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January 7, 2010

VIA ELECTRONIC MAIL
Timothy.lafon@volvo.com

Mr. Tim LaFon
Mack Trucks, Inc.
7900 National Service Road
PO Box 26115
Greensboro, NC 27409

Re: **EA09-009**

Dear Tim,

This letter is to provide you with test findings of the Bendix valves you provided to us and requested to have inspected and tested from the field evaluation conducted the week of August 3, 2009.

Background Information

A team consisting of representatives from Mack, NHTSA, Bendix, Meritor and Haldex inspected 5 vehicles in Pennsylvania during the week of August 3, 2009. Various air brake components were removed from the vehicles for evaluation, including Bendix valves. The Bendix valves that were removed and required analysis were 3 MV-3, 5 E-8P and 1 R-14 (used to replace a Haldex relay valve).

Inspection/Test Results

The following tests were performed:

1. Valve operation according to the relevant Bendix specification for new E-8P, MV-3, and R-14.
2. Disassembly of all valves and inspection of seals.
3. Durometer analysis of o-Ring (of select components) and rubber spring of E-8P.

The criteria for Pass/Fail are part of the Bendix test specification and considered to be proprietary. If needed, Bendix can and will request Confidentiality (49 CFR Part 512) from NHTSA and submit the criteria directly to NHTSA.

E-8P – As noted in the table below, the valves performed within the parameters defined in the Bendix specification for new valves. Force versus delivery curves indicate normal operation. Ascending and descending hold pressures of 20, 40 and 60 psi (primary delivery) did not indicate any major shifts in delivery pressures.

Operational Test Results of the E-8P

TEST PARAMETER	RESULT
Leakage with 120 PSI at both primary & secondary supply and 0 PSI delivery pressure	PASS
Full Application leakage with 120 PSI at both primary & secondary supply	PASS
Dynamic Application Differential with 120 PSI at both primary & secondary supply	PASS
Primary Supply leakage with 80 psi delivery and 120 PSI at the supply	PASS
Secondary Supply leakage with 80 psi delivery and 120 PSI at the supply	PASS

The valves were disassembled and inspected for foreign contaminants, degradation of rubber seals, or damage to internal components. The rubber springs showed compression, which may have contributed to differential spike at low pressure. There were heavy impressions on the Inlet/Exhaust valves. Durometer readings indicate minimal difference from nominal values. Some oil was present in the valves, which possibly could be heat related.

R-14 – As noted in the table below, initial test found the valve leaking between service cover and body; the valve did not meet all the parameters of the test specification. The cover was removed and the static o-ring was found to be pinched. The customer had replaced a Haldex relay valve with the Bendix R-14 valve. It was confirmed by a Bendix representative that the cover had been removed during its installation and its removal to retrieve fittings and this is likely how the o-ring was pinched. Also the assembly drawing calls out a 90° service port location, however the part was at 180° off location. This supports that the customer disassembled and re-assembled the unit. The o-ring was replaced with a new o-ring and the valve performed within the parameters defined in the Bendix specification for new valves. Operational and differential curves show that the valve functioned satisfactorily.

Operational Test Results of the R-14

TEST PARAMETER	Results As Received	Results Replace O-ring
Leakage with 120 PSI at supply and 0 PSI delivery pressure	PASS	PASS
Delivery with 120 PSI at supply and apply & release 120 PSI at balance port	PASS	PASS
Balance leakage with 120 PSI at supply and 10 PSI at balance port	PASS	PASS
Balance leakage with 0 PSI at supply and 120 PSI at balance port	PASS	PASS
Delivery with 120 PSI at supply and gradual increase to 120 PSI at delivery	NOT PASS	PASS
Supply leakage with 60 PSI at delivery and 120 PSI at the supply	NOT PASS	PASS
Supply leakage with 100 PSI at delivery and 120 PSI at the supply	NOT PASS	PASS
Delivery leakage with 0 PSI at supply and 120 PSI at delivery	NOT PASS	PASS

The valves were disassembled and inspected for foreign contaminants, degradation of rubber seals, or damage to internal components. There was heavy oil and grit contamination. The inlet/exhaust seat showed wear from the oil mix contamination.

MV-3 –As noted in the table below, the valves did not perform within all the parameters defined in the new valve Bendix specification.

Operational Test Results of the MV-3

TEST PARAMETER	RESULT CXN612-1696	RESULT CXN612-4367	RESULT CXN612-4366
With both buttons in, Delivery pressure build with no lag with 120 PSI at supply	PASS	PASS	PASS
Pull parking button out, Trailer supply button to also pop out	PASS	PASS	PASS
With both buttons in, pull Trailer supply button out, Parking button to remain pushed in.	PASS	PASS	PASS
120 PSI at primary supply port, secondary supply port open to atmosphere, push both buttons in, measure leakage at primary supply.	NOT PASS	NOT PASS	NOT PASS
With Trailer button in, bleed down supply, measure trip pressure.	PASS	PASS	PASS
With Parking button in, bleed down supply, measure trip pressure.	PASS	PASS	PASS
With Trailer button held in, bleed down supply, delivery must exhaust.	PASS	NOT PASS	NOT PASS
Supply pressure at both primary and secondary supply, push Trailer button in, bleed down primary supply to verify double check valve function.	PASS	PASS	PASS
Primary supply open to atmosphere, secondary supply with pressure, both buttons out, measure leakage at secondary supply.	PASS	PASS	PASS

The valves were disassembled and inspected for foreign contaminants, degradation of rubber seals, or damage to internal components. The double check valve on all three valves were contaminated with oil and damaged in one valve (...1696). This caused the leakage in the "buttons in" test. When the damaged double check valve was replaced in the one valve (...1696), the valve passed all performance requirements. The exhaust seal of the tractor plunger was contaminated and damaged in two of the valves (...4367 & 4366). Material analysis determined that the substance found on the o-rings and exhaust seal was a mixture of the standard Bendix grease, water and an alcohol. The durometer of several o-rings was found to be under specification, which may have contributed to the Buttons In leakage results.

Comments:

With the exception of the MV-3, all devices performed within the tolerances allowed in the respective Bendix specifications for new valves. The E-8P valves required extra travel to apply compared to the new valve specifications. This is consistent with the results expected of valves with compressed graduation springs (rubber springs). The measured compression is not necessarily beyond what is expected of products that have been on in-service vehicles for this length of time. As noted above, the R-14 was disassembled at the inspection site and not properly re-assembled, which resulted in a pinched o-ring. After replacing the o-ring the valve met all the new valve specifications.

With respect to the MV-3 valves evaluated, the valves did not meet the new valves specifications for leakage with both buttons pushed in and there was contamination found in all valves. As stated, material analysis will be conducted on the contamination.

Note: None of the vehicles had complaints concerning the parking brake system, as the vehicles were in service at the time of the inspection.

Should you have any further questions or concerns, please contact me at 440/329-9386.

Best Regards,

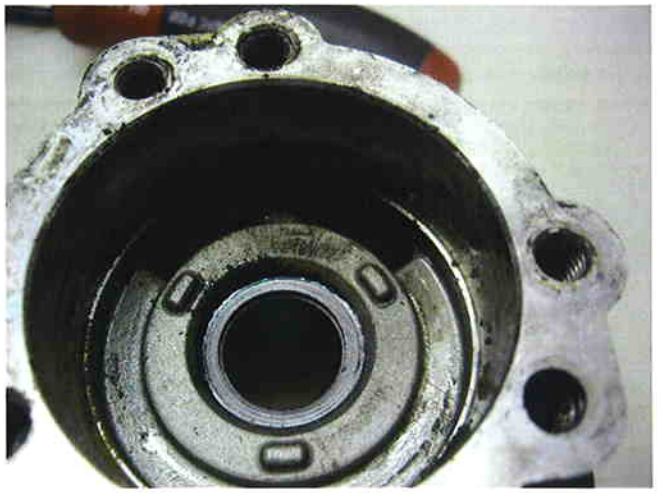
Rafael Dominguez
Director Product Safety

Cc: Jim Szudy – Bendix CVS

Appendix 1 – E8-P

E-8P – Unit CXN612-4367

Secondary Inlet/Exhaust Valve 	Secondary Body Cavity 
Secondary Piston 	Plunger Side Cavity 
Primary Plunger 	Rubber Spring 

Primary Cavity	Primary Inlet/Exhaust Valve
	

E-8P – Unit CXN612-1696

Secondary Inlet/Exhaust Valve	Secondary Body Cavity
	

Secondary Piston

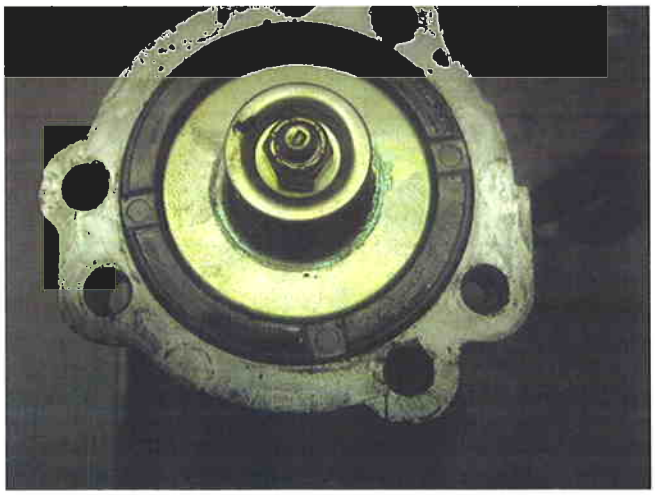
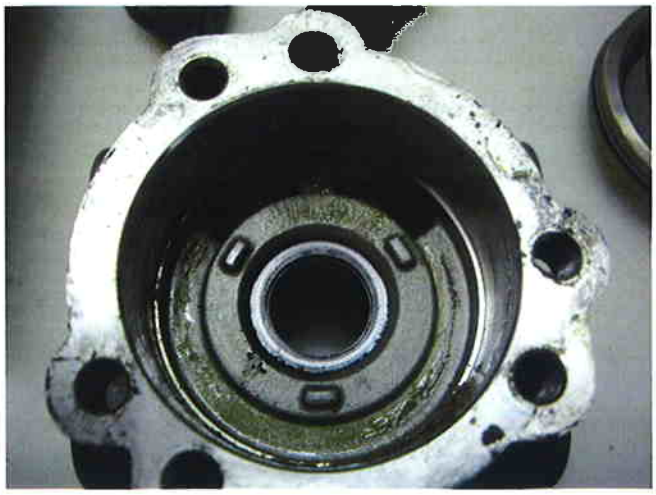
Plunger Side Cavity

Primary Plunger

Rubber Spring

Primary Inlet/Exhaust Valve

E-8P – Unit CXN612-4366

Secondary Inlet/Exhaust Valve	Secondary Body Cavity
	
Secondary Piston	Top View of plunger and rubber spring washer
	
Plunger Side Cavity	Primary Plunger
	

Rubber Spring

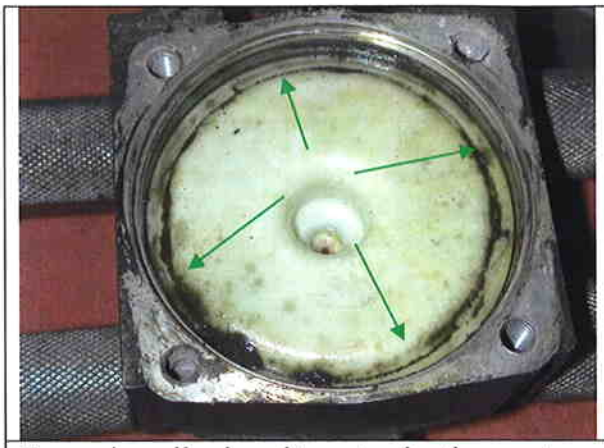
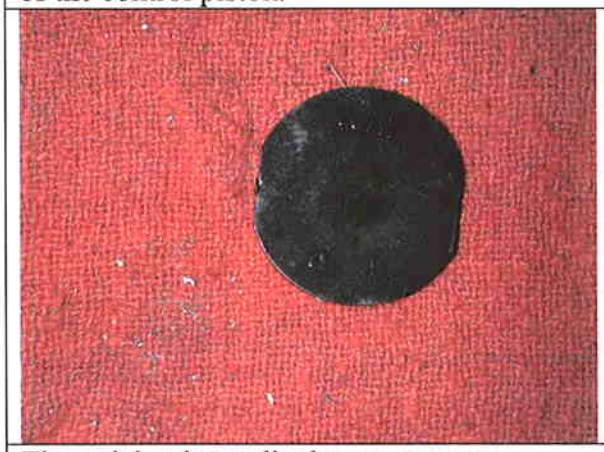
Primary Inlet/Exhaust Valve

Internal Oil Wetness

APPENDIX 2 – R-14

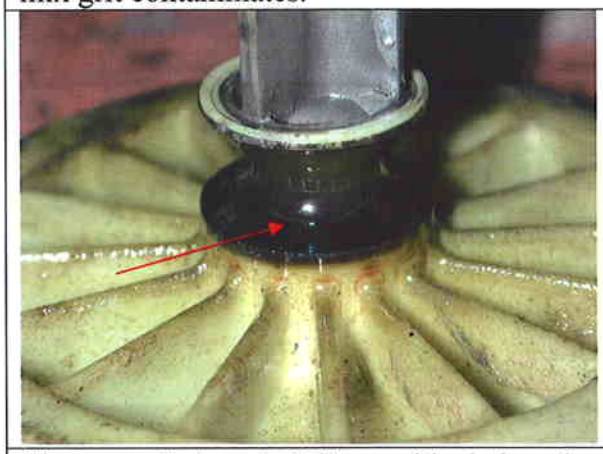
R-14 – Unit CXN612-1696

	
As received, found no part number or date code on body. OE label 5012296. Assembly drawing calls out a 5013270 with a 90° service port location. Photo shows the service port is 180° off location. Thus, customer may have disassembled and assembled unit.	Photo shows that the exhaust cover was not disassembled.
	
The cover bolts with fresh wrench markings indication of disassemble.	Initial bench test blow leakage found static o-ring pinched. Again, indication of improper re-assembly by customer. Note that a new o-ring was installed so to complete the evaluation.

	
Excessive oil mix grit contamination on top of the control piston.	Excessive oil contamination inside the service quick release cavity
	
The quick release diaphragm appears normal. Light cupping.	Excess oil residue inside service cap port area.
	
Exhaust inlet cavity shows less contaminates. Lacking grease.	I/E valve OD surface lacks grease.

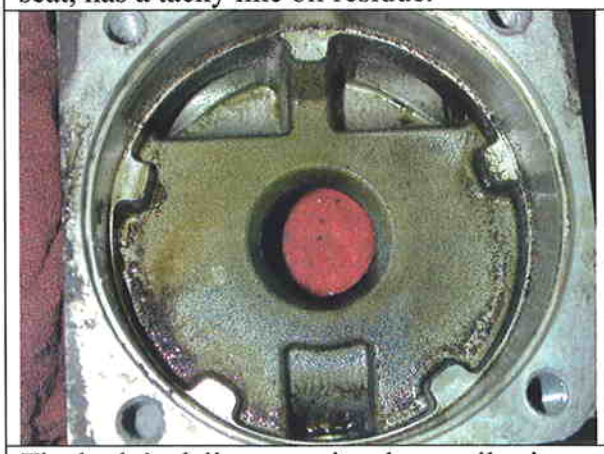
I/E valve seat shows excessive wear from oil mix grit contaminates.

Control piston's delivery side shows excessive oil and grit contaminates.



The control piston's delivery side, below the seat, has a tacky like oil residue.

The piston o-ring groove area shows oil contaminates residue.



The body's delivery cavity shows oil grit contaminates.

APPENDIX 3 – MV-3

MV-3 – Unit CXN612-1696

Separation Cover

Trailer Plunger

Crude on Overdrive

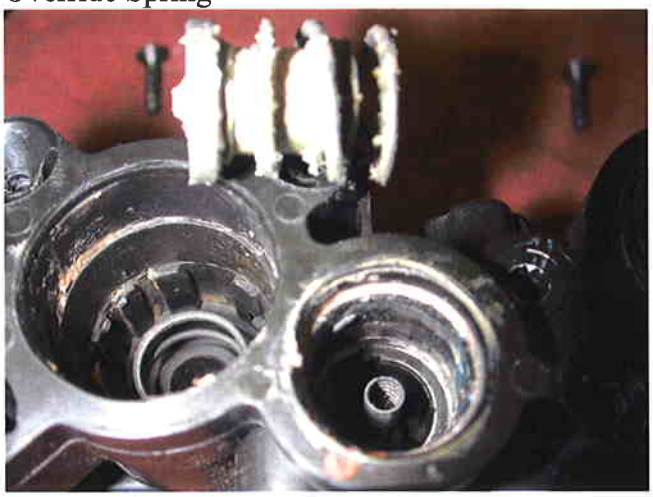
Double Check Valve

Double Check Valve

Double Check Valve

Side View

Override Spring



Tractor Plunger – dry o-ring

Tractor exhaust seal – dry o-ring

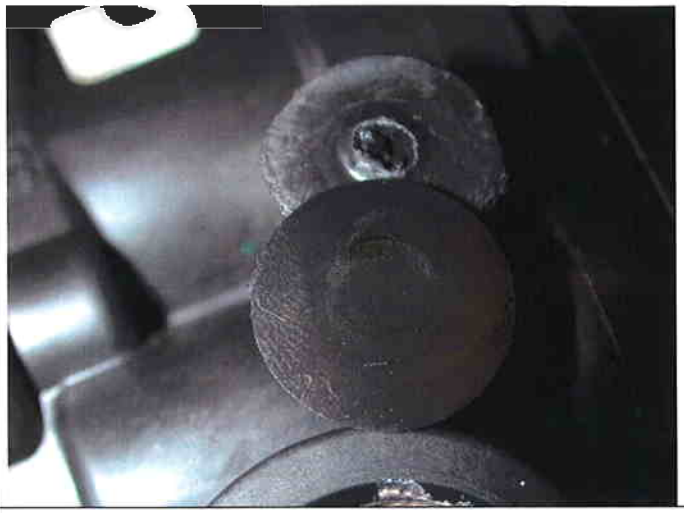
MV-3 – Unit CXN612-4367

Tractor exhaust seal

Tractor exhaust seal

Trailer exhaust seal

Double check valve



Double check valve

Double check valve bore – oil

MV-3 – Unit CXN612-4366

Tractor exhaust seal

Tractor exhaust seal

Tractor exhaust seal

Trailer exhaust seal