oil present at the exhaust of drain valves, air dryers or aftercoolers is normal and indicates that these components are functioning properly, removing contaminants from the system.

Vehicles equipped with a desiccant type air dryer that incorporates a filter (separator) for removing oil from the air will normally minimize oil passed through to the reservoir. The oil collects in the air dryer with condensed moisture and is periodically purged. Often, the routing or location of the air dryer exhaust port can amplify concerns about oil passing, depending on where the purged oil / water mixture is expelled on the vehicle, e.g. on a fender or onto a fuel tank. This can mistakenly be identified as "problem" oil passing, when in actuality the air dryer and compressor are functioning properly.

Vehicles may be equipped with condensing type aftercoolers or drain valves instead of an air dryer. These devices have little or no affect on preventing oil or water from being passed through the system and into the reservoir.

If after reviewing these general comments excessive oil passing is still suspected proceed to Step 1.

Step 1: Reservoir Draining

If excessive oil is passing from the air compressor, the air dryer filter element and desiccant may become saturated. One of the first signs of oil saturated filter element or desiccant cartridge is moisture appearing in the reservoirs.

The first step in determining if a compressor is passing an excessive amount of oil is to drain the reservoirs and monitor the amount of water and/or oil removed.

Check reservoir drain valves to ensure that they are functioning properly. It is recommended that the vehicle should be equipped with functioning automatic valves or have all reservoirs drained to zero (0) psi (0 kPa) daily or optimally to be equipped with a desiccant type air dryer prior to the reservoir system.

If when draining the reservoirs there is an absence of water and/or oil, the compressor and all compressor support systems are operating properly and there is no need to proceed further. If the expulsion from the dryer purge occurs in a location such that it affects vehicle appearance, reroute the purge.

If water and/or oil are present, and the duration since the last reservoir draining is known and consistent with **Table A**, go to Step 2.

If the reservoirs have not been drained according to **Table A**, follow the suggested frequency for two cycles. If at the end of the second cycle, water and/or oil are drained, further investigation is needed. Proceed to Step 2.

An absence of water and/or oil after the second draining indicates the compressor and all compressor support systems are operating properly. Continue to perform reservoir draining on a regular basis as outlined in **Table A**.

Step 2: External Influences

At this point it should have been established through observations made in Step 1 that conditions exist causing excessive oil passing. This does not indicate that immediate removal of the compressor is necessary or that the compressor is the root cause for this issue. Removal of the compressor at this point usually leads to the replacement of several compressors over a period of time without resolution of the issue.

The support systems, which control and contribute to the compressor operation must be examined. There are many external influences, which can affect compressor oil passing. The influences can be grouped into subcategorizes as follows:

- Vehicle operation
- Engine operation
- Compressor inlet air supply system
- Compressor coolant supply system
- Compressor oil supply and return system

Proceed to Step 3.

Step 3: Vehicle Operation

Vehicle operation is the driving factor for compressor performance and influences all of the systems that control and contribute to compressor operation.

Check vehicle system leakage. Vehicle system leakage should not exceed industry standards of 1 psi (6.9 kPa) pressure drop per minute without brakes applied and 3 psi (20.7 kPa) pressure drop per minute with brakes applied. If leakage is excessive, check for system leaks and repair.

After determining that the system leakage meets industry standards the compressor duty cycle must be established. Duty cycle is the percent of time the compressor is loaded during a period of operation. As duty cycle increases, the amount of oil passed into the system increases.

Example:
If two compressors, which pass the same amount of oil when operated at the same duty cycle, are placed on two vehicles which are identical except for duty cycle, the compressor on the vehicle with the greater duty cycle would pass more oil into the system. The amount of effluent purged from the dryer would be greater on the vehicle with the greater duty cycle. Thus the relative amount of oil at the purge of the dryer is not only an indication of the level of oil passed by the compressor but also the duty cycle of the compressor.

Compressors that operate with duty cycles of 25% or less will have an expected life equal to the normal warranty period. As duty cycles extend beyond 25% the expected life will decrease.

It is recommended that the compressor duty cycle should not exceed 25% and the average charge period should not exceed 90 seconds to ensure the normal life of the compressor and dryer. By keeping the charge time at or below 90 seconds the compressor operating temperature is lower reducing oil consumption, carbon formation, and discharge temperatures. By keeping discharge temperatures lower the dryer's ability to remove oil and moisture is increased.

Once the duty cycle is established review **Table A** for the vehicle application and make sure that the compressor and air dryer combination installed on the vehicle match those recommended based on duty cycle. If the vehicle is not properly equipped a change of the compressor and/or air dryer maybe necessary.

If the duty cycle exceeds the recommended 25%, two options are available:

- Reduce the amount of demand by redesigning the air system.

- Increase system maintenance through more frequent reservoir draining, dryer cartridge change out, and discharge line replacement.

Optimizing systems in Steps 4, 5, 6, and 7 may also help if the duty cycle cannot be reduced.

If the duty cycle does not exceed 25% proceed to step 4.

Step 4: Compressor Inlet Air Supply System

Check for damaged, defective or dirty air filter on engine or compressor. Check for leaking, damaged or defective compressor air intake components (i.e. induction line, fittings, gaskets, filter bodies, etc.). Damaged or leaking lines as well as dirty filters result in unfiltered intake air being supplied to the compressor. Operating the compressor with unfiltered intake air results in excessive wear to the upper piston rings and cylinder bores in a relatively short time. If any one of these conditions is found make all necessary repairs and/or filter replacement. Once the compressor is damaged in such a manner the compressor must be replaced.

The maximum allowable air inlet restriction (vacuum) is 25 inches (6.2kPa) of water. Exceeding this limit will cause air along with oil to be drawn from the compressor crankcase into the delivery air. If high inlet vacuum exists, check compressor air inlet line for kinks, excessive bends or other restrictions. *(The compressor intake should **not** be connected to any part of the exhaust gas recirculation (E.G.R.) system on the engine. Reconfigure the inlet to remove this connection if present).* Perform necessary repair or replacement to damaged or malfunctioning components and place vehicle back into service.

If inlet air is clean and free of restriction proceed to Step 5.

Step 5: Compressor Coolant Supply System

Coolant temperature at the water outlet port of the compressor must not exceed 220°F (104°C). Temperatures beyond this level result in high cylinder temperatures. The results of high temperatures are:

- Cylinder bore distortion-causing oil to pass by the rings.
- Breakdown of lubrication between piston ring and bore causing premature wear.
- Breakdown of oil causing carbon formation.
- High dryer inlet temperatures causing a loss of drying efficiency.

Indicators of insufficient cooling include:

- Heavy carbon deposits in the cylinder head, discharge line or fittings.
- Carbonized oil deposits in the inlet cavity.
- Discoloration of the compressor cylinders or cylinder head.

If any one of the above indicators is present, measure coolant temperature under normal operating conditions. If coolant temperature is above recommendations inspect the coolant lines and fittings for accumulated rust scale, kinks and restrictions. Remove accumulated grease, grime or dirt from the cooling fins. Optimum cooling is achieved when engine coolant flows into the compressor at one end and out at the opposite end with the inlet at the lowest port (recommended coolant flow is 0.5 gpm at idle and a minimum of 2.5 gpm at max rpm). If these actions do not succeed in reducing the coolant temperature, consult the engine manufacturer for determination of additional methods to reduce the coolant temperature.

If the compressor operated under these conditions replace the compressor.

If coolant temperature is at or below recommendations proceed to Step 6.

Step 6: Compressor Oil Supply and Return System

Check the engine oil pressure with a test gauge and compare the reading to the engine specifications. Higher than specified pressure can result in an excessive amount of oil in the compressor crankcase which will increase the likelihood of oil on the cylinder walls and opportunity to migrate past the piston rings. *(Bendix does not recommend restricting the compressor oil supply line because of the possibility of plugging the restriction with oil* *contaminants)*. If the oil pressure is high, make necessary repairs to return the oil pressure to engine specification and proceed to the next paragraph.

Oil return to the engine should not be in any way restricted. Restrictions present in the oil drain connection from the compressor to the engine can cause a build up of oil in the compressor crankcase sump and increased oil passing. There is no easy method to measure the quantity of oil drain back or to monitor crankcase oil level. By design the amount of drain back to the engine should be sufficient under most circumstances.

Areas to check to make sure the oil drain is as efficient as possible are:

- For flange mounted compressors internally drained back to the engine, it is important that the drain ports are aligned and not restricted by gasket or sealant used during the compressor installation.
- For compressors with external drain lines check for excessive bends, kinks and restrictions in the oil return line. Minimum recommended oil return line size is 1/2" I.D. (12.7mm). Return line must constantly descend from the compressor to the engine crankcase.

If restrictions in the drain back system are found make appropriate repairs.

If oil pressure and oil return are found to be OK or repairs were made, proceed to Step 7.

Step 7: Engine Operation

Engine power angle and tilt can affect oil drain back from the compressor on flange mounted applications. These angles cause the drain to be higher than a portion of the crankcase resulting in the trapping of oil below the drain level. During operation the piston rods dip into the trapped oil and carry the oil to the cylinder walls. The increased amount of oil on the cylinder walls results in more oil migrating past the piston rings. TF-750 compressors are more susceptible to this condition because they have longer strokes. If the vehicle is equipped with a TF-750 compressor and thus far the cause for excessive oil passing has not been found install a bottom drain cover. If either the engine power angle or tilt is excessive, add a bottom drain to the compressor and place vehicle back into service.

Check the engine crankcase pressure with a test gauge and compare the reading to engine specifications. Excessive engine crankcase pressure can cause oil to be forced pass the piston rings increasing oil passing. If excessive pressure is found repair the cause of the excessive pressure and place vehicle back into service.

If engine power angle and tilt are not causing flooding or the compressor is already bottom drained and engine crankcase pressure is within specifications proceed to Step 8.

Step 8: Compressor Replacement

Replace the compressor only after reviewing all items in each of the preceding steps.

TABLE A

COMPRESSOR & AIR DRYER APPLICATION SELECTION MATRIX

This matrix is intended for use as a general guide; if you have experience with applications contrary to those listed below, **Use your experience as a guide**. If your vehicle is equipped with high air usage accessories not referred to below, use the compressor duty cycle guide at the bottom of the matrix (i.e. air wipers, tag axles regularly lifted for cornering, large accessory air cylinders, air start, etc.)

Application	**Braked Axles**	**Comp. Type**	**ADSP**	**ADIP or AD9 or ADIS**	**AD9EP**	**Twin ADIP or Twin AD9**	**By-pass Air Dryer**
School Bus	2-3	TF-550	√	√			
Highway Travel Coach	2-3	TF-550	√	√			
City Transit Bus	2-3	TF-750			√	√	
Pick-up & Delivery	2-3	TF-550	√	√			
	4-7	TF-550		√			
Line Haul	2-5	TF-550	√	√			
	6-8	TF-550		√			
	9-11	TF-750			√		
	>11	TF-1400				√	
Rural or Commercial Refuse	2-3	TF-750		√			
Residential Refuse	2-3	TF-750			√		
City Refuse (with Work Brake)	2-3	TF-750		√			
Concrete Mixer	2-4	TF-750			√		
Dump Truck	2-3	TF-550		√			
	4-7	TF-750			√		
Off-Highway/Construction*	2-7	TF-1400		√			
	8-9	TF-1400			√		
	>9	TF-1400				√	
Logger	3-5	TF-750		√			
	>5	TF-1400			√		
Low Boy	3-7	TF-750			√		
Bulk Off-Load (Pump-Off) or CTI**		TF-1400					√
Compressor Duty Cycle			0-15%	0-20%	20-40%	40-60%	>60%
Compressor Duty Cycle			Low	Low	High	High	High
Reservoir Drainage Frequency***			Check Monthly		Every Month or 4000 miles		

* In Off-Highway applications where electronic engines are used, a TF-550 compressor may be sufficient.
** Required to run two (2) governors, one at 85 psi and one at 120 psi to reduce strain on drive train when compressor inlet is turbocharged.
*** Vehicles without an air dryer must be drained daily.

Note: It is recommended that the compressor duty cycle not exceed 25% to ensure the normal life of the compressor. In circumstances where duty cycle is anticipated to exceed 25%, a larger compressor model (i.e. a TF-750 instead of a TF-550) is recommended.

INFORMATION SHEET
If further technical assistance is required, fill out the following information prior to contact.

General Information
Company Name:______________________________
Contact Name: ______________________________
Title:______________________________
Phone Number:______________ Fax Number:______________

Vehicle Information
Year:__________Make: __________ Model:__________
Mileage\Hours:______________________________
Unit Number: ______________________________
Number of braked axles: ______________________________
Vocation: ______________________________
Location: ______________________________
Configuration: (4x2, 4x4, …)______________________________
Number of similar units in fleet: ______________________________

Engine Information
Manufacturer:______________________________
Model: ______________________________
HP rating:______________________________
Maximum speed: ______________________________
Mileage\Hours:______________________________

Compressor Information
Model: ______________________________
Pc No:______________________________
Serial No: ______________________________
Mileage\Hours:______________________________
Inlet configuration: (Naturally Aspirated, Turbocharged) ______________________________

Air Dryer Information
Model: __________ Pc. No.: __________ Serial. No.:__________
Time in service/time since last cartridge change:______________________________
Location on vehicle:______________________________
Discharge line length:______________________________

Performance Information
What is the reservoir draining interval? ______________________________
What is the quantity of oil/water present when drained? ______________________________

What was the system pressure drop after 5 minutes without brakes applied? ______________
What was the system pressure drop after 5 minutes with brakes applied?______________

What is the compressor duty cycle? ______________________________
What is the average charge time?______________________________
What is the average purge time? ______________________________

What is the air cleaner service interval?______________________________
What is the maximum vacuum reading at the inlet of the compressor?______________
What is the maximum coolant temperature at the outlet port of the compressor? ______________

Is oil pressure within engine specifications? ______________________________
Is engine crankcase pressure within engine specifications?______________________________