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Section 1

Excerpt from Volvo's ordering system

Attachment 1

☒ By Option	☐ By Model		
Code	Ex. 980?		
Description	?Drag Link? Ex. ?Volcano?		
Reset Search	Search / Refresh		
Use ? for unknown characters in a Code or to locate a word anywhere in a Description. See examples above			
Category	Sub Category	Code	Description
FRONT AXLE	STEERING LINKAGE	I9A1	SEALED DRAG LINK
FRONT AXLE	STEERING LINKAGE	I9AA	GREASEABLE DRAG LINK

Section 2
Copies required by Question 6
(Service, Warranty, and other
documents)

Pollock Kevin

From: DEBBIE KEENER
To: RANDY MULLER; RAY T MARTIN; RAYMOND R. LESTRANGE; RICKY A. MILLER; STEVE DAY; STEVEN DESOUSA; TERRY HUTCHISON; THOMAS D. RUBLE; THOMAS KING; TIM BARNHARDT; VINCE LINDLEY; W. HAROLD SMITH; WARREN SPRADLIN
FX540-674-7204; WESLEY MARSH; PHILLIPS, T. HOYT; PARAH, ARMAND; ROGER C. MORIN; MIKE ZINK; MICHAEL BULLINS; RAY DUECK; TIMOTHY J. REDDEN; MAURICE A SUTTON; ROB SIMPSON; MUKESH PATEL.; KENT IVAN AKE BIRGE; KENNETH G. MOORE; RICHARD MARSHALL; KEN CULVER; JOHN MONTGOMERY; JOHN M. ATALLAH; JOHN P. SHEHAN; JOE C ANDERSON; JIMMY CROTTS; POLLOCK, KEVIN R
Subject: 6430.301 - Steering Linkage Inspection
Attachments: 6430301.pdf



6430301.PDF
(121 KB)

--- Received from VTNA.VGH204DK DEBBIE KEENER 00-06-12 11:40

DISTRICT SERVICE MANAGER INFORMATION LETTER

NUMBER: 6430.301
DATE: 000608
SUBJECT: Steering Linkage Inspection
MODEL(S): All
ISSUED BY: Kevin Pollock
APPROVED: Guenter Schlottmann

Inspection Procedure for TRW Ball Socket Wear
This letter supersedes DSM Letter 6430.300, dated 991019

In an effort to resolve concerns with inspection and removal of TRW manufactured steering linkages, the attached service bulletin, TRW Service Bulletin #LNK-105 "Inspection Procedure for TRW Ball Socket Wear" can be used.

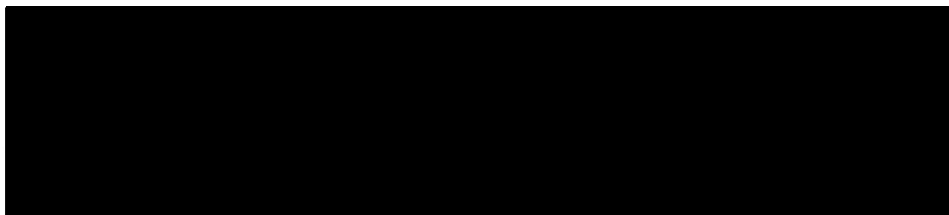
It should be noted that this procedure is divided into two separate and distinctive situations;

- 1) The "Truck Shop Inspection Procedure" is to be followed whenever the truck is being inspected at a service location.
- 2) The "Inspection Station Criteria" is based on National DOT out of service criteria from the CVSA, and is intended to be used as a guideline when the vehicle is stopped for inspection while in use (i.e. a roadside inspection).

Please note that axial movement is to be inspected by hand pressure only (approximately 100lbs.), not by use of any tools to apply leverage.

*There is one attachment with this DSM Letter. Hard copies will be forwarded to designated areas only.

FOR INTERNAL INFORMATION ONLY



TRW Automotive

Steering & Suspension Systems

Service Bulletin #LNK-105

Inspection Procedure for TRW Ball Socket Wear

Revised May, 2000

This TRW Commercial Steering Division service bulletin has been written to help you repair commercial vehicles more efficiently. This bulletin should not replace your manuals; you should use them together. These materials are intended for use by properly trained, professional mechanics, NOT "Do-it-yourselfers". You should not try to diagnose or repair steering problems unless you have been trained, and have the right equipment, tools and know-how to perform the work correctly and safely.

Truck Shop Inspection Procedure:

1. Make sure the stud is seated tightly in the steering arm taper, and the nut is tight.
2. With vehicle **engine on**, lightly rock the steering wheel while checking for looseness in any threaded joint, or any movement of the stud nut. Any looseness requires repair.
3. With the **engine off** and wheels straight ahead, push and pull the socket in and out by hand (using approx. 100 lbs. of pressure) in the direction of the ball stud. If no **AXIAL** movement is detected, the socket is operable. Any **AXIAL** movement detected by hand requires replacement of the socket.

WARNING: Do not use a wrench or other object to apply leverage when inspecting sockets. Applying leverage can give skewed results, and damage components. Component damage may ultimately result in loss of steering control.

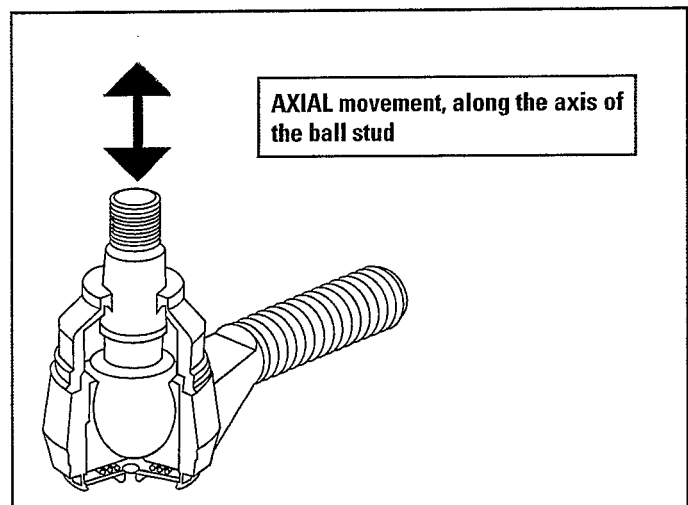
Inspection Station Criteria:

Follow preceding procedures for inspecting ball sockets. Measure any movement detected by hand with a scale for in and out motion on the ball stud axis.

Any motion, other than rotational, between any linkage member and its attachment point of 1/8" (3 mm) or more, measured with hand pressure only, is cause to remove the vehicle from service for immediate socket replacement.

If movement is less than 1/8" (3 mm) the socket should be replaced at the next practical servicing stop.

If no movement is detected by hand the socket is operable.



TRW Commercial Steering Systems

P.O. Box 60
Lafayette, IN 47902
Phone: 765.423.5377
Fax: 765.429.1868



Volvo Trucks North America, Inc.
Greensboro, NC USA

Service Bulletin Trucks

Date	Group	No.	Page
10.2002	643	001	1(1)

TRW Ball Socket Wear
Procedure Literature
VN, VHD

Ball Socket Wear

Procedure Literature

(Effective from October 2002)

Service Bulletin, "Inspection Procedure for TRW Ball Socket Wear", LNK-105 (03.2002)
can now be accessed directly from the official internet site of TRW Corporation.

To review and download this TRW Service Bulletin, please visit:

<http://trucksteering.trw.com/files/Lnk105.pdf>

NOTE: This document is subject to change without notice.

TRW Automotive Commercial Steering Systems

Service Bulletin #LNK-105

Inspection Procedure for TRW Ball Socket Wear

Revised March, 2002

This TRW Commercial Steering Systems' service bulletin has been written to help you repair commercial vehicles more efficiently. This bulletin should not replace your manuals; you should use them together. These materials are intended for use by properly trained, professional mechanics, NOT "Do-it-yourselfers". You should not try to diagnose or repair steering problems unless you have been trained, and have the right equipment, tools and know-how to perform the work correctly and safely.

Truck Shop Inspection Procedure:

1. Make sure the stud is seated tightly in the steering arm taper, and the nut is tight.
2. With vehicle **engine on**, lightly rock the steering wheel while checking for looseness in any threaded joint, or any movement of the stud nut. Any looseness requires repair.
3. With the **engine off** and wheels straight ahead, push and pull the socket in and out by hand (using 50-100 lbs. of pressure) in the direction of the ball stud. If no **AXIAL** movement is detected, the socket is operable. Any free lash detected by hand requires replacement of the socket.

WARNING: Do not use a wrench or other object to apply leverage when inspecting sockets. Applying leverage can give skewed results, and damage components. Component damage may ultimately result in loss of steering control.

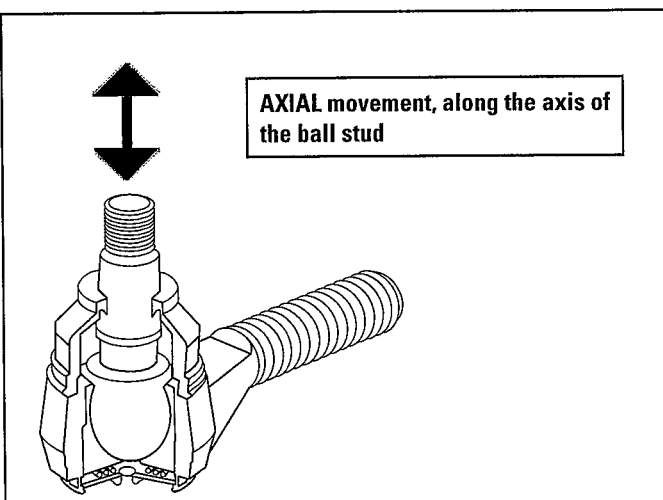
Inspection Station Criteria:

Follow preceding procedures for inspecting ball sockets. Measure any movement detected by hand with a scale for in and out motion on the ball stud axis.

Any motion, other than rotational, between any linkage member and its attachment point of 1/8" (3 mm) or more, measured with hand pressure only, is cause to remove the vehicle from service for immediate socket replacement.

If movement is less than 1/8" (3 mm) the socket should be replaced at the next practical servicing stop.

If no movement is detected by hand the socket is operable.



TRW Commercial Steering Systems
P.O. Box 60
Lafayette, IN 47902
Phone: 317.423.5377
Fax: 317.429.1868



Steering Linkage Wear Check

Wear is checked by gripping the linkage, tie rod or draglink, close to the ball joint and moving the seat of the ball axially. If there is a larger movement, remove the vehicle from service and have the linkage replaced before driving.

Inspection Station Criteria

The joint should not move more than maximum 1/8 in. (3mm) measured with hand pressure only.

Any motion, other than rotational, between any linkage member and its attachment point of 1/8" (3mm) or more, measured with hand pressure only, is cause to remove the vehicle from service for immediate socket replacement.

Truck Shop Inspection Criteria

If no **AXIAL** movement is detected, the socket is operable. Any free lash detected by hand requires replacement of the socket.

68 Service Schedules VN, VHD

Note: Use the information in the table below to determine the operating condition and usage applicable to your vehicle.

For Cummins information: refer to Cummins literature in the introductory package inside your vehicle.

SEVERE DUTY	HEAVY DUTY	NORMAL DUTY 
• Average fuel consumption is over 4.7 liters per 10 km (under 5.0 miles per gallon) • Gross combined weight (GCW) is greater than 45,000 kg (100,000lb.) • Idle time is 40% or higher • Vehicle operates in inner city delivery	• Average fuel consumption is over 4.7 liters per 10 km (under 5.0 miles per gallon) • Gross combined weight (GCW) is greater than 45,000 kg (100,000lb.) • Vehicle operates in regional distribution	• Average fuel consumption is under 3.6 liters per 10km (over 6.5 miles per gallon) • Gross combined weight (GCW) is less than 36,000 kg (80,000 lb.) • On highway operation only

HIGHER OIL QUALITIES			
OIL QUALITY	VDS-2 plus EO-N	VDS-2 plus EO-N	VDS-2 plus EO-N
MILEAGE*	12,000 miles (19,000 km)	15,000 miles (24,000 km)	25,000 miles (40,000 km)
MONTHS*	4	4	4
HOURS*	300	400	600
FUEL USAGE*	2,500 gallons (9,500 liters)	3,000 gallons (11,500 liters)	4,000 gallons (15,000 liters)
NORMAL OIL QUALITIES			
OIL QUALITY	VDS-2 plus CI-4	VDS-2 plus CI-4	VDS-2 plus CI-4
MILEAGE*	9,000 miles (14,000 km)	11,000 miles (18,000 km)	19,000 miles (30,000 km)
MONTHS*	4	4	4
HOURS*	250	300	450
FUEL USAGE*	1,900 gallons (7,100 liters)	2,200 gallons (8,500 liters)	3,000 gallons (11,500 liters)
*Whichever comes first			

Service Schedules VN, VHD 71

TYPE OF OPERATION	CHECK / CHANGE BASIC (4 MONTHS)	CHECK / CHANGE ANNUAL (12 MONTHS)	ADDITIONAL SERVICE
Check Batteries- Dirt, Leakage, Attachment, Specific Gravity of Battery Acid, Fluid Level Connections and Battery Box	X	X	
Check Fuel Tank, Hoses, Pipes Venting and Mounting	X	X	
Check Fuel Water Separator for the Fuel system, Draining of Condensation.	X	X	
Check Tire Wear	X	X	
Check Drive Belts	X	X	
Check Radiator Fan, Bearing Tolerance, Bolt Unions, Fan Cover and Fan Ring with Rubber Seal	X	X	
Check Exhaust Leakage	X	X	
Check Turbocharger	X	X	
Check Steering Linkage	X	X	
Check Front Shock Absorbers	X	X	
Check Front Wheels and Bearings	X	X	
Check Rear Spring Bolts	X	X	

Section 3
Copies required by Question 7
(Assessments/ Analysis)

TRW TRW Fahrwerksysteme	8 D_(isziplinen) Report	Werk Düsseldorf SAP-Nr. 600000276 Rekl.-Nr. 262-2000
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0. Issue: Separated Ball Pin of Customer ROLLINS RO# 528-19580 mileage: 305.000 miles	TRW Z.Nr.: 035-0231-936-454 Kunden Z.Nr.: 8079525 Prod. Date of the drag link: October 1997
--	---

1. Teammembers:	Name Thiel	Dep. QS	Function Zentrale Qualität
------------------------	---------------	------------	-------------------------------

2. Description of Problem: Customer complains a separated ball pin from a.m. ball joint (see foto 1). This separation resulted in misfunction of the truck steering. The complaint drag link was cutted (for transportation) and sent to TRW Chassis Systems Germany for analysis. The screw-in side shows the separation (*only the housing was reshipped*), the press-in side shows corrosion on the ball pin and a disassembled sealing (foto 2).



Foto 1: screw-in side of drag link.



Foto 2: press-in side with disassembled sealing

3. Interim Action: None, because no direct TRW fault is visible.
--

4. Root Cause:
 Screw-in side: due to the missing ball pin (and sealing) it is not possible to analyse the joint for failure root cause. The reason for the separation is corrosion of the ball pin. This means excessive wear of the socket, the housing and the ball pin due to abrasion (*rough surface of the ball pin*). As the diameter of the ball pin is too small it wont be surrounded by the housing any longer. The reason for the corrosion can not be analysed without the ball pin and the sealing.
 Press-in side: The ball pin is also corroded. The reason for the corrosion is a leakage of the sealing. There is no misfunction of the sealing on the cone side visible as there are no continuous corrosion marks beneath the sealing. But there are several leaks due to force on the sealing and the joint. Proofs of this are the damagings of the (metallic) housing (foto 3+4), the character of the leakage of the sealing (foto 5) and the deformation of the metallic sealing ring (foto 6) on the opposite side of the leakage of the sealing.
 Therefore there is no misfunction of the sealing or the assembly but a mistreatment of the joint which resulted in corrosion and (as a matter of abrasion) in separation of the ball pin from the housing.



Foto 3+4: Damages and deformations of the metallic housing. Foto 4 introduces high forces on the side housing-border which also means a damaging of the sealing as visible in foto 5.



Foto 5: Cut and leakage of the sealing due to outer force. This will result in high water ingress into the joint.



Foto 6: Damaging of the sealing ring on the opposite of the damagings in foto 5.

5. Determination of Containment Action: A mistreatment of the joint as visible above is not under TRW responsibility and can not be avoided by TRW actions.	(Zuständig/Verantwortlich; Termin)
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6. Implementation of Containment Action:	(Zuständig/Verantwortlich; Termin)
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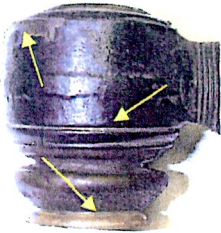
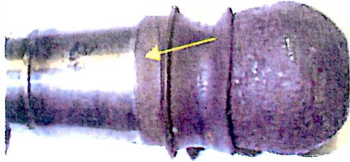
7. Verification of Effectiveness:	(Verantwortlich(Name/Abt.Termin)
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8. Final, congratulate the team: The a.m. analyse shows a mistreatment of the joint due to damaging of the housing and the sealing system, which resulted in water ingress and corrosion of the joint. The separation was the result of an excessive abrasion of the ball pin and the housing. Date: 29 th , Nov 2000 Name: Thiel Dep.: QS Signature:
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Distribution: Customer, TRW US, Team, CS Date: 29 th , Nov 2000 Name: Thiel Dep.: QS Signature:
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TRW TRW Fahrwerksysteme	8 D_(isziplinen) Report	Werk Düsseldorf SAP-Nr. 600000276 Rekl.-Nr. 262-2000
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 TRW Fahrwerksysteme	8 D_(isziplinen) Report	Werk Düsseldorf SAP-Nr. - Rekl.-Nr. 274-2000
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0. Issue: Separation of ball joint of RUAN Drag Link		TRW Z.Nr.: 035-0231-936-454 Kunden Z-Nr.: 8 079 526															
1. Teammembers:	<table border="1"> <thead> <tr> <th>Name</th> <th>Dep.</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td>Wellin</td> <td>KQ</td> <td>Plant Quality</td> </tr> <tr> <td>Thiel</td> <td>QS</td> <td>Central Quality</td> </tr> <tr> <td>Teubert</td> <td>CS</td> <td>Techn. Sales</td> </tr> <tr> <td>Romahn</td> <td>KNP</td> <td>Ind. Engineering</td> </tr> </tbody> </table>	Name	Dep.	Function	Wellin	KQ	Plant Quality	Thiel	QS	Central Quality	Teubert	CS	Techn. Sales	Romahn	KNP	Ind. Engineering	
Name	Dep.	Function															
Wellin	KQ	Plant Quality															
Thiel	QS	Central Quality															
Teubert	CS	Techn. Sales															
Romahn	KNP	Ind. Engineering															
2. Description of Problem: The customer RUAN complaint 1. separation of a ball pin. (History: Part No. 8079525; In service date: 5-8-99; Chassis N760518; Ruan unit # R86588; mileage: 519066 mls; Conventional Tandem Axle Sleeper Tractor). 2. Scoring (see 8D Ruan DL Scoring 081200)																	
3. Interim Action: none, see 4.																	
4. Root Cause: We were sent 4 photos of the adjustable end of the drag link.  Photo 1: Housing and sealing from beside The photo shows an okay positioning of the sealing via Z-ring assembly and no damage on the visible side of the sealing. The ball pin and the clamp ring (on the sealing) are missing. Assembly marks in the sealing groove (information by TRW Portland) give evidence for an originally present clamp ring in the right position. The rolling on the top of the housing shows no damage or potential leakage. There is surface-corrosion due to missing paint on the top-left side of the housing (see photo orientation).  Photo 2: Housing and sealing from taper side The gaiter mouth (sealing) shows corrosion particles in the contact area with the pitman-arm.  Photo 3: Housing with disassembled sealing No corrosion marks or hints for a malfunction of the sealing assembly / Z-ring against the housing are visible. It seems that there is some grease rest visible in the hole of the upper ball seat. The inner side of the housing is completely corroded.  Photo 4: Separated ball pin with sealing support The ball is completely corroded and out of diameter / form. The taper of the ball pin shows complete corrosion of the contact area of ball pin with sealing-labyrinth. The support ring is damaged and worn out.																	

 TRW Fahrwerksysteme	8 D_(isziplinen) Report	Werk Düsseldorf SAP-Nr. - Rekl.-Nr. 274-2000
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4. Root Cause (continue):

The single parts of the joint give the following impression of the separation process:

1. The corrosion of the contact area of the sealing with the pitman-arm (photo 2, gaiter mouth) led to corrosion of the ball pin's taper as a result of abrasion of the gaiter mouth and fading of sealing function. The corrosion as a matter of surface-process migrated beneath sealing and taper into the inner joint. The corrosion of the ball and the housing led to excessive wear due to the rough surface. A result of this is the decreasing diameter of the ball and the encreasing diameter of the aperture. The falling of the ball pin's diameter below the aperture-diameter resulted in the separation of the ball out of the housing.
2. The corrosion status of the ball pin is not normal and will not occur during life time of the joints. Nevertheless massiv damages of the sealing or mistreatment of the joint could lead to massiv water ingress into the housing, which will result in corrosion of the ball and lower ball seat. Excessiv wear could lead to the a.m. effect.

Corrosion effects like this (with artificial water ingress for testing) were simulated. The corrosion process runs for several months. Therefore technical inspection of the drag link should immediately detect corrosion of the ball due to the encreased play. Additionally the knocking noise (due to the missing contact) has to be heard during steering and driving.

5. Determination of Containment Action: (Zuständig/Verantwortlich; Termin)

- Check of Design-FMEA (Team; done and okay 11th, Dec 2000)
- Check of greasing-process (Plant; done and okay 08th Dec 2000)
- Controlling of sealing test (temperature -30°C - +50°C; articulation, rotation, water-jet; test VR-338-96: okay)

6. Implementation of Containment Action: (Zuständig/Verantwortlich; Termin)

none

7. Verification of Effectiveness: (Verantwortlich(Name/Abt. Termin))

none

8. Final:

The complaint parts show corrosion as the root cause for abrasion, excessive wear and therefore separation of the ball pin from the housing. The corrosion status of the housing (no evidence for water ingress over roll over or z-ring sealing assembly) and the ball pin give us the impression of a corrosion process from the pitman-arm over the ball-pin taper into the joint. The Prod. Date of the drag link, the mileage of the truck and the In-Service date let us conclude that the complaint drag link is a spare part, which was assembled into a corroded pitman-arm.

The corrosion-process inside the joint should have been detected during technical inspection due to excessive wear and free play as it is no short-time process. Additionally the occuring knocking noise of the drag link should have been noticed during service.

Date: 11th, Dec 2000

Name: Thiel Dep.: QS Signature:

Distribution: TRW Portland Plant; Team

Date: 11th Dec 2000

Name: Thiel Dep.: QS Signature:

MEMO REPORT
MATERIALS ENGINEERING
TRW COMMERCIAL STEERING DIVISION

PROJECT #: 52-03

DATE: 11/11/03

WRITTEN BY: M.N. Nemani

DISTRIBUTION: Bob Geyer
Dave Hobson

CC: Mitch Monahan
Dave Snitgen
Carl Bandy
Ken Turner

SUBJECT: Volvo – Frito Lay Draglinks

BACKGROUND: Kevin Pollock, Volvo reliability engineer, sent two (2) draglinks to Bob Geyer. The draglinks were manufactured by FWS and were removed from Volvo VN model trucks. One of the draglinks was off of a truck with 544,000 miles. The ball stud separated from the socket on the axle end. The second draglink is intact and was taken off of a truck with 102,700 miles. These two draglinks were submitted to Materials Engineering to document the condition of the parts and to conduct materials evaluation of the separated ball stud and socket housing.

SUMMARY AND CONCLUSIONS:

1. Visual examination of the separated socket components showed that contamination of the socket lead to corrosion and wear of the ball stud resulting in separation.
2. Materials evaluation showed the ball stud and socket housing conform to material and heat treatment specifications.

RESULTS

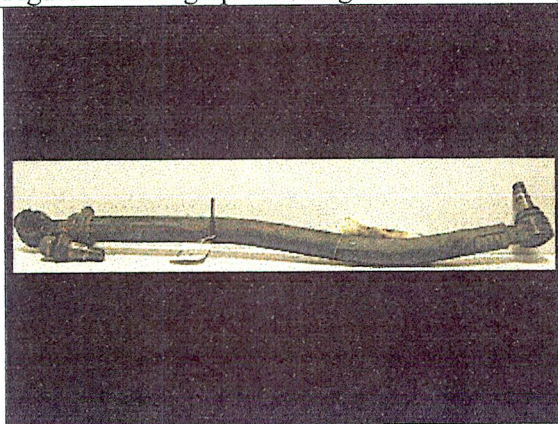
VISUAL EXAMINATION: The 544,000 mile draglink assembly with the separated socket is shown as received in figure 1a. The axle end socket components are shown in figure 1b. Close up views of the ball stud and socket housing are shown in figures 1c and 1d respectively. As can be seen in the photographs, the boot seal was torn and the socket components were covered with heavy rust. No lubricant/grease was evident in the socket. The separated ball stud and socket were cleaned in an ultrasonic cleaner to remove corrosion products on the surface and examined at higher magnifications with a stereomicroscope. The appearance of the cleaned components is shown in figure 2. Wear and heavy pitting due to corrosion are clearly evident on the surface of the ball. The socket housing also shows evidence of heavy corrosion products, which resulted from the damage to the boot seal and resultant ingress of road salts and other debris. The draglink with 102,700 miles appeared to be intact. No damage was observed to either socket assembly. The two socket ends of this draglink are shown in figures 1e and 1f.

Metallographic Evaluation: Axial metallographic sections through the ball and socket housing were prepared for metallographic evaluation. Figure 3a and 3b shows the induction hardened case of the ball stud. The cross section also exhibits the pitting profile observed at the surface. The microstructure of the case consisted of fine medium Carbon tempered martensite. Micro hardness measurements were made 0.010 inches below the surface with a Knoop indenter and 500 gram load. Hardness was equivalent to HRC 56 (Knoop hardness 644-653). Core hardness was equivalent to HRC 30-32 (Knoop hardness 311-324). The microstructure of the socket housing consisted of a mixture of fine lamellar pearlite and ferrite, indicative of a low Carbon steel as expected. Hardness of the socket housing material was measured to be equivalent to HB 162 (Knoop hardness 176).

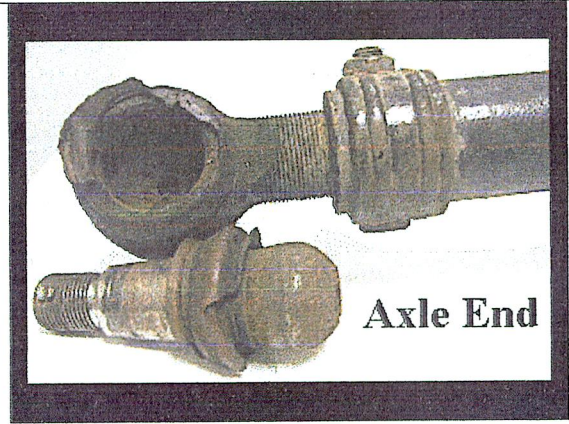
Chemical analysis: Chemical composition of ball stud and socket housing from the axle end of the 544,000-mile drag link was analyzed using an optical emission spectrometer and Carbon-Sulfur determinator. Results (in weight %) are shown below. Results indicate ball stud and socket housing were manufactured from SAE5140 and SAE 1035 equivalent steels, as specified.

Element	C	S	P	Si	Cr	Ni	Mo	Mn	Cu	Al
Ball stud	0.45	0.028	0.008	0.11	1.08	0.12	0.03	0.73	0.14	0.024
Socket housing	0.37	0.025	0.010	0.20	0.15	0.07	0.02	0.66	0.12	0.023

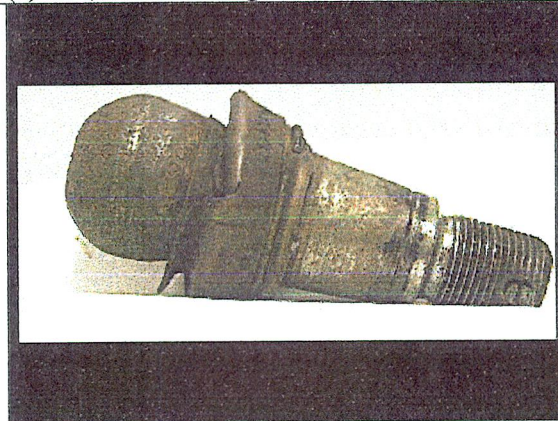
Figure 1: Photographs of drag links as received



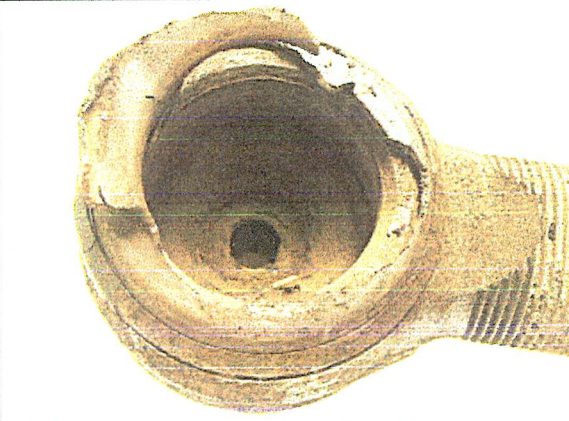
(a) 544,000 mile drag link assembly as received



(b) Separated ball stud and socket



(c) Close up view of ball stud



(d) Close up view of socket housing



(e) Axle end of 102,700 mile drag link



(f) Other end of 102,700 mile drag link

Figure 2: Photographs of ball stud and socket after cleaning

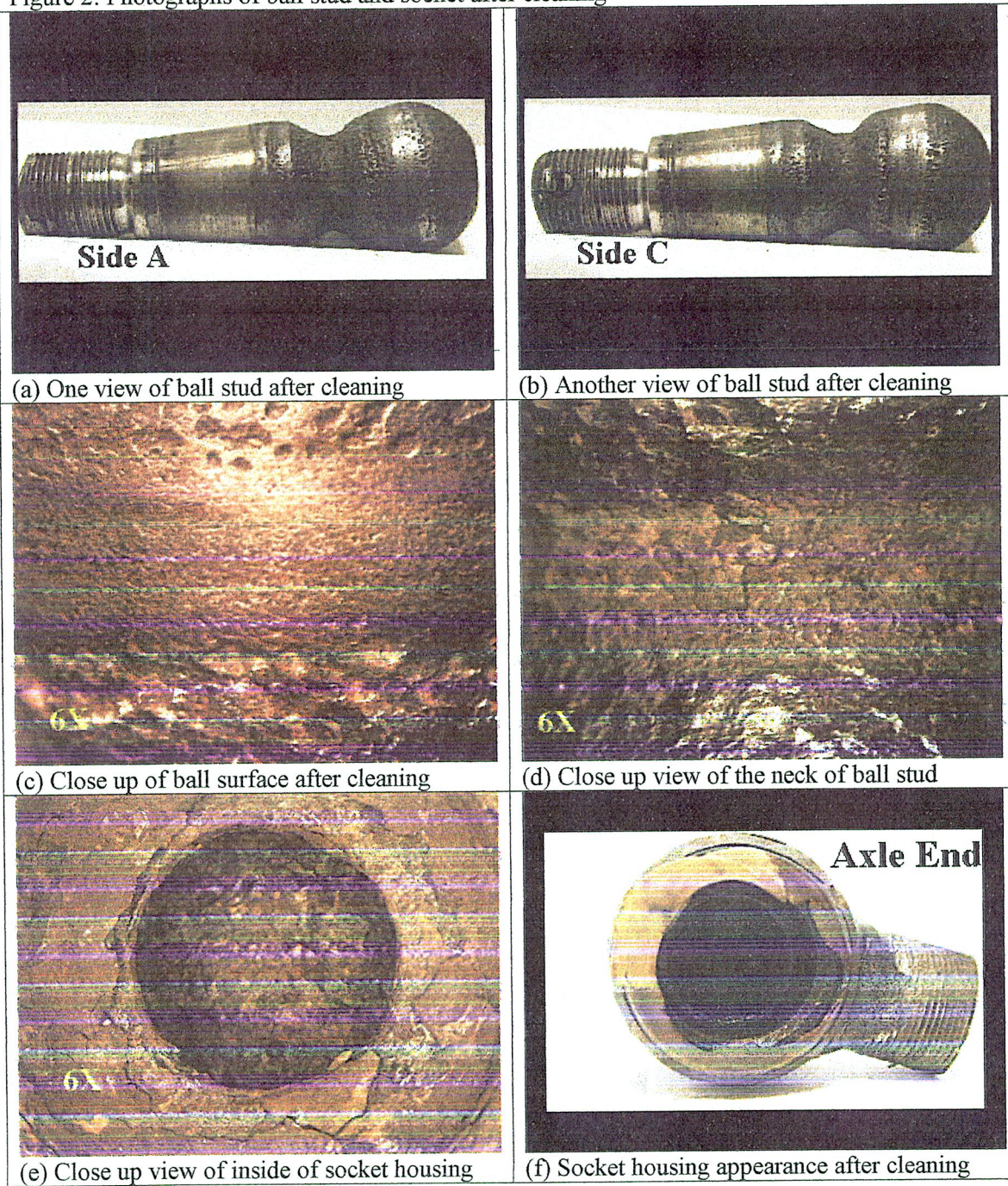
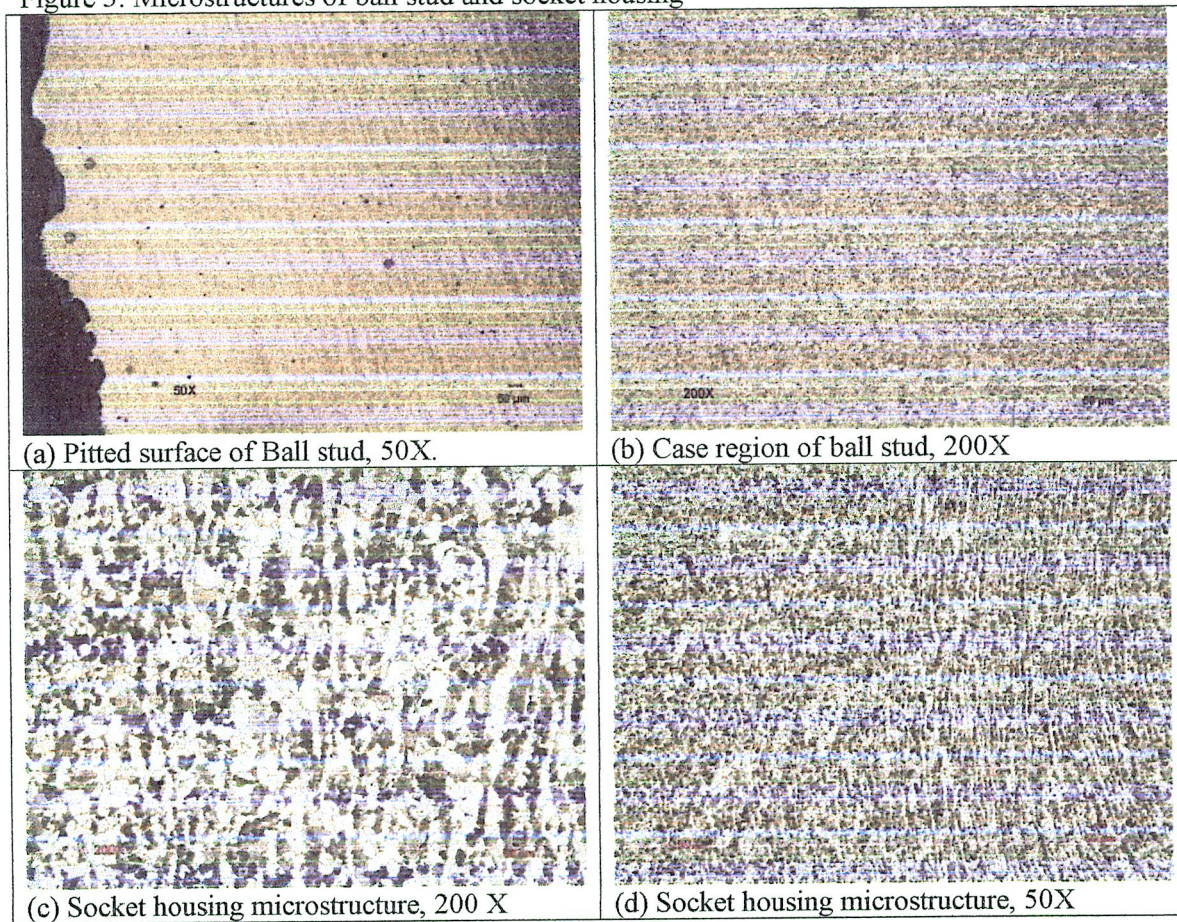


Figure 3: Microstructures of ball stud and socket housing



TRW Engineering Analysis Report

Commercial Steering Systems, Portland Plant



TRW Project #: **EA-27-03**

Customer Information

Customer:

Customer Contact:

OEM:

Volvo Trucks North America

OEM Contact:

Mike Brumley, Mack/Volvo NA
:Field Support

Customer Part Number:

8079525

TRW FWS Part No.:

035- 0231-936-454

Part and Vehicle Information

Mileage:

Service Mileage Unknown

Model:

Volvo VNL 64T

Part In-Service Dates:

Not Provided

Reason for Return

Fleet request for analysis of TRW FWS draglinks due to reported excessive wear on the adjustable end. In addition requested TRW to provide a cut-away socket for viewing purposes.

Report Distribution

John Fleure, Ryder Transportation
Mike Brumley, Mack/Volvo NA
Dave Snitgen, TRW Chief Eng., Global Linkage
Urs Teubert, TRW FWS Application Engineer
Ken Turner, TRW Portland Plant Product Engineer
Dave Hobson, TRW, Manager Quality Systems

Carl Bandy, TRW CSS Sales Representative
Brian Shivley, TRW Portland Plant Quality Manager
Mike Dunmire, TRW CSS Sales Account Manager
Robert Grimes, TRW CSS Technical Support
Buzz Hazen, TRW CSS Field Service Support

Analysis

As Received:

Fifteen TRW Fahrwerksysteme draglinks were returned to TRW Portland, Michigan facility on 11/17/03. The parts were returned from recent vehicle inspections performed by Ryder customers, IR, Melroe and Praxair. The parts returned are believed to be service parts as the vehicle in-service dates range from 3/10/1999 to 2/12/2001 with vehicle mileages ranging from 304,545 to 811,097. The part in-service dates and mileages were not reported to TRW.

Analysis:

The visual analysis of the drag link ends included the seal, the ball stud and grease. The functional analysis included radial lash and axial compliance where warranted.

The adjustable end of the draglink experienced higher levels of wear when compared to the non-adjustable ends. The non-adjustable end axial compliance indicates that the parts were not worn to a level recommended for removal. However, upon inspection of the seals, five were found to be damaged and in one case the seal was not returned. Due to the difficulty in determining the cause of the seal damage, the condition of the grease was taken into consideration. There is grease degradation in 10 of the 15 non-adjustable drag link ends, indicating contamination in the socket for an undetermined period of time.

On the adjustable end, 11 of the 15 axial compliance results warranted removal. The axial compliance results range from .042-.180 inches. TRW's inspection criteria for draglink removal and replacement is wear at or greater than .060 inches. In addition, 3 of the 4 draglinks with acceptable axial compliance, had damaged seals and/or notable contamination. In all cases, there was grease degradation.

Photos are provided at the end of this report.

Prepared By: Sheila Pulling; Technical Services

Date: 12/10/03

Page 1 of 3

TRW Engineering Analysis Report

Commercial Steering Systems, Portland Plant



Results Summary

1. TRW recommends a review of maintenance procedures and intervals to ensure timely wear detection and proper seal inspections.
2. The socket wear is due to contamination from a variety of environmental factors combined with the inability to purge contamination from the socket. The rate of wear is increased when contamination is introduced in the socket cavity.

Photos

Photo: (738:C) UNIT: 348053

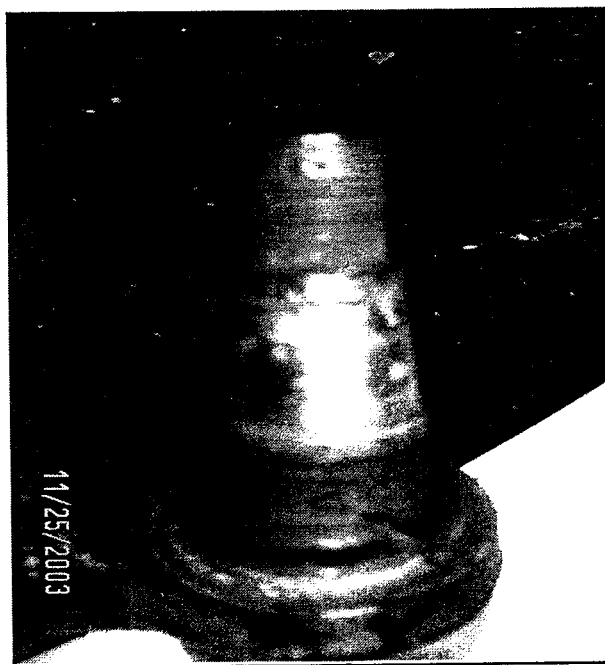
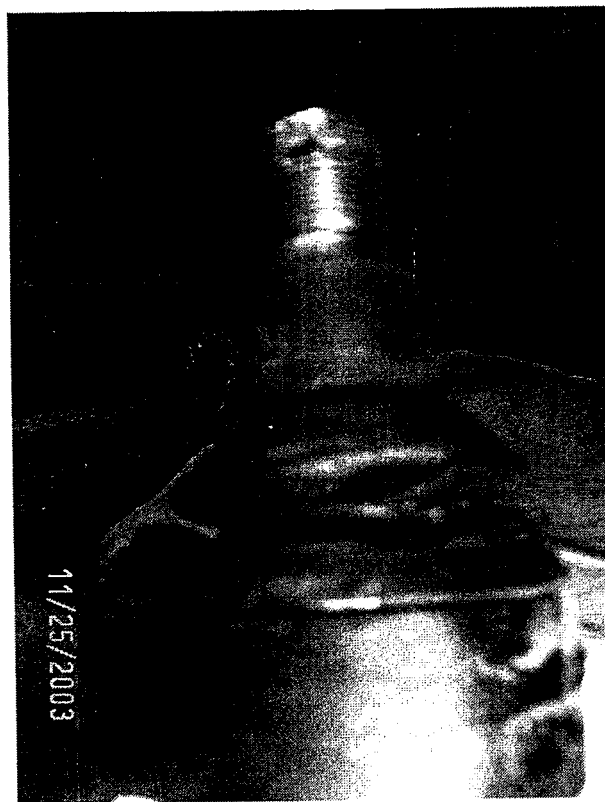


Photo (739:N) UNIT 766313:



Photo (739:N) UNIT 766313:



TRW Engineering Analysis Report

TRW Project #: EA-1-08-A Revision A

Report Date: March 24th, 2008



Part Information		Vehicle Information	
Customer:		Unit #:	Not Provided
Customer Contact:		Mileage:	330,000
Customer Part Number:		OEM:	Not Provided
Description:	Vertical Drag Link Assembly	Fleet:	Not Provided
TRW Part Number:		VIN #:	N401495
Other Identification:		Other:	

Reason For Return: Ball Stud Separation

Results Summary: The failure mode of the socket is excessive wear of the ball stud and bearing. The socket met all TRW material and metallurgical requirements for the components. The wear was due to corrosion of the ball stud and contamination of the socket.

Report Author: Mitch Monahan, Plant Metallurgist, TRW

Report Distribution:

Mike Dunmire, Account Manager TRW

Brian Shivley, Quality Manager, TRW

Dave Hobson, Manager Quality Systems, TRW

Jon Thelen, Product Engineering Manager, TRW

Jack McCullough, Director of Quality NA Steering, TRW

Ron Sichau, Account Manager, TRW

Background Information

Volvo returned two drag links for evaluation. The drag links were manufactured by FWS and have Group 31 socket ends. The ball stud from the adjustable end of one drag links had separated from the socket. The ball stud from the adjustable end of the second socket was loose, but not separated. The reported VIN of the drag link with the separation was N401495. The reported mileage was 330,000. No data was reported for the other vehicle.

Testing and Evaluation

Visual Examination: The sockets were examined in the as-received condition. The socket with the ball stud separation, Figure 1, was dry of grease and was corroded. The boot seal was not damaged. After visual examination, the closure cap was cut away in order to remove the inner components for evaluation:

- Ball Stud: The ball stud, Figure 2, exhibited significant wear. The ball, undercut, and upper shank areas were heavily corroded.
- Steel Bearing: The bearing exhibited significant wear and was heavily corroded
- Spring and Spring Seat: Each of these components was heavily corroded. The inside of the socket is shown in Figure 3.

The socket with the non-separated ball stud, Figure 4, contained some grease. The grease was relatively dry and contaminated. The boot seal was not damaged. After the visual examination, the closure cap was cut away in order to remove the inner components for evaluation:

- Ball Stud: The ball stud, Figure 5, exhibited significant wear. The ball, undercut, and upper shank areas were heavily corroded.
- Steel Bearing: The bearing exhibited significant wear and was heavily corroded
- Spring and Spring Seat: Each of these components was heavily corroded. The inner components were coated with dry, caked grease.

Surface Hardness: Due to corrosion and wear of the ball studs and bearings, surface hardness of the components could not be measured.

Chemistry: Chemical analysis the ball studs was performed using optical emission spectroscopy. The results are given in Table 1. The specified material for these ball studs is 41SrS4V. The chemistry falls within the acceptable chemical range.

TRW Engineering Analysis Report – Project EA-1-08

Revision A

Metallography: Each ball stud and bearing was sectioned through the wear and non-wear areas and prepared for metallographic evaluation. The near surface microstructure of each ball stud was martensitic. The microstructure of the bearings consisted of tempered martensite with some retained austenite. Microhardness traverses were conducted in non-wear areas using a Knoop indenter and 500-g load. The test results are summarized in Table 2.

Table 1: Chemical Analysis of the ball stud (in weight percent).

	C	Mn	P	S	Si	Cr	Mo	Ni	Al	V
Separated Stud	0.42	0.70	0.01	0.02	0.07	1.06	0.01	0.07	0.01	0.01
Loose Stud	0.42	0.80	0.02	0.02	0.19	1.12	0.03	0.11	0.03	0.01
41CrS4V	0.38- 0.45	0.60- 0.90	0.035 max	0.02- 0.04	0.40 max	0.90- 1.20				

Table 2: Hardness and Effective case depth test results.

	Hardness Specification	Hardness Test Result ¹	Effective Case Depth Specification	Effective Case Depth Test Result
Separation – Stud	55 - 61 HRC	56	1.5-3.0 mm	1.80
Non Separation – Stud		57		2.20
Separation – Bearing	650-750 HV	674	0.2-0.4 mm	0.25
Non Separation - Bearing		674		0.30

1 – Converted from Knoop, measured using a 500-g load.

TRW Engineering Analysis Report – Project EA-1-08

Revision A

Figure 1: Photograph of the socket with the separated ball stud threaded socket end as-received showing the condition of the socket.

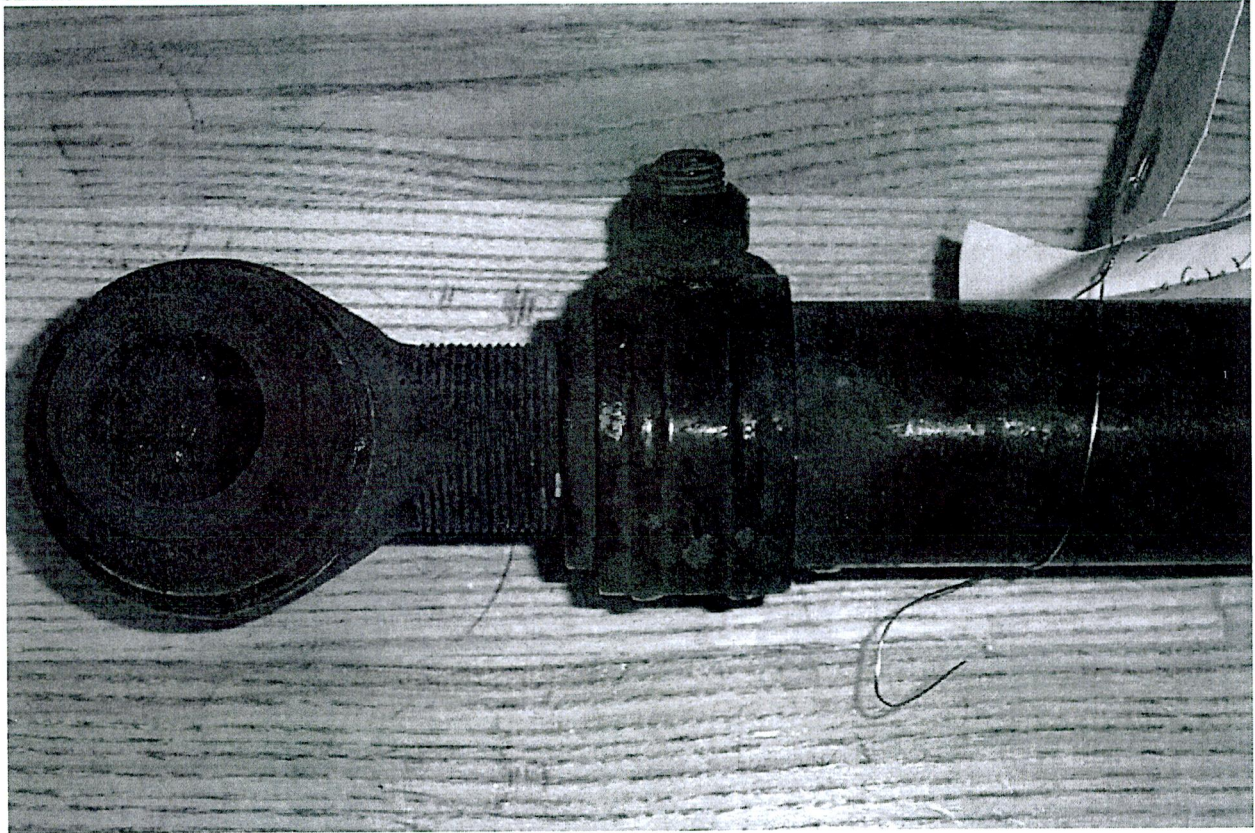
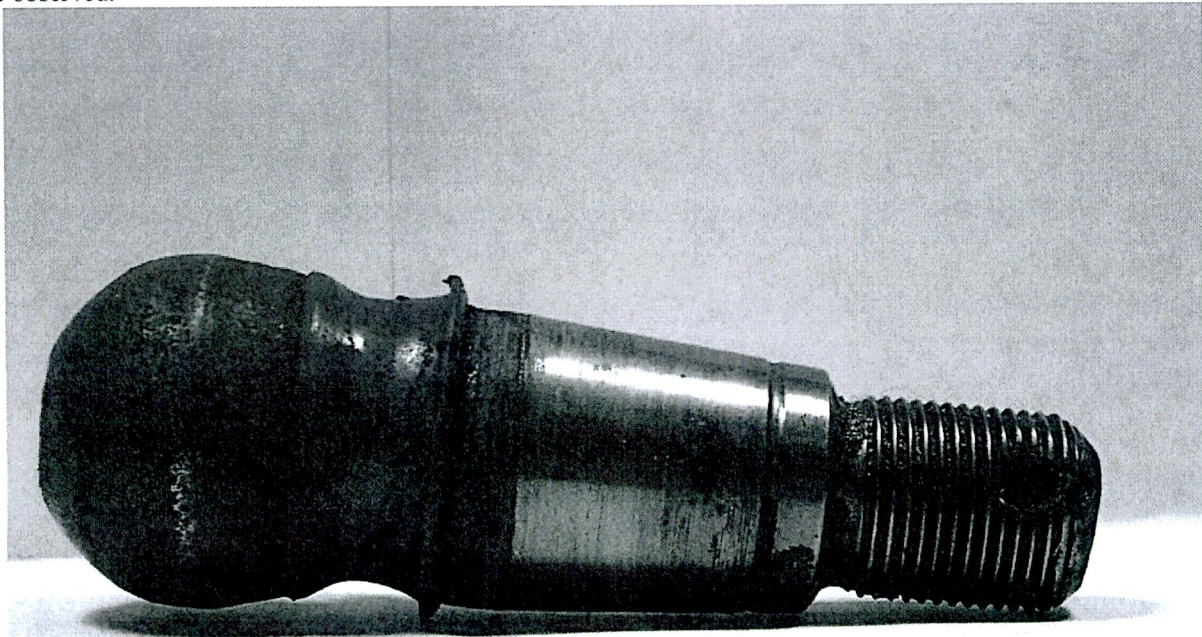


Figure 2: Photograph of the ball stud removed from the right hand socket, light polishing of the bearing surface can be observed.



TRW Engineering Analysis Report – Project EA-1-08

Revision A

Figure 3: Photograph of the socket after the boot seal was removed indicating the condition of the internal components.

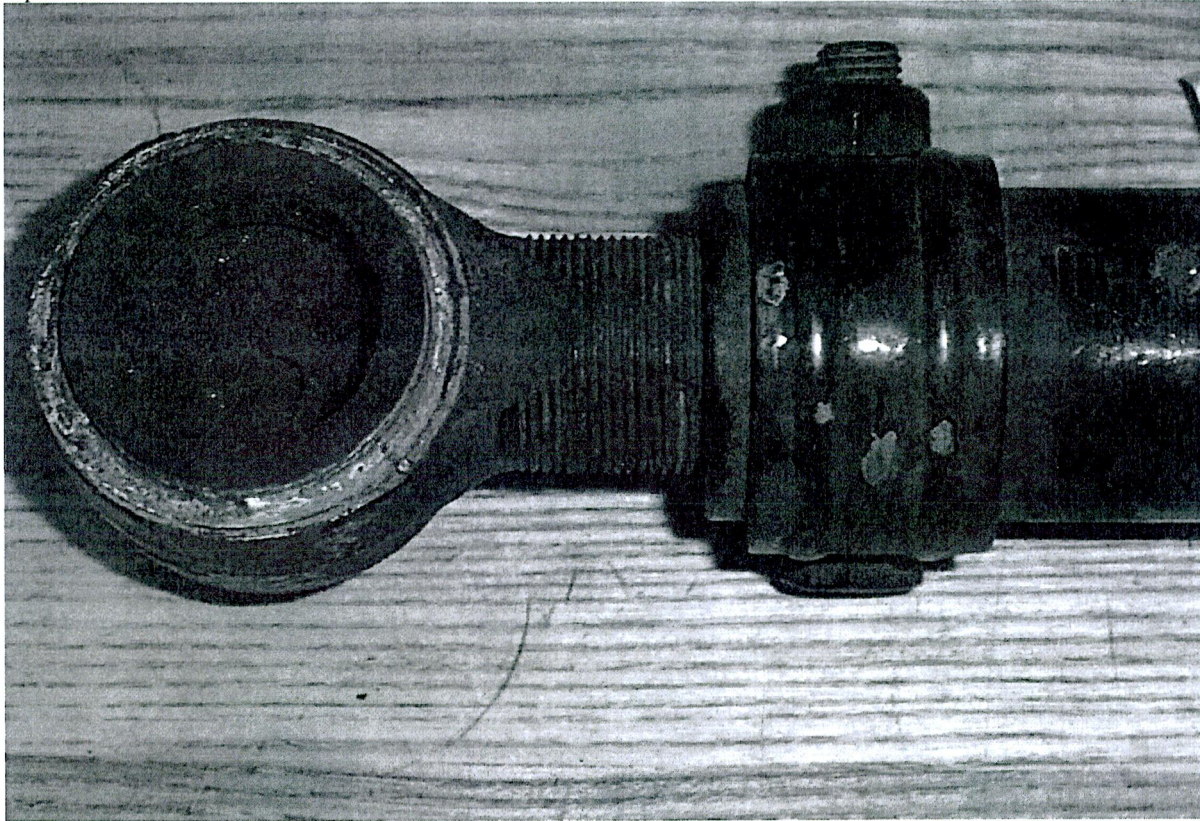
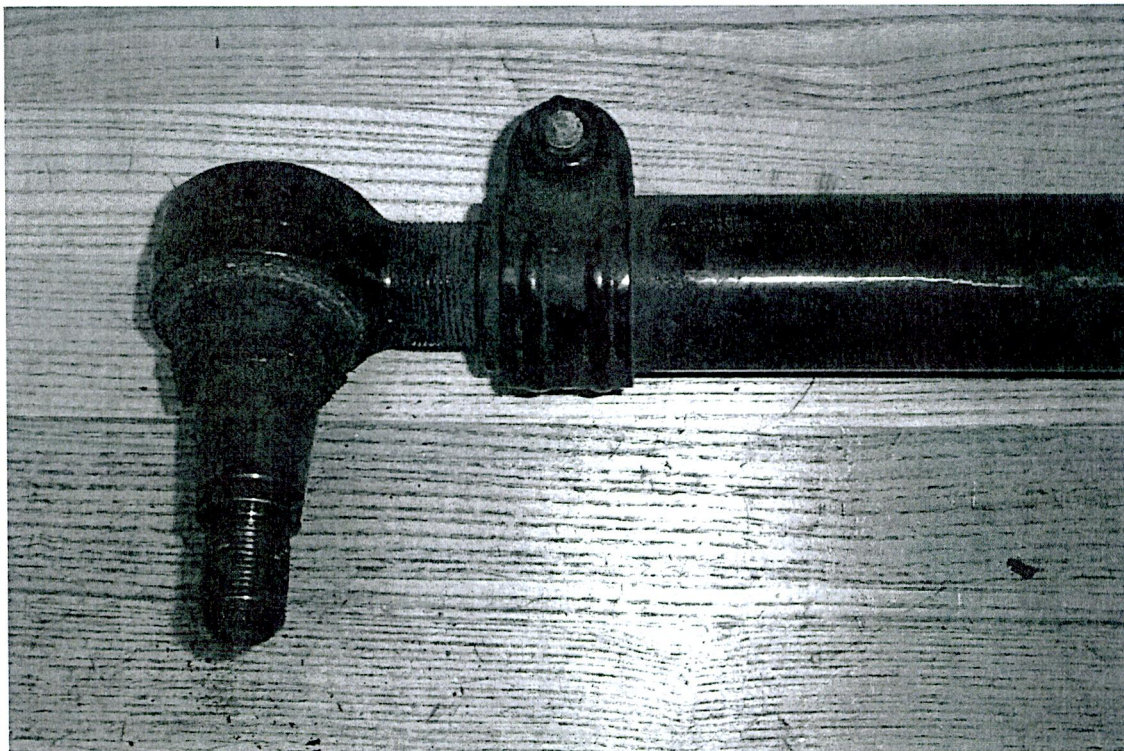


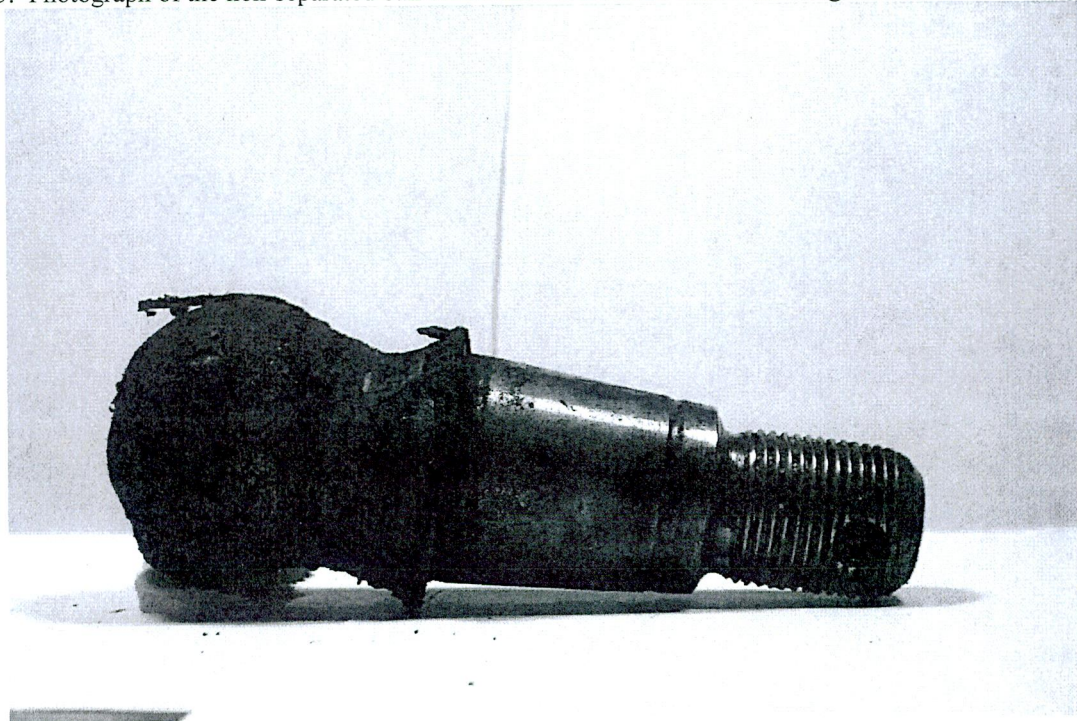
Figure 4: Photograph of the socket with the non-separated ball stud with the boot seal removed showing its as-received condition.



TRW Engineering Analysis Report – Project EA-1-08

Revision A

Figure 5: Photograph of the non-separated ball stud removed from the socket showing the condition of the grease.



Section 4
Aftermarket sales required by
Question 9

1 1 1 3 Supers. str. search
Part id

8079525

VO

Sta Cons.cd Str F 1 S DCN
Notes

Ord.final date

Tech.info N

Reg.date 20050120 Sup.typ

Final date 20050618 Resp.user RU30110

Rec Rec.info

010 VO 20371221

1.000 LINK ARM

F1S

13 Part info 14 Supersedes 15 Chg descr. 16 Supers. str 17 Conn.Ana/DCN

18 Part reg 19 Chg part info 20 Crossindex 21 RASA str.lines 10 Rhelp

006 THIS IS THE FIRST PAGE

VTP 08/11/05 15:07:37

2 1 0 4 Customer order statistics 220 THIS PART IS SUPERSEDED
Partid

8079525 VO LINK ARM
Period 12 13 01 02 03 04 05 06 07
C-1

Misc
Kits
Period 08 09 10 11 12 13 01 02 03
C-1

Misc
Kits
Period 04 05 06 07 08 09 10 11
C-1

Misc
Kits

ROLL 13 AVER 13P AVER 6P Total 05 Total 06 Total 07 Curr Tot
3013

Exch Misc Kit-Fc C1 Curr -Fc Fc-P 13 Fc-P 01 Fc-P 02
0.0 0.0 0.0 0.0

1 Parts info 2 Stock bal 3 Del schedule 4 Customer order 5 MMI Refill
6 Del promises 7 Scrap order 8 Advise history 9 Val del sched 10 Rhelp

VTP 08/11/05 15:07:52

2 1 0 4 Customer order statistics 220 THIS PART IS SUPERSEDED
 Partid

20371221 VO LINK ARM
 Period 12 13 01 02 03 04 05 06 07
 C-1 1036 939 931 733 1014 1094 1184 877 1031

Misc
 Kits
 Period 08 09 10 11 12 13 01 02 03
 C-1 985 1127 1127 938 841 717 543 802 922

Misc
 Kits
 Period 04 05 06 07 08 09 10 11
 C-1 1050 877 852 958

Misc
 Kits
 ROLL 13 AVER 13P AVER 6P Total 05 Total 06 Total 07 Curr Tot
 7562 581.6 301.6 11253 14026 12599 6004
 Exch Misc Kit-Fc C1 Curr -Fc Fc-P 13 Fc-P 01 Fc-P 02
 0.0 0.0 0.0 0.0

1 Parts info 2 Stock bal 3 Del schedule 4 Customer order 5 MMI Refill
 6 Del promises 7 Scrap order 8 Advise history 9 Val del sched 10 Rhelp
 VTP 08/11/05 15:08:09

1 1 1 3 Supers. str. search
Part id

20371221

VO

Sta Cons.cd Str F 1 S DCN
Notes

Ord.final date

Tech.info N

Reg.date 20070927 Sup.typ

Final date 20080709 Resp.user RU30110

Rec Rec.info

010 VO 21128332

1.000 LINK ROD

13 Part info 14 Supersedes 15 Chg descr. 16 Supers. str 17 Conn.Ana/DCN

18 Part reg 19 Chg part info 20 Crossindex 21 RASA str.lines 10 Rhelp

006 THIS IS THE FIRST PAGE

VTP 08/11/05 15:11:27

2 1 0 4 Customer order statistics
 Partid

21128332 VO LINK ROD
 Period 12 13 01 02 03 04 05 06 07
 C-1
 Misc

Kits
 Period 08 09 10 11 12 13 01 02 03
 C-1 45
 Misc

Kits
 Period 04 05 06 07 08 09 10 11
 C-1 194 789 897 994 1011
 Misc

Kits
 ROLL 13 AVER 13P AVER 6P Total 05 Total 06 Total 07 Curr Tot
 3930 302.3 647.5 4005

Exch Misc Kit-Fc C1 Curr -Fc Fc-P 13 Fc-P 01 Fc-P 02
 75 989.2 996.9 1003.8 1010.8

1 Parts info 2 Stock bal 3 Del schedule 4 Customer order 5 MMI Refill
 6 Del promises 7 Scrap order 8 Advise history 9 Val del sched 10 Rhelp
 VTP 08/11/05 15:09:50

2 1 0 4 Customer order statistics 220 THIS PART IS SUPERSEDED
Partid

8083227

VO LINK ARM

Period	12	13	01	02	03	04	05	06	07
--------	----	----	----	----	----	----	----	----	----

C-1

Misc

Kits

Period	08	09	10	11	12	13	01	02	03
--------	----	----	----	----	----	----	----	----	----

C-1

Misc

Kits

Period	04	05	06	07	08	09	10	11
--------	----	----	----	----	----	----	----	----

C-1

Misc

Kits

ROLL 13	AVER 13P	AVER 6P	Total 05	Total 06	Total 07	Curr Tot
---------	----------	---------	----------	----------	----------	----------

15

Exch	Misc	Kit-Fc	C1	Curr -Fc	Fc-P 13	Fc-P 01	Fc-P 02
				0.0	0.0	0.0	0.0

1 Parts info	2 Stock bal	3 Del schedule	4 Customer order	5 MMI Refill
6 Del promises	7 Scrap order	8 Advise history	9 Val del sched	10 Rhelp

VTP 08/11/05 15:12:53

1 1 1 3 Supers. str. search
Part id

8083227

VO

Sta Cons.cd Str F 1 S DCN
Notes

Ord.final date

Tech.info N

Reg.date 20040602 Sup.typ

Final date 20050313 Resp.user RU30110

Rec Rec.info

010 VO 20588242

1.000 LINK ROD

F1S

13 Part info 14 Supersedes 15 Chg descr. 16 Supers. str 17 Conn.Ana/DCN
18 Part reg 19 Chg part info 20 Crossindex 21 RASA str.lines 10 Rhelp

VTP 08/11/05 15:13:08

2 1 0 4 Customer order statistics 220 THIS PART IS SUPERSEDED
 Partid

	20588242				VO	LINK ROD				
Period	12	13	01	02	03	04	05	06	07	
C-1	6	3	2	4	7	3	2	6	6	
Misc										
Kits										
Period	08	09	10	11	12	13	01	02	03	
C-1	5	3	3	3	9	2	1	3	6	
Misc										
Kits										
Period	04	05	06	07	08	09	10	11		
C-1	5	8	2	7						
Misc										
Kits										

	ROLL 13	AVER 13P	AVER 6P	Total 05	Total 06	Total 07	Curr Tot
	43	3.3	1.5	52	46	55	32
Exch	Misc	Kit-Fc	C1	Curr -Fc	Fc-P 13	Fc-P 01	Fc-P 02
				0.0	0.0	0.0	0.0

1 Parts info 2 Stock bal 3 Del schedule 4 Customer order 5 MMI Refill
 6 Del promises 7 Scrap order 8 Advise history 9 Val del sched 10 Rhelp
 VTP 08/11/05 15:13:32

1 1 1 3 Supers. str. search
Part id

20588242

VO

Sta Cons.cd Str F 1 S DCN

Ord.final date

Tech.info N

Notes

Reg.date 20070927 Sup.typ

Final date 20080710 Resp.user RU30110

Rec Rec.info

010 VO 21128334

1.000 LINK ROD

13 Part info 14 Supersedes 15 Chg descr. 16 Supers. str 17 Conn.Ana/DCN
18 Part reg 19 Chg part info 20 Crossindex 21 RASA str.lines 10 Rhelp

VTP 08/11/05 15:13:55

2 1 0 4 Customer order statistics
Partid

	21128334				VO	LINK	ROD		
Period	12	13	01	02	03	04	05	06	07
C-1									
Misc									
Kits									
Period	08	09	10	11	12	13	01	02	03
C-1									
Misc									
Kits									
Period	04	05	06	07	08	09	10	11	
C-1				1	5	3	3	4	
Misc									
Kits									

	ROLL 13	AVER 13P	AVER 6P	Total 05	Total 06	Total 07	Curr Tot
	16	1.2	2.6				16
Exch	Misc	Kit-Fc	C1	Curr -Fc	Fc-P 13	Fc-P 01	Fc-P 02
				0.0	0.0	0.0	0.0

1 Parts info 2 Stock bal 3 Del schedule 4 Customer order 5 MMI Refill
6 Del promises 7 Scrap order 8 Advise history 9 Val del sched 10 Rhelp

VTP 08/11/05 15:14:11

2 1 0 4 Customer order statistics

Partid

8073373

VO LINK ARM

Period	12	13	01	02	03	04	05	06	07
C-1	6	20	14	9	13	14	10	15	11

Misc

Kits

Period	08	09	10	11	12	13	01	02	03
C-1	22	9	9	10	9	8	10	8	11

Misc

Kits

Period	04	05	06	07	08	09	10	11
C-1	17	7	12	15	10	20	9	2

Misc

Kits

ROLL 13	AVER 13P	AVER 6P	Total 05	Total 06	Total 07	Curr Tot	
138	10.6	11.3	193	229	153	124	
Exch	Misc	Kit-Fc	C1	Curr -Fc	Fc-P 13	Fc-P 01	Fc-P 02
			3	8.0	8.0	9.0	9.0

1 Parts info 2 Stock bal 3 Del schedule 4 Customer order 5 MMI Refill
 6 Del promises 7 Scrap order 8 Advise history 9 Val del sched 10 Rhelp

VTP 08/11/06 08:58:21

Section 5
Information pertaining to
Question 10

REG NR 2-600

1 RELEVANT DOCUMENTS

Resistance to weather

Resistance to ozon

Resistance to liquids

SAEJ193 sep 79
ASTM D518

2 PROPERTY REQUIREMENTS

The torque for rotation of the ball pin shall be between :

Ø30 . 1-9 Nm
 Ø35 : 1,5-11 Nm
 Ø40 : 2-14 Nm
 Ø50 · 3-19Nm

The starting friction before test, at the end positions may not exceed the mean torque value by more than 50%.

15 FEB. 1984

TEKNISK BESTÄMMELSE / TECH. REG.

BENAMING NAME TECHN REGULATIONS FOR
STEERING RODS AND TRACK RODS

RITN NR	AVD/DEPT	TYP TYPE	GRUPP GROUP				
	54120	LV	2-5:00				
SIGN	RITAD	GODK X	GRANSKAD	GODK PROD	RITN NR DRAWING NO	BLAD SHEET	UTGAVA/ISSUE
DATUM	DM	840113			6950661	1/8	01

Test method

Measuring temperature . $+23 \pm 2^{\circ}\text{C}$

Before measuring, the ball joint shall be conditioned by turning the ball pin conically 90° at an angle of max. 10° . The torque shall be measured at a constant velocity of ca 5 rpm.

2.2

Temperature resisting

The gaiter shall be intact as regards cracks and wear after the test

Test method

The ball joint shall be mounted in a fixture corresponding to its installation in the vehicle.(as drawn)

Test to be made with 2 different temperatures :

1. - 40°C

2. $+80^{\circ}\text{C}$

Ball stud movements test time 5×10^5 turning movement
of the angle movement

Angle movements 5° less than the max permissable angle
and this with a frequency of 2-5Hz

Turning movements : $\pm 15^{\circ}$ with a frequency of 12-18% of the
angle movement frequency

Additional when testing on $+80^{\circ}\text{C}$, a continuous
press-less water spray on the gaiter
shall be sprayed for at least 2h.

Water temp. : $+80^{\circ}\text{C}$

2.3

Ozon-resistance

No formation of cracks are allowed on the gaiter.

Test method

The gaiter to be placed in an ozon chamber for at least 168 h with 50 pphm ozon at a temperature of $30^{\circ}\text{C} \pm 5^{\circ}$.

Test procedure acc. to STD 1027, 3231 (ASTMD1149)
The sample shall be mounted on a plexiglass mandrel so that a 20% stretching of the nominal diameters of the gaiter at the ball stud and ball joint housing is obtained.

Tests shall also be carried out with the gaiter mounted on a ball joint assembly. The ball joint shall be at an angle of $15^{\circ} \pm 2^{\circ}$ in relation to the neutral position.

3

PRODUCT APPROVAL DEMANDS

3.1 Water resistance of the gaiter material

Max. 20% increase in volume after storage in water at $+70^{\circ}\text{C}$ for 170h

Test method

Test procedure acc to STD 1027, 6131

3.2 Wear test

No axial play difference between stud-bearing may occur before and after $1,2 \cdot 10^6$ tilts measured with plus and minus 500N

Test method (8 specimens)

The ball joint shall be mounted in a fixture corresponding to the installation in a truck, where the ball pin can move as stated in 2.2

During the tilts, an axial force (sinus curved load) shall be put into the rods with a frequency of 3 Hz.

FORCE (kN)	BALL DIAMETER
$\pm 2,5$	24 - 27
$\pm 3,5$	30
$\pm 5,0$	35
$\pm 6,5$	40 - 50

Tilts = angle movement frequency 2 Hz

Turning frequency 0,2 Hz (see fig. SAE J 193 sept. 79).
An emulsion of 5 l water + 150 g Arizona dust + 5% natrium chloride (equivalent of road dirt) has to be sprayed over the joint every 10th minute.

1.10^6 number of tilts at + 20°C

1.10^5 number of tilts at - 40°C

1.10^5 number of tilts at +50°C

3.3 Oil and grease resistance of the gaiter

Max. 25% increase in volume after 170 h storage at +70°C in ASTM oil II or in the ball joint grease in question.

Test method

Test procedure acc. to STD1027, 6131.

3.4 Weather resistance of the gaiter

Grade 0 acc. to grade scale in STD 1027, 3131 is required for an approved test (no formation of cracks).

15 FEB. 1984

Test method

Test procedure corresponds in principle to STD 1027, 3131 mainly to ASTM D518 method A.

The test shall however be carried out with the gaiter mounted separately on a plexiglass mandrell, so that a 50% stretching of the nominal diameters of the gaiter at the ball pin and ball joint housing is obtained.

Testing time :

April - October : 6 weeks
November - March 12 weeks

When the testing time exceeds the above limits, the time shall be adjusted to this by dividing or multiplying by two

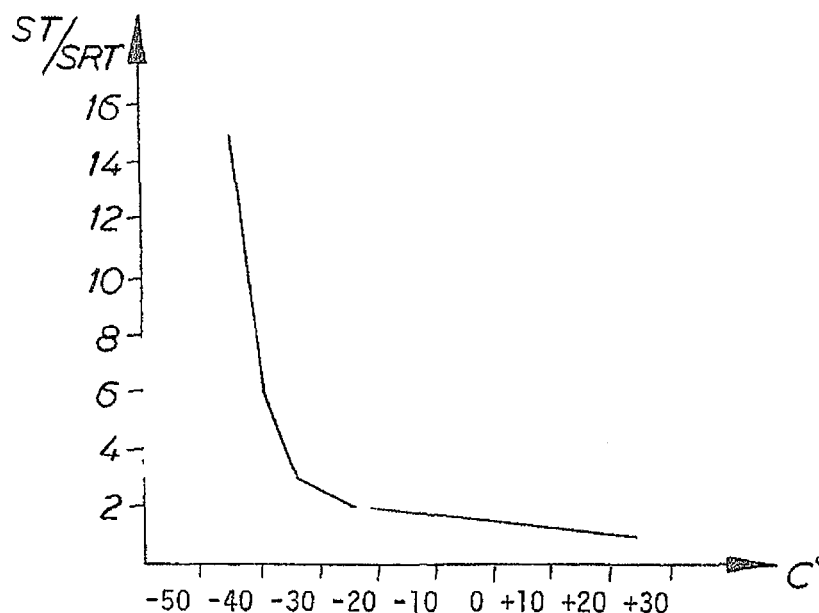
Test shall also be carried out on a complete gaiter mounted and tilted according to 2 2

3 5

Separate gaiter in cold

Stiffening of the gaiter in cold must not exceed the values stated in diagram I below.

Max. permitted deformation force at +23° $\pm 2^{\circ}\text{C} = 10 \text{ N}$



15 FEB. 1986

6850661

BELGIUM

TECHNICAL REGULATION

RITN NR / DRAWING NO

6850661

BLAD / SHEET

6/8

UTGAVI / ISSUE

01

Test method

The gaiter shall be compressed 10 mm at test temperatures +23°, 0°, - 10°, - 20°, - 30°, - 35°, - 40° and - 45° with a compression speed of 4 mm/s.

The deformation and force shall be registered. A suitable deformation point shall be determined on the force deformation curves obtained which during the entire temperature range (+23°C to - 45°C) gives a sure reading for the deformation force.

From these values, the ST/SRT factors shall be calculated.

$$\frac{ST}{SRT} = \frac{\text{Force at temp. in question}}{\text{Force at } + 23^{\circ} (\pm 2^{\circ}C)}$$

The sample shall be allowed to return to room temperature between every test temperature.

4

ENDURANCE (MIN. 4 SPECIMENS)

The supplier has to show us that the complete ball joints do not show any fatigue or that the axial play difference between the position of the ball pin must not exceed 2 mm measured with a compression force of 600N and a tensile force of 100N for a load spectrum shown as an example in the fig.

This means Wohler or life curves for different types of load spectrums are requested.

Required load spectrum is depending on front axle pressure and steering geometry, relevant fatigue diagrams must be available for each type of ball joint diameter.

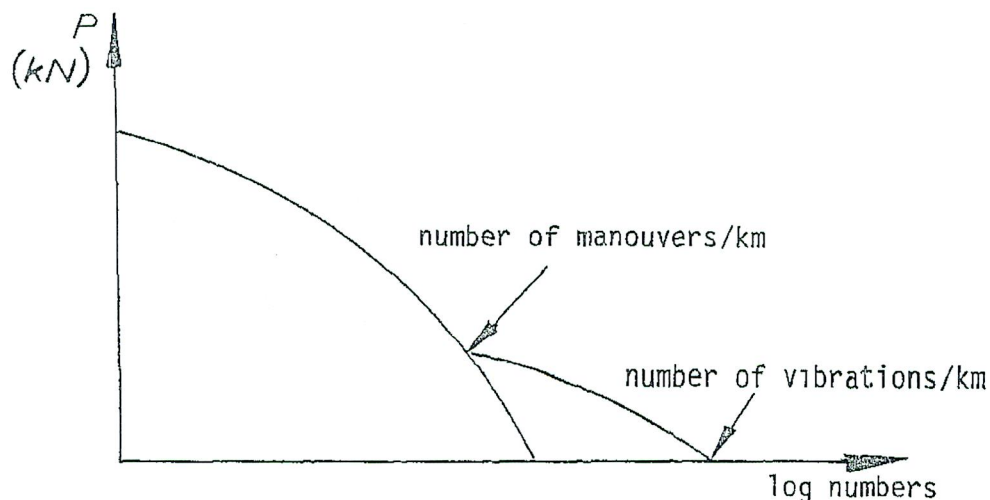
No screw connections should come loose during the endurance test.

To be discussed

Load spectrum for Ø 35 ball

+ 31 kN 1.10⁴ loads (min 4 specimens)

+ 25 kN 5.10⁵ loads (min 4 specimens)



- CDFI : Urban traffic : 5 manoeuvres/km Design life $0,5 \cdot 10^6$ km
- CDFII: Long range traffic : 4 man/km Design life $0,8 \cdot 10^6$ km
- Long range traffic : 1 man/km Design life $1 \cdot 10^6$ km

5 The buckling load shall be calculated and tested

6 CLAMPING SECURITY

6.1 When applying a torque of 40% of the maximum specified tightening torque to the locknut of the clamp, the ball stud housing shall not rotate below a torque of 50 Nm.
The clamp opening shall be on the opposite side of the split in the tube.

6.2 When the rod is installed and the nut on the clamp is torqued as in the truck, the torque shall not drop more than 20% after a period of 24 hours.

7 IDENTIFICATION OF MATERIAL

All info as material specifications and complete drawings of each detail shall be delivered to Volvo quality control dept. before approval of design dept. can be given.

This info will be used as identification of approved tested parts.

15 FEB. 1984

TRW Automotive
Commercial Steering Systems

Service Bulletin #LNK-105

Inspection Procedure for TRW Ball Socket Wear

Revised March, 2002

This TRW Commercial Steering Systems' service bulletin has been written to help you repair commercial vehicles more efficiently. This bulletin should not replace your manuals; you should use them together. These materials are intended for use by properly trained, professional mechanics, NOT "Do-it-yourselfers". You should not try to diagnose or repair steering problems unless you have been trained, and have the right equipment, tools and know-how to perform the work correctly and safely.

Truck Shop Inspection Procedure:

1. Make sure the stud is seated tightly in the steering arm taper, and the nut is tight.
2. With vehicle **engine on**, lightly rock the steering wheel while checking for looseness in any threaded joint, or any movement of the stud nut. Any looseness requires repair.
3. With the **engine off** and wheels straight ahead, push and pull the socket in and out by hand (using 50-100 lbs. of pressure) in the direction of the ball stud. If no **AXIAL** movement is detected, the socket is operable. Any free lash detected by hand requires replacement of the socket.

WARNING: Do not use a wrench or other object to apply leverage when inspecting sockets. Applying leverage can give skewed results, and damage components. Component damage may ultimately result in loss of steering control.

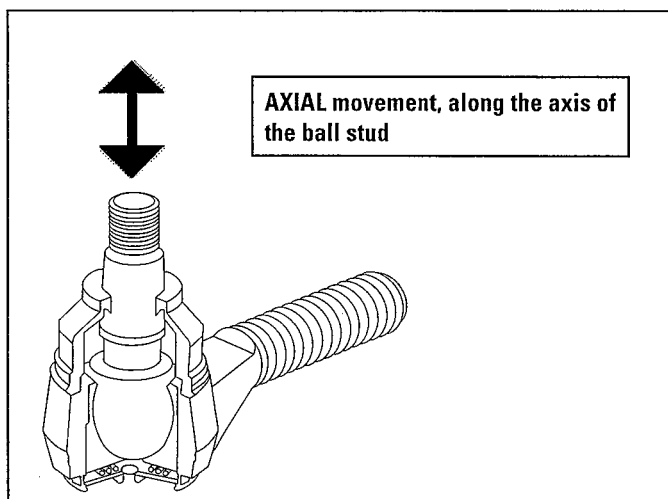
Inspection Station Criteria:

Follow preceding procedures for inspecting ball sockets. Measure any movement detected by hand with a scale for in and out motion on the ball stud axis.

Any motion, other than rotational, between any linkage member and its attachment point of 1/8" (3 mm) or more, measured with hand pressure only, is cause to remove the vehicle from service for immediate socket replacement.

If movement is less than 1/8" (3 mm) the socket should be replaced at the next practical servicing stop.

If no movement is detected by hand the socket is operable.



TRW Commercial Steering Systems
P.O. Box 60
Lafayette, IN 47902
Phone: 317.423.5377
Fax: 317.429.1868

Section 6
Copies of communications required by
Question 12

Pollock Kevin

From: GREGORY A. YOUNG (X2768)
To: POLLOCK; KEVIN R; KENT IVAN AKE BIRGE
Cc: Priddy Jeffrey; DONALD L. COLDWELL
Subject: Unapproved Inspection Procedure for VN Drag Links

--- Received from PARTS3.YOUNG GREGORY A. YOUNG 00-04-27 16:24

Kevin,

I am forwarding this memo Kent Birge. He is the technical writer responsible for Preventive Maintenance in Service Publications.

Kent please handle and copy me upon resolution.

Thanks,

Greg

--- Received from VTNA.POLLOCK POLLOCK,KEVIN R 00-04-27 14:48

Greg,
Would you please review and comment on the following memo.
Thanks,
Kevin Pollock
NRV Reliability
x7434

--- Received from VTC10.COLDWELL DONALD L. COLDWE 00-04-24 15:54

Kevin/Guenter

The service procedure located in VN Binder 0-2 group 170, Preventive Maintenance, VNL, VNM, PV776-TSP21358/1, page 64, item 79. This has come to our attention since distribution of the TRW "Check It Out" video along with TRW and Meritons recommended inspection guide lines for ball joints to our Dealers. This will need to be reviewed as soon as possible.

Don.

From: Carl.Bandy@trw.com
To: vtna.dab@memo.volvo.com
Cc: vtc10.coldwell@memo.volvo.com, vtna.bridges@memo.volvo.com, vtna.conrads@memo.volvo.com, vtna.stadler@memo.volvo.com, Dave.Hobson@trw.com, Dave.Snitgen@trw.com, Sheila.Pulling@trw.com
Date: Mon, 24 Apr 2000 05:29:18 -0700
Subject: Unapproved Inspection Procedure for VN Drag Links

Dave,

Confirming my phone message there is a wrong inspection procedure in the Volvo preventive maintenance manual, page 64. Section 79, Steering Linkage Wear Check says to use a large plier to check ball stud movement. This procedure would result in movements that would condemn sockets that are to specification.

All steering linkage wear checks should be performed with hand pressure only not to exceed 100 pounds of force. This is the standard practice that has been adopted throughout the industry in North America and supported by all Departments of Transportation.

TRW has been involved in several claims for worn drag links believed due to improper inspection. We do not supply the tie rod on the VN directly but suggest Volvo review its replacement of tie rod ends on the VN. If this procedure is used on the Tie Rod it would result in similar claims and or replacement.

Please advise what our next step will be to correct this manual and advise dealers accordingly.

Regards

Carl Bandy

--- 00-04-24 15:54 --- Sent to

-> VTNA.VWT205GS	GUENTER SCHLOTTMANN	003690G
-> VTNA.POLLOCK	POLLOCK,KEVIN R	003204
CC:		
-> VTNA.DAB	DAVID BACHMEIER	010771
-> VTNA.BRIDGES	TREVOR BRIDGES	003779

--- 00-04-27 14:48 --- Sent to

-> PARTS3.YOUNG	GREGORY A. YOUNG (X2768)	10516
CC:		
-> VTC10.COLDWELL	DONALD L. COLDWELL	30064

--- 00-04-27 16:24 --- Sent to

-> VTNA.POLLOCK	POLLOCK,KEVIN R	003204
-> PARTS.BIRGE	KENT IVAN AKE BIRGE	10516
CC:		
-> PARTS.PRIDDY	JEFF PRIDDY	10519
-> VTC10.COLDWELL	DONALD L. COLDWELL	30064

Pollock Kevin

From: DEBBIE KEENER
To: RANDY MULLER; RAY T MARTIN; RAYMOND R. LESTRANGE; RICKY A. MILLER; STEVE DAY; STEVEN DESOUSA; TERRY HUTCHISON; THOMAS D. RUBLE; THOMAS KING; TIM BARNHARDT; VINCE LINDLEY; W. HAROLD SMITH; WARREN SPRADLIN
FX540-674-7204; WESLEY MARSH; PHILLIPS, T. HOYT; PARAH, ARMAND; ROGER C. MORIN; MIKE ZINK; MICHAEL BULLINS; RAY DUECK; TIMOTHY J. REDDEN; MAURICE A SUTTON; ROB SIMPSON; MUKESH PATEL.; KENT IVAN AKE BIRGE; KENNETH G. MOORE; RICHARD MARSHALL; KEN CULVER; JOHN MONTGOMERY; JOHN M. ATALLAH; JOHN P. SHEHAN; JOE C ANDERSON; JIMMY CROTTS; POLLOCK, KEVIN R
Subject: 6430.301 - Steering Linkage Inspection
Attachments: 6430301.pdf



6430301.PDF
(121 KB)

--- Received from VTNA.VGH204DK DEBBIE KEENER 00-06-12 11:40

DISTRICT SERVICE MANAGER INFORMATION LETTER

NUMBER: 6430.301
DATE: 000608
SUBJECT: Steering Linkage Inspection
MODEL(S): All
ISSUED BY: Kevin Pollock
APPROVED: Guenter Schlottmann

Inspection Procedure for TRW Ball Socket Wear
This letter supersedes DSM Letter 6430.300, dated 991019

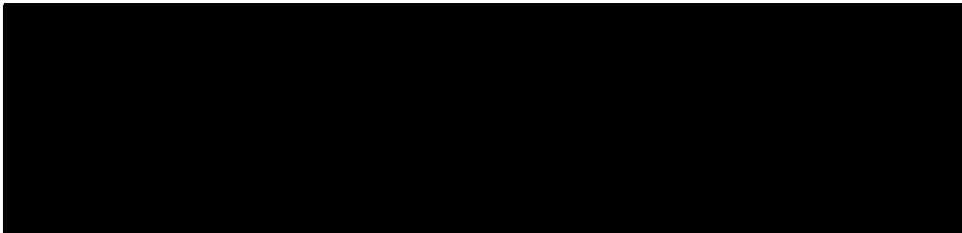
In an effort to resolve concerns with inspection and removal of TRW manufactured steering linkages, the attached service bulletin, TRW Service Bulletin #LNK-105 "Inspection Procedure for TRW Ball Socket Wear" can be used.

It should be noted that this procedure is divided into two separate and distinctive situations;
1) The "Truck Shop Inspection Procedure" is to be followed whenever the truck is being inspected at a service location.
2) The "Inspection Station Criteria" is based on National DOT out of service criteria from the CVSA, and is intended to be used as a guideline when the vehicle is stopped for inspection while in use (i.e. a roadside inspection).

Please note that axial movement is to be inspected by hand pressure only (approximately 100lbs.), not by use of any tools to apply leverage.

*There is one attachment with this DSM Letter. Hard copies will be forwarded to designated areas only.

FOR INTERNAL INFORMATION ONLY



TRW Automotive

Steering & Suspension Systems

Service Bulletin #LNK-105**Inspection Procedure for TRW Ball Socket Wear**

Revised May, 2000

This TRW Commercial Steering Division service bulletin has been written to help you repair commercial vehicles more efficiently. This bulletin should not replace your manuals; you should use them together. These materials are intended for use by properly trained, professional mechanics, NOT "Do-it-yourselfers". You should not try to diagnose or repair steering problems unless you have been trained, and have the right equipment, tools and know-how to perform the work correctly and safely.

Truck Shop Inspection Procedure:

1. Make sure the stud is seated tightly in the steering arm taper, and the nut is tight.
2. With vehicle **engine on**, lightly rock the steering wheel while checking for looseness in any threaded joint, or any movement of the stud nut. Any looseness requires repair.
3. With the **engine off** and wheels straight ahead, push and pull the socket in and out by hand (using approx. 100 lbs. of pressure) in the direction of the ball stud. If no **AXIAL** movement is detected, the socket is operable. Any **AXIAL** movement detected by hand requires replacement of the socket.

WARNING: Do not use a wrench or other object to apply leverage when inspecting sockets. Applying leverage can give skewed results, and damage components. Component damage may ultimately result in loss of steering control.

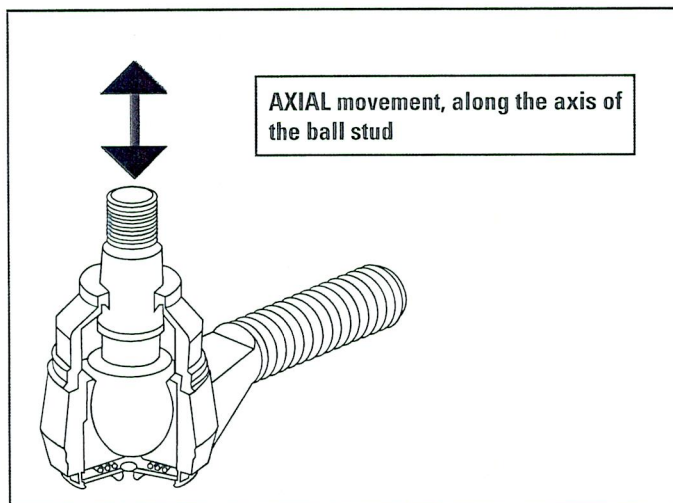
Inspection Station Criteria:

Follow preceding procedures for inspecting ball sockets. Measure any movement detected by hand with a scale for in and out motion on the ball stud axis.

Any motion, other than rotational, between any linkage member and its attachment point of 1/8" (3 mm) or more, measured with hand pressure only, is cause to remove the vehicle from service for immediate socket replacement.

If movement is less than 1/8" (3 mm) the socket should be replaced at the next practical servicing stop.

If no movement is detected by hand the socket is operable.

**TRW Commercial Steering Systems**

P.O. Box 60
Lafayette, IN 47902
Phone: 765.423.5377
Fax: 765.429.1868

Pollock Kevin

From: POLLOCK,KEVIN R
To: sheila.pulling@trw.com
Subject: PCR's

Attachments: ruan.htm



RUAN.HTM (40
KB)

--- Received from VTNA.POLLOCK 540-674-7434

00-11-16 11:21

--- Received from VTNA.POLLOCK 540-674-7434

00-11-03 15:30

Sheila,
Product concern report below is for the Rollins truck. This link is being shipped via UPS with
the following tracking number: [REDACTED]
The attached html file is the product concern report for the Ruan unit with 519k miles.
--Kevin

VNV523 VOLVO TRUCKS NORTH AMERICA, INC. 11/03/00 15:19:48
REPORT NBR: 00000978 PRODUCT CONCERN UPDATE DATE ENTERED: 062600
VIN: 4VG7DARH5WN [REDACTED] MILEAGE: 305000 TOTAL VEHICLES: 1 SOURCE: 77304
OWNER: ROLLINS LEASING BLD: 010898 INSERV: 020898 DEALER: 77304
USE CODE: 11 MODEL: VNL64T TOT FLT MDL: 250 PHOTOS: COPY:
EST. PER VEHICLE LABOR: \$0 EST. PER VEHICLE PARTS: \$0

FUNCT GRP: 643 REASON CODE: 10 R.O. DATE: 062300 TOTAL: \$0
CAUSAL PART: 8079525 DESC: DRAG LINK ORG PART: Y
COMP S/N: VENDOR: 6200 TRW FAHRWERKSYSTEME GMBH

CONCERN: BALL JOINT END SEPARATED FROM DRAG LINK ASSY. INCIDENT REPORTED TO
S.DAY DURING PHONE CALL WITH OWNING ROLLINS LOCATION.

CAUSE: UNKNOWN.

CORRECT: CUST INSTALLED NEW PART. REMOVED PARTS HAVE BEEN REQUESTED SENT
DIRECTLY TO KEVIN POLLOCK

REPLY: INSTALL NEW DRAG LINK. WILL REVIEW CAUSAL PART WHEN RECEIVED.
063000

BY: UT00295 POLLOCK, KEV PART RETURN REQUEST: BULLETIN:
WHAT NEXT? CS2203 00000978 CONTINUE:
ENTER CHANGES, NEW REPORT NBR, OR (X) TO CONTINUE

---- 00-11-03 15:30 ---- Sent to

-> sheila.pulling@trw.com

---- 00-11-16 11:21 ---- Sent to

-> sheila.pulling@trw.com

Product Concern System					
Tech Service	Warranty	Sales Engineering	Interpretations	Cab Repair/Paint	
Discrepancy		TMAC	Search	Glossary	Help

Tech Service

User ID: ut00996 *

Chassis ID: N760518

Contact
First: RichardContact
Last: KeenContact
Phone: 336-393-4707

Contact Ext:

Part
Number: 8079525Function
Group: 643VMRS
Number:Claim
Number:Claim Line
#:Vehicle
Mileage: 519,066 *Email
Address: vtna.rkeen@memo.volvo.comStatus: Open ☐

Comments:

This truck has High Mileage and the drag link came aprt while the truck was on the road. there has been a 2nd drag link with 200,000 miles sent to Kevin Pollock @ NRV Reliability dept. The 2nd drag link was removed due to excessive wear (1/4" of movement per Ruan terminal manager)

Resolution:

Volvo Remarks:

Complete all required fields (indicated by a red asterisk) and as much additional information as possible. Enter comments below to further describe the Concern. Attach images as appropriate.

When all information is complete, Click Send at either top or bottom of screen.

If you wish to start over or cancel your entry, click Clear.

If you wish to change your Concern type, Click Clear and then click the appropriate Concern Type in the menu at the top of screen.

To locate concerns entered into this new system use the "Search" function located on the menu above.

The "Help" menu can provide assistance using the new Product Concern System.

Attach Images

To attach images, click Browse. In the Choose File window, locate the folder containing your images. Select the appropriate image and double click it. The path to your image will appear in the field next to the Browse button that you clicked. Repeat the above instructions, clicking on other Browse buttons to add additional images.

No Pictures for This Concern!!!

Click button to submit this Concern.

Send

Pollock Kevin

From: Sheila.Pulling@trw.com
To: POLLOCK,KEVIN R
Subject: Re: 251237

Attachments: 8d_60000.doc; 8d_RuanD.doc



8D60000.DOC (118 KB)



8DRUAND.DOC (193 KB)

From: Sheila.Pulling@trw.com
To: VTNA.POLLOCK@MEMO.VOLVO.COM
Date: Thu, 21 Dec 2000 10:26:17 -0800
Subject: Re: 251237

Kevin:

Attached are the 8-D reports for the TRW-FWS linkage which were returned by Volvo customers [REDACTED]. I believe Carl Bandy has discussed the results with yourself during his visit. If you have any additional questions, please contact Carl or myself.

Have a safe and enjoyable holiday season.

Sheila Pulling
TRW-Technical Services
Portland Plant
sheila.pulling@trw.com

>>> "POLLOCK,KEVIN R" <VTNA.POLLOCK@MEMO.VOLVO.COM> 12/14/00 2:13:00 PM >>>
--- Received from VTNA.POLLOCK 540-674-7434 00-12-14 14:13

Sheila,
Here is the data on the Armour Transport Truck. I received a message today that the other parts shipped on 12/13.
--Kevin

Truck Number: 251237
Customer: Armour Transport
Build Date: 111099
In-Service Date: 112499
Front Axle P/N's: Volvo;8086547, Meritor;FF-967-NX-2
Mileage: 303452 kilometers

----- 00-12-14 14:13 ----- Sent to -----
-> sheila.pulling@trw.com

 TRW Fahrwerksysteme	8 D_(isziplinen) Report	Werk Düsseldorf SAP-Nr. - Rekl.-Nr. 274-2000
---	--	---

0. Issue: Separation of ball joint of RUAN Drag Link	TRW Z.Nr.: 035-0231-936-454 Kunden Z.Nr.: 8 079 526
---	--

1. Teammembers:	Name	Dep.	Function
	Wellin	KQ	Plant Quality
	Thiel	QS	Central Quality
	Teubert	CS	Techn. Sales
	Romahn	KNP	Ind. Engineering

2. Description of Problem:
 The customer RUAN complaint
 1. separation of a ball pin. (History: Part No. 8079525; In service date: 5-8-99; Chassis N760518; Ruan unit # R86588; mileage: 519066 mls; Conventional Tandem Axle Sleeper Tractor).
 2. Scoring (see 8D_Ruan DL Scoring 081200)

3. Interim Action:
 none, see 4.

4. Root Cause:
 We were sent 4 photos of the adjustable end of the drag link.



Photo 1: Housing and sealing from beside

The photo shows an okay positioning of the sealing via Z-ring assembly and no damage on the visible side of the sealing. The ball pin and the clamp ring (on the sealing) are missing. Assembly marks in the sealing groove (information by TRW Portland) give evidence for an originally present clamp ring in the right position. The rolling on the top of the housing shows no damage or potential leakage. There is surface-corrosion due to missing paint on the top-left side of the housing (see photo orientation).



Photo 2: Housing and sealing from taper side

The gaiter mouth (sealing) shows corrosion particles in the contact area with the pitman-arm.



Photo 3: Housing with disassembled sealing

No corrosion marks or hints for a malfunction of the sealing assembly / Z-ring against the housing are visible. It seems that there is some grease rest visible in the hole of the upper ball seat. The inner side of the housing is completely corroded.

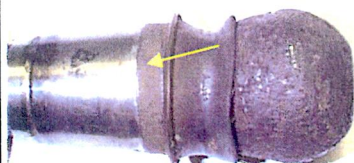


Photo 4: Separated ball pin with sealing support

The ball is completely corroded and out of diameter / form. The taper of the ball pin shows complete corrosion of the contact area of ball pin with sealing-labyrinth. The support ring is damaged and worn out.

 TRW Fahrwerksysteme	8 D(isziplinen) Report	Werk Düsseldorf SAP-Nr. - Rekl.-Nr. 274-2000
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4. Root Cause (continue):

The single parts of the joint give the following impression of the separation process:

1. The corrosion of the contact area of the sealing with the pitman-arm (photo 2, gaiter mouth) led to corrosion of the ball pin's taper as a result of abrasion of the gaiter mouth and fading of sealing function. The corrosion as a matter of surface-process migrated beneath sealing and taper into the inner joint. The corrosion of the ball and the housing led to excessive wear due to the rough surface. A result of this is the decreasing diameter of the ball and the encreasing diameter of the aperture. The falling of the ball pin's diameter below the aperture-diameter resulted in the separation of the ball out of the housing.
2. The corrosion status of the ball pin is not normal and will not occur during life time of the joints. Nevertheless massiv damages of the sealing or mistreatment of the joint could lead to massiv water ingress into the housing, which will result in corrosion of the ball and lower ball seat. Excessiv wear could lead to the a.m. effect.

Corrosion effects like this (with artificial water ingress for testing) were simulated. The corrosion process runs for several months. Therefore technical inspection of the drag link should immediately detect corrosion of the ball due to the encreased play. Additionally the knocking noise (due to the missing contact) has to be heard during steering and driving.

5. Determination of Containment Action: (Zuständig/Verantwortlich; Termin)

- Check of Design-FMEA (Team; done and okay 11th, Dec 2000)
- Check of greasing-process (Plant; done and okay 08th Dec 2000)
- Controlling of sealing test (temperature -30°C - +50°C; articulation, rotation, water-jet; test VR-338-96: okay)

6. Implementation of Containment Action: (Zuständig/Verantwortlich; Termin)

none

7. Verification of Effectiveness: (Verantwortlich(Name/Abt.Termin)

none

8. Final:

The complaint parts show corrosion as the root cause for abrasion, excessive wear and therefore separation of the ball pin from the housing. The corrosion status of the housing (no evidence for water ingress over roll over or z-ring sealing assembly) and the ball pin give us the impression of a corrosion process from the pitman-arm over the ball-pin taper into the joint. The Prod. Date of the drag link, the mileage of the truck and the In-Service date let us conclude that the complaint drag link is a spare part, which was assembled into a corroded pitman-arm.

The corrosion-process inside the joint should have been detected during technical inspection due to excessive wear and free play as it is no short-time process. Additionally the occuring knocking noise of the drag link should have been noticed during service.

Date: 11th, Dec 2000

Name: Thiel Dep.: QS Signature:

Distribution: TRW Portland Plant; Team

Date: 11th Dec 2000

Name: Thiel Dep.: QS Signature:

TRW TRW Fahrwerksysteme	8 D_(isziplinen) Report	Werk Düsseldorf SAP-Nr. 600000276 Rekl.-Nr. 262-2000
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0. Issue: Separated Ball Pin of Customer ROLLINS RO# 528-19580 mileage: 305.000 miles	TRW Z.Nr.: 035-0231-936-454 Kunden Z.Nr.: 8079525 Prod. Date of the drag link: October 1997
---	---

1. Teammembers:	Name Thiel	Dep. QS	Function Zentrale Qualität
------------------------	---------------	------------	-------------------------------

2. Description of Problem: Customer complaints a separated ball pin from a.m. ball joint (see foto 1). This separation resulted in misfunction of the truck steering. The complaint drag link was cutted (for transportation) and sent to TRW Chassis Systems Germany for analysis. The screw-in side shows the separation (*only the housing was reshipped*), the press-in side shows corrosion on the ball pin and a disassembled sealing (foto 2).



Foto 1: screw-in side of drag link.



Foto 2: press-in side with disassembled sealing

3. Interim Action: None, because no direct TRW fault is visible.
--

4. Root Cause:
 Screw-in side: due to the missing ball pin (and sealing) it is not possible to analyse the joint for failure root cause. The reason for the separation is corrosion of the ball pin. This means excessive wear of the socket, the housing and the ball pin due to abrasion (*rough surface of the ball pin*). As the diameter of the ball pin is too small it wont be surrounded by the housing any longer. The reason for the corrosion can not be analysed without the ball pin and the sealing.
 Press-in side: The ball pin is also corroded. The reason for the corrosion is a leakage of the sealing. There is no misfunction of the sealing on the cone side visible as there are no continuous corrosion marks beneath the sealing. But there are several leaks due to force on the sealing and the joint. Proofs of this are the damagings of the (metallic) housing (foto 3+4), the character of the leakage of the sealing (foto 5) and the deformation of the metallic sealing ring (foto 6) on the opposite side of the leakage of the sealing.
 Therefore there is no misfunction of the sealing or the assembly but a mistreatment of the joint which resulted in corrosion and (as a matter of abrasion) in separation of the ball pin from the housing.



Foto 3+4: Damages and deformations of the metallic housing. Foto 4 introduces high forces on the side housing-border which also means a damaging of the sealing as visible in foto 5.



Foto 5: Cut and leakage of the sealing due to outer force. This will result in high water ingress into the joint.



Foto 6: Damaging of the sealing ring on the opposite of the damagings in foto 5.

5. Determination of Containment Action: A mistreatment of the joint as visible above is not under TRW responsibility and can not be avoided by TRW actions.	(Zuständig/Verantwortlich; Termin)
---	------------------------------------

6. Implementation of Containment Action:	(Zuständig/Verantwortlich; Termin)
---	------------------------------------

7. Verification of Effectiveness:	(Verantwortlich(Name/Abt.Termin)
--	-----------------------------------

8. Final, congratulate the team: The a.m. analyse shows a mistreatment of the joint due to damaging of the housing and the sealing system, which resulted in water ingress and corrosion of the joint. The separation was the result of an excessive abrasion of the ball pin and the housing. Date: 29 th , Nov 2000 Name: Thiel Dep.: QS Signature:
--

Distribution: Customer, TRW US, Team, CS	Date: 29 th , Nov 2000 Name: Thiel Dep.: QS Signature:
--	--

 TRW Fahrwerksysteme	8 D_(isziplinen) Report	Werk Düsseldorf SAP-Nr. 600000276 Rekl.-Nr. 262-2000
--	--	---

Pollock Kevin

From: Pollock Kevin
Sent: Friday, November 30, 2001 3:03 PM
To: Schlottmann Guenter
Subject: Tidewater Transit

Summary of trip to Tidewater Transit;

Customer has expressed concerns about ball socket movement on draglink part number 8079525. On previous visit, I removed three draglinks and had them forwarded to TRW for review. These links did not pass the current truck shop inspection procedure that is based on industry standard. TRW reviewed the parts and concluded that they are "functional".

Investigation has revealed that the ball socket by design has an allowable movement of .035" to .041" under a load of 750 pounds. Using hand pressure only, the ball socket can be moved .005" to .010" on a new link, and around .020" on a link with approximately 100k miles. However, there is no inspection procedure in place for the typical North American technician to use. Using the current industry standard inspection method, a new draglink can be condemned and removed under the truck shop inspection removal criteria (reference TRW Service Bulletin LNK105, attached to DSM letter 6430.301).

Our visit to Tidewater Transit was twofold; One, to provide the customer some education on the design differences between the typical North American design and the European group 31 type design that we install on our trucks. Two, to collect data on ball socket end movement of draglinks in service, as well as ball socket end movement on new replacement draglinks on in-service vehicles. The data collection is the beginning step of developing a reliable inspection procedure for the North American market.

--kp

Kevin Pollock
Reliability Engineer
Volvo Trucks North America g
4881 Cougar Trail Rd.
Dublin, VA 24084 USA
☎: 540-674-7434
☎: 540-674-7204
✉: kevin.pollock@volvo.com

Tracking: Recipient
Schlottmann Guenter

Read
Read: 12/3/2001 11:05 AM

Pollock Kevin

From: Doyal Jim
Sent: Friday, April 12, 2002 2:22 PM
To: Eisenbarth Mark; Vincoli Mike; Adams James; Majic Smiljan; Pollock Kevin; Anderson Joseph; Bachmeier Dave; Bohman Lennart; Burcham Greg (ory); Coldwell Donald; Culver Ken (neth); Curri Mark; Doyal Jim; Gordon Terry; Holderfield Greg (ory); Kananen Eric; Karendal Mark; Keen Richard; Keener Debbie; Leadmon William; Lewis James; Lindley Vince (nt); Lytton Duane; Mason Dale; McAlexander Dwight; McCleery Shawn; Montgomery John; Moore Kenneth; Olinger John; Parah Armand; Pollock Kevin; Poulson Jerry; Powell Charles; Rose Bob; Schaefer Skip; Schlottmann Guenter; Shehan John; Spradlin Warren
Subject: QJ 643-34

Concerns.....: 643-34
Item title.....: DRAGLINK BALL SOCKET WEAR
Case Manager.....: JIM DOYAL
Chassis Types....: VN
Causing Articles:
8079525

Problem description:
010423
MRQ 7581-271 reports draglink experiencing premature wear.
Peak warranty claim rate was 1.6% for August 1997.
Service Parts YTD consumption rate is 258 a month.

Investigation:
Evaluate returned parts (4 pieces) and use to make decision to move forward.

Solution:
020122
After collecting additional drag links, it has been determined that we do not have a premature wear out problem. The problem is that the service bulletin doesn't adequately take into account the difference in the European design drag link versus the North American. Both design have an internal spring to take up wear, the North American design has a very stiff spring with a short spring travel, whereas the European design has a softer spring with longer travel.
DCN Numbers:
QJ Factories:

New Articles:

QJ Journal:
020412
DSM letter 6430.302 has been issued, which included a revised vendor Service Bulletin. The significant change in the Service Bulletin is that it now emphasizes HAND FORCE only, that is, no tools or leverage is to be used in checking for draglink wear. The amount of force has also been revised to "50-100lbs", instead of 100lbs. The wording "free lash" has been added to define axial movement. For information purposes, 100lbs is just below the threshold require to compress the internal spring with the European draglink, but since the Bulletin is intended to cover domestic draglinks as well, the 100lb upper limit was retained for consistency with what had already been distributed for DOT inspection.

This QJ is closed.

Pollock Kevin

From: RODDY-JOHN [JOHN.RODDY@macktrucks.com]
Sent: Wednesday, March 19, 2003 5:24 PM
To: kevin.pollock@volvo.com; debbie.smith@volvo.com
Subject: BRIAN MORGAN - 778342

Attachments: mvc-018s.jpg; mvc-019s.jpg



mvc-018s.jpg
(39 KB)



mvc-019s.jpg
(37 KB)

--- Received from MACFLSVC.JR2953A ----- 03-03-19 16:24

KEVIN,

SUBJECT: ACCIDENT INVOLVING 778342

PER OUR PHONE CONVERSATION 3/19/03, HERE ARE THE PICTURES AND THE CONVERSATIONS THAT I HAD WITH THE DEALER AND THE CUSTOMER.

3/18/03 - RECEIVED A CALL FROM MARK CUSH, GENERAL MANAGER OF YOUNG VOLVO 5559D, CANTON, OHIO. MARK INFORMED ME THAT THEY HAD A CUSTOMER WHO WAS INVOLVED IN AN ACCIDENT. MARK WOULD LIKE ME TO TAKE A LOOK AT THE DRAG LINK AS SOON AS POSSIBLE, TO DETERMINE IF IT FELL OFF PRIOR TO THE ACCIDENT. I ADVISED MARK THAT I COULD STOP AT THERE DEALERSHIP ON 3/19/03.

3/19/03 - WENT TO YOUNG VOLVO 5559D, CANTON, OHIO. SPOKE TO ROY RIDGWAY, SERVICE MANAGER FOR YOUNG VOLVO AND DIANE FORNERIEST, SERVICE WRITER FOR YOUNG VOLVO. ROY INFORMED ME THAT THE CHASSIS WAS AT THERE BODY SHOP, SEPARATE FROM THE DEALERSHIP. MEANTIME DIANE PULLED UP THE CUSTOMER INFORMATION.

SELLING DEALER: YOUNG VOLVO 5559D

CUSTOMER: [REDACTED]

PHONE: [REDACTED]

MODEL: VNL64T

SERIAL: 778342

CURRENT MILEAGE: 501,493

IN SERVICE DATE: 022699

WARRANTY COVERAGE: BASIC COVERAGE 1 YEAR - 100,000 MILES

WENT TO JAY MAC BODY SHOP (YOUNG'S BODY SHOP) AND SPOKE WITH TOM KATZENBAUGH, SHOP MANAGER OF THE FACILITY. TOM SHOWED ME THE TRUCK. TOM HAS ALREADY STARTED TO WORK WITH BRIAN'S INSURANCE COMPANY ON MAKING THE NECESSARY REPAIRS.

PHOTOGRAPHED THE DRAG LINK:

PICTURE 18 - CLOSE UP OF BOOT/SOCKET

PICTURE 19 - DRAG LINK ON AXLE

PICTURE 20 - BALL STUD

PICTURE 21 - BOOT/SOCKET

PICTURE 22 - STEERING GEAR NOTE NEW HOSE CLAMP ON TO HOSE

PICTURE 23 - BOOT/SOCKET

PICTURE 24 - TEARS IN BOOT

PICTURE 25 - BOTTOM OF DRAG LINK

PICTURE 26 - 396 FEDERAL INSPECTION PERFORMED IN FEBRUARY

2003

BEFORE I LEFT THE DEALERSHIP, I SPOKE TO MARK CUSH BY CELL PHONE. MARK SAID THAT THE CUSTOMER WOULD LIKE TO SPEAK TO ME. WOULD I CALL HIM BEFORE I LEFT THE BODY SHOP.

3/19/03 AT 12:50 PM. - TOM CONTACTED BRIAN BY PHONE. I SPOKE WITH BRIAN.

BRIAN INFORMED ME THAT THE ACCIDENT HAPPENED ON SATURDAY, 3/15/03 AT 3:30 PM. - ON INTERSTATE 70 AT THE 129 MILE MARKER, EAST OF COLUMBUS, OHIO NEAR BUCKEYE LAKE. HE STATED THAT THE TRUCK WENT RIGHT, HE TRIED TO CORRECT IT, THERE WAS NO RESISTANCE IN THE WHEEL, THE TRUCK CONTINUED OFF THE RIGHT SIDE OF THE ROAD INTO A SWAMPY DITCH. CUSTOMER WAS PULLING A TANKER LOAD OF HAZARDOUS WASTE MATERIAL. THE MUD BOGGED HIM DOWN AND KEPT THE UNIT UP-RIGHT.

OHIO STATE HIGHWAY PATROL MADE AN ACCIDENT REPORT NUMBER 23759.

BRIAN ADVISED ME THAT HIS INSURANCE COMPANY: FIRST GUARD, OF STERLING HTS., MICHIGAN: HAS ALREADY ADVISED HIM THAT THEY WILL NOT PAY FOR THE FAILED PART, WHICH THEY ARE CONCLUDING IS THE DRAG LINK. HIS OTHER EXPENSES SO FAR ARE: \$500.00 DEDUCTIBLE, RECOVERY EXPENSE OF \$1,535.00, HOOK UP AND WASH OF THE MUD, BEFORE THE PUCO WOULD ALLOW THE TRUCK TO BE TOWED OF \$285.00, TOW TO JAY MAC BODY SHOP IN CANTON, OHIO OF \$525.00.

BRIAN STATED THAT THERE WAS ONLY LANDSCAPE DAMAGE. NO SIGNAGE OR LAMP POSTS DAMAGE, AND NO DAMAGE TO THE TRAILER.

BRIAN ADVISED ME THAT HIS COMPANY THAT HE IS LEASED TO, A.J. WEIGAN, HAD PERFORMED A PM AND A 396 FEDERAL INSPECTION ON 2/4/03.

BRIAN COMPLAINED THAT THIS TRUCK HAS ALREADY HAD TWO STEERING GEAR BOXES REPLACED, AND IT IS LEAKING AGAIN. I INFORMED HIM THAT OUR RECORDS INDICATED THAT HE HAD ONLY TWO DISPLAYS REPLACED. BRIAN STATED THAT YOUNG'S RECORDS WERE NOT CURRENT DUE TO THE PAST SERVICE MANAGER, NOT KEEPING GOOD RECORDS.

BRIAN ALSO COMPLAINED THAT IN OCTOBER OF 2002 HE HAD TO HAVE HIS STEER AXLE U BOLTS REPLACED AND FEBRUARY 2003, HE HAD TO HAVE THE REAR U BOLTS REPLACED DUE TO BROKEN U BOLTS. SUPERIOR SPRING IN CANTON, OHIO, ADVISED HIM THAT VOLVO DOES NOT USE STRONG ENOUGH U BOLTS. THEY REPLACED THEM WITH HEAVIER U BOLTS THAT THEY BEND ON SITE.

I ASKED BRIAN WHAT HE WANTED FROM VOLVO TRUCKS. HE INFORMED ME:

1. DOES VOLVO HAVE A PROBLEM WITH THE DRAG LINKS FALLING OFF? I ADVISED HIM THAT I AM FAIRLY NEW TO VOLVO, BUT WAS NOT AWARE OF A PROBLEM.
2. IF SO, WHY HAS THE CUSTOMERS NOT BEEN ADVISED?
3. HOW DO YOU CHECK THE DRAG LINK SINCE THEY ARE NON GREASEABLE. I ADVISED THAT THEY SHOULD BE CHECKED FOR MOVEMENT IN THE JOINT AND TEARS IN THE BOOT. HE ADVISED HIS COMPANY WOULD HAVE REPLACED IT HAD THEY SEEN THEM.

4. WHO IS GOING TO PAY ALL OF HIS EXPENSES THAT HE IS OUT?
I ADVISED HIM THAT HE NEEDS TO TURN THIS OVER TO HIS
INSURANCE. HIS WARRANTY ONLY COVERED THESE ITEMS FOR 1
YEAR OR 100,000 MILES. THEREFORE HE WAS OUT OF WARRANTY.

HE ADVISED ME THAT HE DID TURN IT OVER TO HIS INSURANCE
COMPANY, AND HIS COMPANY WILL LET HIM USE ONE OF THERE
TRUCKS, HOWEVER HE WOULD NOT MAKE THE REVENUE THAT HE
MAKES WITH HIS OWN TRUCK.

5. HE DOES NOT WANT HIS TRUCK BACK. HE IS TALKING TO
BRIAN ABOUT TRADING IT IN.

HE CONCLUDE THAT HE IS GOING TO THE TRUCK SHOW, AND WHAT
SHOULD HE SAY ABOUT HIS VOLVO? I TOLD HIM THAT HE GOT
500,000 MILES OF GOOD SERVICE OUT OF IT. I CAN NOT PUT
WORDS IN HIS MOUTH.

I ADVISED BRIAN THAT I WOULD FORWARD THIS REPORT AND
PICTURES TO VOLVO, AND ADVISE THE DEALER WHEN I HEAR
SOMETHING. HE WANTED TO KNOW HOW LONG THAT WOULD BE? I
TOLD HIM THAT I DID NOT KNOW.

THANK YOU.

JOHN RODDY

CC: AL ZUBACK
DEBBIE SMITH

NOTE: AL AND DEBBIE - I HAVE SENT YOU THIS EMAIL FOR YOUR
INFORMATION. IF YOU WANT THE ADDITIONAL PICTURES, PLEASE
ADVISE. IF NOT I WILL ONLY SEND THEM TO KEVIN.

----- 03-03-19 16:24 ----- Sent to -----
-> kevin.pollock(a)volvo.com
-> MACFLSVC.AZ6410A ZUBACK-AL SRV-3259
-> debbie.smith(a)volvo.com

Pollock Kevin

From: RODDY-JOHN [JOHN.RODDY@macktrucks.com]
Sent: Tuesday, March 25, 2003 10:01 AM
To: MCUSH@YOUNGTRUCKS.COM; kevin.pollock@volvo.com
Subject: BRIAN MORGAN REPORT - 778342

--- Received from MACFLSVC.JR2953A ----- 03-03-25 09:01

MARK,

AS PER YOUR REQUEST AND BRIAN'S, I SENT IN THE PHOTO'S AND INFORMATION TO VOLVO RELIABILITY ENGINEERING FOR AN EVALUATION. THE TEXT AND THE PICTURES WERE REVIEWED. IT IS VOLVO'S OPINION THAT THE PICTURES INDICATED A BALL SOCKET AND BALL STUD, THAT HAS NOT BEEN PROPERLY CHECKED AND MAINTAINED. IT WAS NOTED THAT THE BOOT WAS TORN, WHICH ALLOWS THE JOINT TO BE EXPOSED TO THE ELEMENTS, AND THE GREASE TO BE DISPLACED. THE JOINT APPEARED DRY AND RUSTY, AND THE BALL STUD APPEARED TO BE WORN.

IN THE "OWNERS MANUAL" AND THE "OPERATOR'S MANUAL, MAINTENANCE AND ENGINE", THE OPERATOR IS INSTRUCTED TO "CHECK THE STEERING WHEEL FOR EXCESSIVE FREE PLAY" AND TO CHECK THE CONDITION OF THE FRONT AXLE AND STEERING SYSTEM FOR "NO LOOSE, WORN, BENT, DAMAGED, OR MISSING PARTS". WHEN THEY PERFORM THE REQUIRED PRE-TRIP INSPECTION.

ADDITIONALLY, THE MANUAL, "MAINTENANCE AND ENGINE" DETAILS REQUIREMENTS THAT THE VEHICLE BE SERVICED AT INTERVALS OF NO MORE THAN 15,000 MILES OR 4 MONTHS. IN REGULAR SERVICES, THE "STEERING AND SUSPENSION" SECTION STATES: "INSPECT STEERING SHAFT, DRAG LINK AND TIE-ROD FOR DAMAGE AND WEAR". THE MANUAL, "MAINTENANCE AND ENGINE", ALSO PROVIDES CRITERIA FOR INSPECTION OF THE LINKAGE.

IT IS VOLVO'S OPINION, THAT IF THE VEHICLE HAD BEEN PROPERLY INSPECTED AND SERVICED, THE THIS DRAGLINK WOULD HAVE BEEN REMOVED FROM SERVICE.

JOHN RODDY

cc: AL ZUBACK
KEVIN POLLOCK

----- 03-03-25 09:01 ----- Sent to -----
-> MCUSH(a)YOUNGTRUCKS.COM
-> MACFLSVC.AZ6410A ZUBACK-AL SRV-3259
-> kevin.pollock(a)volvo.com

Pollock Kevin

From: RODDY-JOHN [JOHN.RODDY@macktrucks.com]
Sent: Thursday, April 10, 2003 4:30 PM
To: kevin.pollock@volvo.com
Subject: BRIAN MORGAN R

--- Received from MACFLSVC.JR2953A ----- 03-04-10 16:30

KEVIN AND AL,

FYI:

DURING MY VISIT TO YOUNG VOLVO 5559D, ON 4/8/03. MARK CUSH THE GENERAL MANAGER ADVISED ME, THAT BRIAN MORGAN ADVISED THEM, THAT HE HAD BEEN CONTACTED BY THE DEPARTMENT OF TRANSPORTATION SAFETY BOARD, IN WASHINGTON DC. REQUESTING INFORMATION REGARDING HIS ACCIDENT AND DRAGLINK FAILURE.

JOHN RODDY

--- Received from MACFLSVC.JR2953A ----- 03-03-25 09:01

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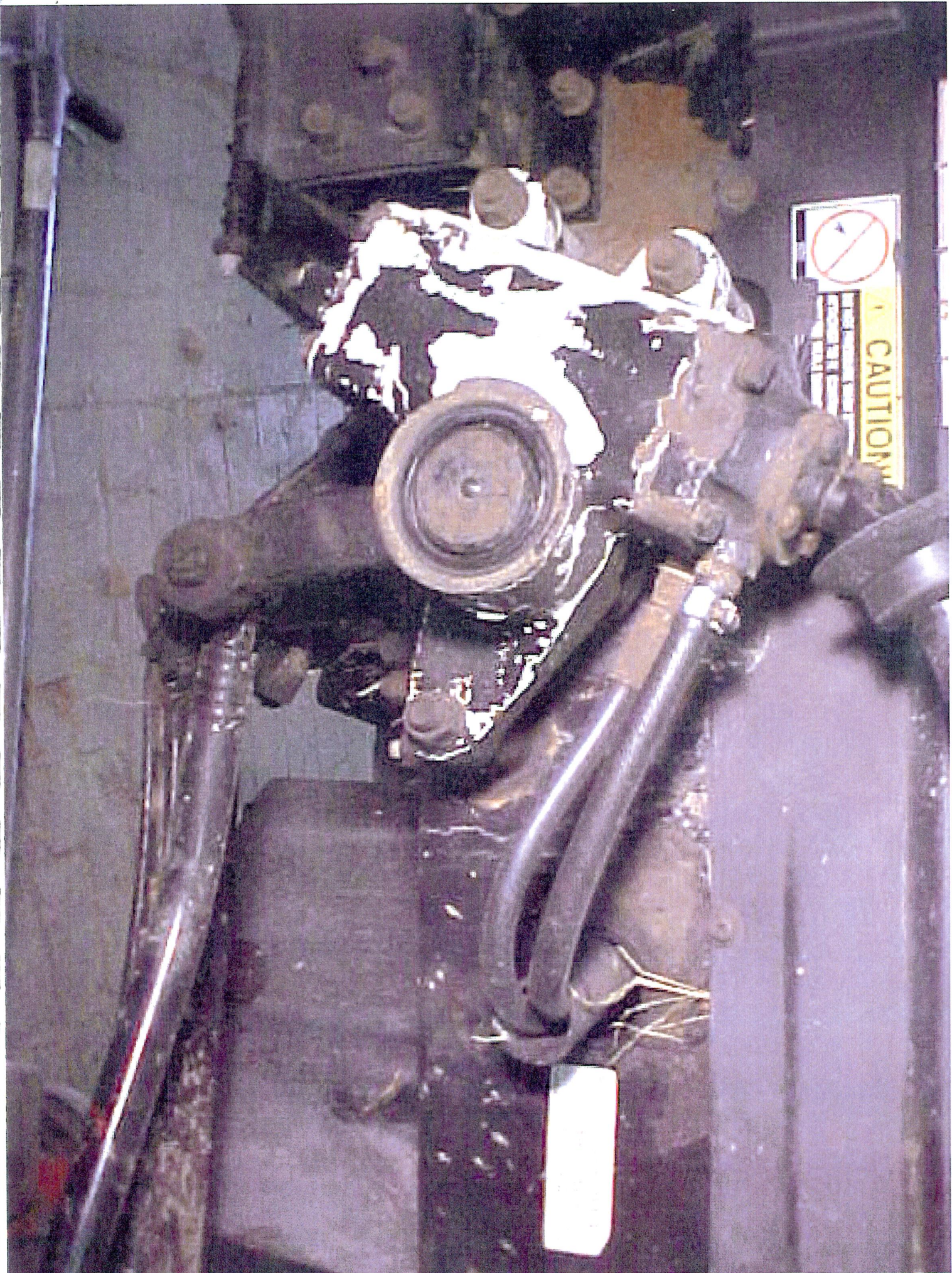
















TO WRITE ON THIS LABEL USE AN INDELIBLE, PERMANENT INK MARKER.
PEN OR PENCIL THAT WILL NOT FADE IN DIRECT SUNLIGHT

ANNUAL VEHICLE INSPECTION LABEL NO. 9226871

COMPLETED MONTH FEB. YEAR 2003

A RECORD OF THIS VEHICLE'S ANNUAL VEHICLE INSPECTION REPORT IS
MAINTAINED ☒ FOR CARS ☐ OTHER IDENTITY

A. J. WEILAND INC.
PO BOX 130
DOVER, OH. 44622
678-5501

LOCAL LICENSE EXPIRATION NUMBER

CERTIFICATION: THIS VEHICLE HAS PASSED AN INSPECTION IN ACCORDANCE
WITH SECTION 501.17 THROUGH 501.23
VEHICLE IDENTIFICATION: IF THE VEHICLE IS NOT READILY, CLEARLY, AND
PERMANENTLY MARKED, CHECK ONE AND COMPLETE.

☒ SELECT UNIT NUMBER

☐ LICENSE/REGISTRATION NUMBER

☐ VEHICLE IDENTIFICATION NUMBER

☐ OTHER

776

Department of Transportation, Bureau of Motor Vehicle Safety, Washington, D.C. 20590

4-2000 (Rev. 1-99)

Lafon Tim (othy)

From: Scharf Heino
Sent: Tuesday, November 07, 2006 4:28 PM
To: Lafon Tim (othy)
Subject: TRW Drag Link Separations

Tim,

We have had a handful (two or three) legal claims involving drag link separations. The drag links are made by TRW. The drag link ball stud should not be confused with tie rod end ball studs which were the subject of a series of recalls. The first recall was brought to our attention by TRW who advised of manufacturing issues (absence of adequate case hardening??). There were two subsequent recalls which simply increased the number of vehicles recalled.

The drag link separations mentioned above occurred on high mileage trucks. What was found was that the rubber boot on the rear ball stud (the one that connects to the upper steering arm) had been damaged and/or torn off. This allowed grit and other contaminants to collect inside the socket. Corrosion followed eventually reducing the size of the ball so the socket fell off. In every case, there was an accident and the issue was which came off first. In one instance the ball was actually bigger than the opening clearly indicating the separation occurred as a result of the accident.

Plaintiff's attorneys are trying to argue the tie rod end recall is somehow tied to the drag link separation. TRW advises these are very different designs. In some case the link itself is bent, also indicating the link was connected at the time of impact.

A loose condition can be found by direct inspection at the time of the DOT required inspection, but it also manifests itself as excessive steering wheel play. We have included in our operators manual advices on what to watch for in regard to excessive play. The operators manual mirrors what is found in the Federal regs (49CFR, Appendix G to Subchapter B (Minimum Periodic Inspection Standards), paragraph 7.a.

Heino

Lafon Tim (othy)

From: Lafon Tim (othy)
Sent: Monday, November 13, 2006 4:35 PM
To: Tom.Bowman@dot.gov
Subject: RE: Drag Link Sep'n

Tom,
The vehicle in question was only subject to one Safety Recall which is RVXX0205 (Tie Rod Ball Sockets NHTSA number 02V-037.005). The recall repair on this vehicle was performed on September 16, 2002; therefore, this vehicle has been addressed for the safety defect. Also, this recall involved the tie rod not the drag link.

I researched our recall information for recalls involving the drag link and found two recalls, one of which is RVXX0401 (NHTSA recall #:04V-078). This affected vehicles built during the period of August 1 through November 25, 2003. Since the vehicle in question was manufactured on May 9, 2000, it would not be subject to the recall. The other was a recall initiated by TRW (NHTSA # 01E-004) which involved certain drag links manufactured in the US from July 14 through July 25, 1999. This vehicle would have not been subject to the recall since it was manufactured in May of 2000 and had a style of drag link not subject to the recall.

So in response to your question below on whether this vehicle would have been subject to an earlier recall or should it have been, the answer is no.

I have not heard of any customer complaints related to the drag link; however, I have asked our Data Analyst to research our service claims.

One thing that I found interesting was that the mileage on the vehicle in question was very high,, 650K. This makes me wonder whether the vehicle was properly maintained. If the ball socket were loose or excessively worn, I would expect it would have manifested itself to have excessive steering wheel play.

We have included in our operators manual advices on what to watch for in regard to excessive play. Also, steering wheel lash requirements are codified in 49 CFR 393.209 which also mentions that Universal joints and ball-and-socket joints shall not be worn, faulty or repaired by welding thus implying that they should be inspected and maintained.

I hope this answers your questions. If you need anything else, please don't hesitate to contact me.

I plan to be in DC on Jan. 16 and 17th and plan to stop by if that will be ok.

Best Regards,
Tim

-----Original Message-----

From: Tom.Bowman@dot.gov [mailto:Tom.Bowman@dot.gov]
Sent: Tuesday, October 31, 2006 2:06 PM
To: Lafon Tim (othy)
Subject: Drag Link Sep'n

See attached.

Owner-driver has retained the separated drag link but may be cautious about surrendering it for inspection.

I'd like to know if veh was subject to an earlier campaign / should it have been?

Along that line, I am concerned whether VTNA has received other complaints for drag link / tie rod end (same end joints used for each) during the approx period that this vehicle was built.

Tom Bowman
ODI-NHTSA
202-366-2583

Lafon Tim (othy)

From: Lafon Tim (othy)
Sent: Monday, November 13, 2006 6:07 PM
To: Tom.Bowman@dot.gov
Subject: RE: Drag Link Sep'n

Tom,
Upon further review, I found 11 customer complaints this afternoon involving 13 trucks, 10 of which claimed separation while the others complained of excessive play.

On the ones that involved separation, a common theme, high mileage, was shared by most if not all. Additionally, several spoke of lack of maintenance, torn boots, and rod ends being full of rust and debris.

I spoke with our Legal group also who acknowledged that there were two to three legal claims on drag link separations. These vehicles were also high mileage trucks. According to legal, what was found was that the rubber boot on the rear ball stud (the one that connects to the upper steering arm) had been damaged and/or torn off. This allowed grit and other contaminants to collect inside the socket. Corrosion followed eventually reducing the size of the ball so the socket fell off. In at least one of three claims it was found that the separation occurred as a result of the accident.

Based on the information that I have, I still believe that if the vehicles would have been properly maintained, the issue would have not manifested itself to a separation. This is apparent with the fact that this occurred on high mileage trucks and that several of the claims acknowledge that the protective boot was torn and that there was rust and debris present. Also, the three trucks stating excessive play and were appropriately corrected; therefore, did not result in separation.

I still want to discuss this with our product reliability folks who were involved in responding to the customer complaints to see what was done and to see if any additional information is available. Also, I want to speak with TRW to see what recommendations there are regarding the maintenance/life of the component.

If you have any questions, please feel free to give me a call. I will keep in touch and let you know if I find any more information relevant to the case.

Best Regards,
Tim

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Tom Bowman
ODI-NHTSA
202-366-2583

Lafon Tim (othy)

From: Lafon Tim (othy)
Sent: Wednesday, November 15, 2006 8:56 AM
To: 'Tom.Bowman@dot.gov'
Subject: RE: Drag Link Sep'n

Attachments: 20061114181311231.pdf



2006111418131123
1.pdf (264 KB)...

Tom,

According to product reliability, all parts that were returned had damaged boots/seals that in turn allowed water/debris to enter and resulted in degradation of the ball over time.

We are sure that if proper inspection would have been done that the drag link would have been replaced thus avoiding the separation.

I have attached service inspection procedure from TRW. This instruction notes that they should not use a wrench or other objects to apply leverage because this can possibly cause damage to the seal. Part of this may be that they are damaging the seal/ boot when trying to prize apart the joint with something like a pry bar. Also, these are lube free so it is important to recognize that damaged boots warrant replacement.

Volvo's position is that this is not a safety defect. Lack of maintenance on this component as well as other components can lead to undesirable consequences. This is why we provide information in our operators and service manuals and companies like TRW provide guidance like the attached inspection information.

Best Regards,
Tim

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Sent: Monday, November 13, 2006 6:07 PM
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If you have any questions, please feel free to give me a call. I will keep in touch and let you know if I find any more information relevant to the case.

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Tom Bowman
ODI-NHTSA
202-366-2583



TRW Automotive
Commercial Steering Systems

Service Bulletin #LNK-105

Inspection Procedure for TRW Ball Socket Wear

Revised March, 2002

This TRW Commercial Steering Systems' service bulletin has been written to help you repair commercial vehicles more efficiently. This bulletin should not replace your manuals; you should use them together. These materials are intended for use by properly trained, professional mechanics, NOT "Do-it-yourselfers". You should not try to diagnose or repair steering problems unless you have been trained, and have the right equipment, tools and know-how to perform the work correctly and safely.

Truck Shop Inspection Procedure:

1. Make sure the stud is seated tightly in the steering arm taper, and the nut is tight.
2. With vehicle **engine on**, lightly rock the steering wheel while checking for looseness in any threaded joint, or any movement of the stud nut. Any looseness requires repair.
3. With the **engine off** and wheels straight ahead, push and pull the socket in and out by hand (using 50-100 lbs. of pressure) in the direction of the ball stud. If no **AXIAL** movement is detected, the socket is operable. Any free lash detected by hand requires replacement of the socket.

WARNING: Do not use a wrench or other object to apply leverage when inspecting sockets. Applying leverage can give skewed results, and damage components. Component damage may ultimately result in loss of steering control.

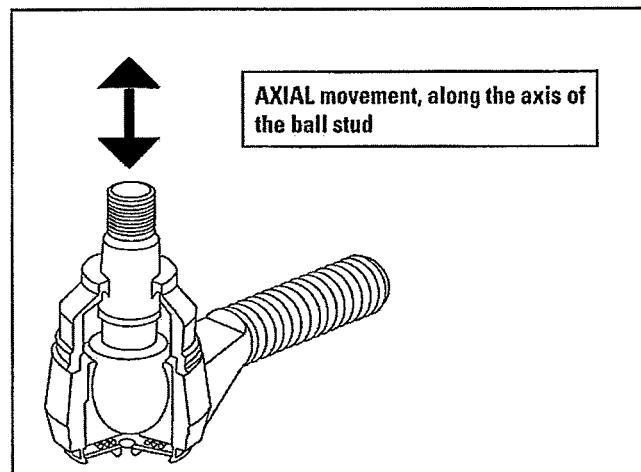
Inspection Station Criteria:

Follow preceding procedures for inspecting ball sockets. Measure any movement detected by hand with a scale for in and out motion on the ball stud axis.

Any motion, other than rotational, between any linkage member and its attachment point of 1/8" (3 mm) or more, measured with hand pressure only, is cause to remove the vehicle from service for immediate socket replacement.

If movement is less than 1/8" (3 mm) the socket should be replaced at the next practical servicing stop.

If no movement is detected by hand the socket is operable.



TRW Commercial Steering Systems
P.O. Box 60
Lafayette, IN 47902
Phone: 317.423.5377
Fax: 317.429.1868

Lafon Tim (othy)

From: Tom.Bowman@dot.gov
Sent: Wednesday, November 15, 2006 9:30 AM
To: Lafon Tim (othy)
Subject: FW: Drag Link Sep'n

-----Original Message-----

From: Bowman, Tom <NHTSA>
Sent: Tuesday, November 14, 2006 10:45 AM
To: 'Lafon Tim (othy)'
Cc: Boyd, Richard <NHTSA>; Jones, Andre <NHTSA>
Subject: RE: Drag Link Sep'n

First of all, thanks for your response.

ODI is aware of a separate separation report (making our count = 2) that VTNA reported through EWR; I was waiting for the vehicle details so we could add that to your list. (Now that you have found an add'l 10 you may have already accounted for this one).

Given that a drag link separation has significant and obvious safety ramifications, I think 10 is way too many even for high mileage vehicles.

I would also think high mileage would not be a significant mitigating factor for drag link joint end-life since high mileage = lots of freeway driving = relatively clean environment + few steering maneuvers and therefore a fairly gentle application compared to on-off road, construction, refuse, and the like.

ODI is requesting more information about the 10 separation incidents: pls provide a list identifying VIN, MY, Model, vocation, Owner or Fleet Name (& contact name if fleet), Phone No, Date Reported, Mileage at Sep'n, whereabouts of parts, & campaign status (i.e. never campaigned, unresponsive to campaign XXX, etc.)

Also, advise whether these are all "sealed for life" joints or require lube and advise VTNA inspection / maintenance / replacement recommendations (other than bulletin provided, if any) for these drag links.

Have the separated ends been inspected by VTNA supplier?; what is their assessment?

Also, what has been VTNA policy regarding fleets who have had a separation ?

Alert your mgt to expect a PE inquiry.

Tom Bowman
ODI-NHTSA
202-366-2583

-----Original Message-----

From: Lafon Tim (othy) [mailto:timothy.lafon@volvo.com]
Sent: Monday, November 13, 2006 7:07 PM
To: Bowman, Tom <NHTSA>

Subject: RE: Drag Link Sep'n

Tom,

Upon further review, I found 11 customer complaints this afternoon involving 13 trucks, 10 of which claimed separation while the others complained of excessive play.

On the ones that involved separation, a common theme, high mileage, was shared by most if not all. Additionally, several spoke of lack of maintenance, torn boots, and rod ends being full of rust and debris.

I spoke with our Legal group also who acknowledged that there were two to three legal claims on drag link separations. These vehicles were also high mileage trucks. According to legal, what was found was that the rubber boot on the rear ball stud (the one that connects to the upper steering arm) had been damaged and/or torn off. This allowed grit and other contaminants to collect inside the socket. Corrosion followed eventually reducing the size of the ball so the socket fell off. In at least one of three claims it was found that the separation occurred as a result of the accident.

Based on the information that I have, I still believe that if the vehicles would have been properly maintained, the issue would have not manifested itself to a separation. This is apparent with the fact that this occurred on high mileage trucks and that several of the claims acknowledge that the protective boot was torn and that there was rust and debris present. Also, the three trucks stating excessive play and were appropriately corrected; therefore, did not result in separation.

I still want to discuss this with our product reliability folks who were involved in responding to the customer complaints to see what was done and to see if any additional information is available. Also, I want to speak with TRW to see what recommendations there are regarding the maintenance/life of the component.

If you have any questions, please feel free to give me a call. I will keep in touch and let you know if I find any more information relevant to the case.

Best Regards,
Tim

-----Original Message-----

From: Lafon Tim (othy)
Sent: Monday, November 13, 2006 4:35 PM
To: 'Tom.Bowman@dot.gov'
Subject: RE: Drag Link Sep'n

Tom,

The vehicle in question was only subject to one Safety Recall which is RVXX0205 (Tie Rod Ball Sockets NHTSA number 02V-037.005). The recall repair on this vehicle was performed on September 16, 2002; therefore, this vehicle has been addressed for the safety defect. Also, this recall involved the tie rod not the drag link.

I researched our recall information for recalls involving the drag link and found two recalls, one of which is RVXX0401 (NHTSA recall #:04V-078). This affected vehicles built during the period of August 1 through November 25, 2003. Since the vehicle in question was manufactured on May 9, 2000, it would not be subject to the recall. The other was a recall initiated by TRW (NHTSA # 01E-004) which involved certain drag links manufactured in the US from July 14 through July 25, 1999. This vehicle would have not been subject to the recall since it was manufactured in May of 2000 and had a style of drag link not subject to the recall.

So in response to your question below on whether this vehicle would have

been subject to an earlier recall or should it have been, the answer is no.

I have not heard of any customer complaints related to the drag link; however, I have asked our Data Analyst to research our service claims.

One thing that I found interesting was that the mileage on the vehicle in question was very high, 650K. This makes me wonder whether the vehicle was properly maintained. If the ball socket were loose or excessively worn, I would expect it would have manifested itself to have excessive steering wheel play.

We have included in our operators manual advices on what to watch for in regard to excessive play. Also, steering wheel lash requirements are codified in 49 CFR 393.209 which also mentions that Universal joints and ball-and-socket joints shall not be worn, faulty or repaired by welding thus implying that they should be inspected and maintained.

I hope this answers your questions. If you need anything else, please don't hesitate to contact me.

I plan to be in DC on Jan. 16 and 17th and plan to stop by if that will be ok.

Best Regards,
Tim

-----Original Message-----

From: Tom.Bowman@dot.gov [mailto:Tom.Bowman@dot.gov]
Sent: Tuesday, October 31, 2006 2:06 PM
To: Lafon Tim (othy)
Subject: Drag Link Sep'n

See attached.

Owner-driver has retained the separated drag link but may be cautious about surrendering it for inspection.

I'd like to know if veh was subject to an earlier campaign / should it have been?

Along that line, I am concerned whether VTNA has received other complaints for drag link / tie rod end (same end joints used for each) during the approx period that this vehicle was built.

Tom Bowman
ODI-NHTSA
202-366-2583

Lafon Tim (othy)

From: Lafon Tim (othy)
Sent: Monday, November 27, 2006 6:50 PM
To: Tom.Bowman@dot.gov
Subject: RE: ODI list re Drag Link Separations

Attachments: Excerpt for Tim Lafon 11-27-06.doc



Excerpt for Tim
Lafon 11-27-06...

Tom,

I included a chart below yours with the information that I was able to find by researching our records.

Let me know if you need anything else.

Best Regards,
Tim

-----Original Message-----

From: Tom.Bowman@dot.gov [mailto:Tom.Bowman@dot.gov]
Sent: Monday, November 27, 2006 12:10 PM
To: Lafon Tim (othy)
Subject: ODI list re Drag Link Separations

See enclosed

Tom Bowman
ODI-NHTSA
202-366-2583

Tim LaFon
 Manager, Regulatory Affairs Customer Satisfaction
 Volvo Trucks North America
 7900 National Service Road
 P.O. Box 26115
 Greensboro, NC 27409

336-393-2233

11-16-06 EWR review
 Drag Link Separations

Rept #	Rept Date	VIN	I/S Date - Mileage	Name
VTNA 1-4328105	1/28/04	4V4ND4JJ1YN237009 VNI [REDACTED]	537,400 mi.	Ruble; at (dlr) Central Illinois Trucks
VTNA 1-6695801	7/19/04	4VG7DAJH3XN [REDACTED]	unknown	Salem Leasing
same	same	765914	597,576 mi	
VTNA 1-9667984	4/21/05	4VA7BARH7XN781833 [REDACTED]	2/05/99 705,000 mi	Joe Redlawski at J & J Trucking; at (dlr) Stykemain Trucks

Rept #	Rept Date	VIN	I/S Date - Mileage	Name
VTNA 1-4328105	1/28/04	4V4ND4JJ1YN237009 VNI [REDACTED]	537,400 mi.	Ruble; at (dlr) Central Illinois Trucks
VTNA 1-6695801	7/19/04	4VG7DAJH3XN765883 [REDACTED]	unknown	Salem Leasing
SAME AS ABOVE	7/19/04	4VG7DAJHXXN765914* [REDACTED]	597,576 mi	Salem Leasing
VTNA 1-9667984	6/16/05	4VA7BARH7XN781833 [REDACTED]	2/05/99 705,000 mi	Joe Redlawski at J & J Trucking; at (dlr) Stykemain Trucks
VTNA 1-103054627	2/9/06	4V4ND4JJ6YN236552 [REDACTED]	760,000	Gary Dunn
VTNA 1-85122701	7/4/05	4V4ND1GH6YN243990 [REDACTED]	600,000	Royal Trucking Company
VTNA 1-3600404 and 1-3600401	10/27/03	4V4ND3RJ7YN253620 [REDACTED]	unknown	Romauld Krysiuk
VTNA 1-93556307	10/13/05	4V4NC9RJ51N [REDACTED]	559,686	Colonial Freight
VTNA 1-	7/7/03	4V4MC9GHX1N [REDACTED]	402,105	Smith Transport

2787409		VNM64T		
SAME AS ABOVE	7/7/03	4V4MC9GH31N315778** [REDACTED]	345,748	Smith Transport
VTNA 1- 6774001	7/27/04	4VG7DAPFXXN778233 [REDACTED]	407,058	Rollins Leasing

* Referenced in complaint on 4VG7DAJH3XN [REDACTED] as having a "similar failure".

** Referenced in complaint on 4V4MC9GHX1N [REDACTED]

Lafon Tim (othy)

From: Lafon Tim (othy)
Sent: Tuesday, November 28, 2006 9:14 AM
To: Tom.Bowman@dot.gov
Subject: RE: ODI list re Drag Link Separations

Tom ,
Yes all of these were customer complaints stating that there was a separation.

Best Regards,
Tim

-----Original Message-----

From: Tom.Bowman@dot.gov [mailto:Tom.Bowman@dot.gov]
Sent: Tuesday, November 28, 2006 9:11 AM
To: Lafon Tim (othy)
Subject: RE: ODI list re Drag Link Separations

Just so we have no misunderstanding, the incidents you reported are all drag link separations (not loose, torn boot etc, but actual separations), right?

Tom Bowman
ODI-NHTSA
202-366-2583

-----Original Message-----

From: Lafon Tim (othy) [mailto:timothy.lafon@volvo.com]
Sent: Monday, November 27, 2006 7:50 PM
To: Bowman, Tom <NHTSA>
Subject: RE: ODI list re Drag Link Separations

Tom,
I included a chart below yours with the information that I was able to find by researching our records.

Let me know if you need anything else.

Best Regards,
Tim

-----Original Message-----

From: Tom.Bowman@dot.gov [mailto:Tom.Bowman@dot.gov]
Sent: Monday, November 27, 2006 12:10 PM
To: Lafon Tim (othy)
Subject: ODI list re Drag Link Separations

See enclosed

Tom Bowman
ODI-NHTSA
202-366-2583

Lafon Tim (othy)

From: Lafon Tim (othy)
Sent: Tuesday, January 02, 2007 10:16 AM
To: 'Tom.Bowman@dot.gov'
Subject: Drag Link Reports

Attachments: 20061220153131307.pdf; 20061220153219767.pdf; 20061220153243772.pdf;
20061220153348761.pdf



20061220153131307.pdf (1 MB) 20061220153219767.pdf (582 KB)... 20061220153243772.pdf (495 KB)... 20061220153348761.pdf (692 KB)...

Hi Tom,

Attached are the reports that I found.

I can stop by your office on Jan 18th so that we can further discuss this.

Sorry for the late response,

Best Regards,
Tim

MEMO REPORT
MATERIALS ENGINEERING
TRW COMMERCIAL STEERING DIVISION

PROJECT #: 52-03

DATE: 11/11/03

WRITTEN BY: M.N. Nemani

DISTRIBUTION: Bob Geyer
Dave Hobson

CC: Mitch Monahan
Dave Snitgen
Carl Bandy
Ken Turner

SUBJECT: Volvo – Frito Lay Draglinks

BACKGROUND: Kevin Pollock, Volvo reliability engineer, sent two (2) draglinks to Bob Geyer. The draglinks were manufactured by FWS and were removed from Volvo VN model trucks. One of the draglinks was off of a truck with 544,000 miles. The ball stud separated from the socket on the axle end. The second draglink is intact and was taken off of a truck with 102,700 miles. These two draglinks were submitted to Materials Engineering to document the condition of the parts and to conduct materials evaluation of the separated ball stud and socket housing.

SUMMARY AND CONCLUSIONS:

1. Visual examination of the separated socket components showed that contamination of the socket lead to corrosion and wear of the ball stud resulting in separation.
2. Materials evaluation showed the ball stud and socket housing conform to material and heat treatment specifications.

RESULTS

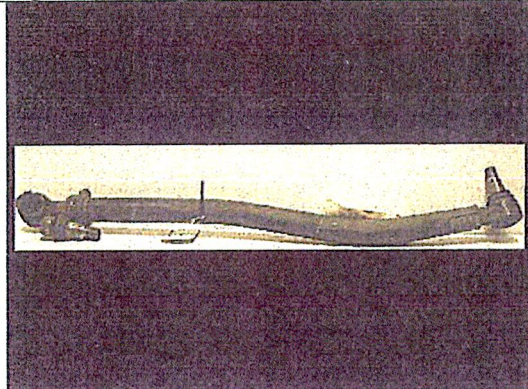
VISUAL EXAMINATION: The 544,000 mile draglink assembly with the separated socket is shown as received in figure 1a. The axle end socket components are shown in figure 1b. Close up views of the ball stud and socket housing are shown in figures 1c and 1d respectively. As can be seen in the photographs, the boot seal was torn and the socket components were covered with heavy rust. No lubricant/grease was evident in the socket. The separated ball stud and socket were cleaned in an ultrasonic cleaner to remove corrosion products on the surface and examined at higher magnifications with a stereomicroscope. The appearance of the cleaned components is shown in figure 2. Wear and heavy pitting due to corrosion are clearly evident on the surface of the ball. The socket housing also shows evidence of heavy corrosion products, which resulted from the damage to the boot seal and resultant ingress of road salts and other debris. The draglink with 102,700 miles appeared to be intact. No damage was observed to either socket assembly. The two socket ends of this draglink are shown in figures 1e and 1f.

Metallographic Evaluation: Axial metallographic sections through the ball and socket housing were prepared for metallographic evaluation. Figure 3a and 3b shows the induction hardened case of the ball stud. The cross section also exhibits the pitting profile observed at the surface. The microstructure of the case consisted of fine medium Carbon tempered martensite. Micro hardness measurements were made 0.010 inches below the surface with a Knoop indenter and 500 gram load. Hardness was equivalent to HRC 56 (Knoop hardness 644-653). Core hardness was equivalent to HRC 30-32 (Knoop hardness 311-324). The microstructure of the socket housing consisted of a mixture of fine lamellar pearlite and ferrite, indicative of a low Carbon steel as expected. Hardness of the socket housing material was measured to be equivalent to HB 162 (Knoop hardness 176).

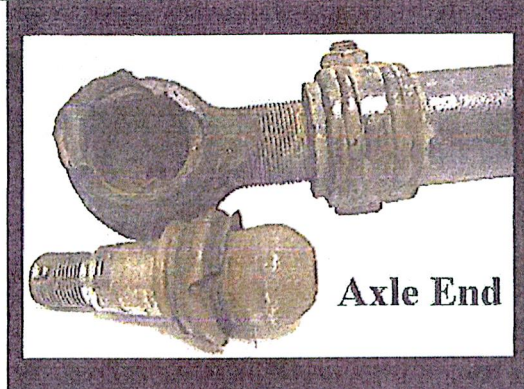
Chemical analysis: Chemical composition of ball stud and socket housing from the axle end of the 544,000-mile drag link was analyzed using an optical emission spectrometer and Carbon-Sulfur determinator. Results (in weight %) are shown below. Results indicate ball stud and socket housing were manufactured from SAE5140 and SAE 1035 equivalent steels, as specified.

Element	C	S	P	Si	Cr	Ni	Mo	Mn	Cu	Al
Ball stud	0.45	0.028	0.008	0.11	1.08	0.12	0.03	0.73	0.14	0.024
Socket housing	0.37	0.025	0.010	0.20	0.15	0.07	0.02	0.66	0.12	0.023

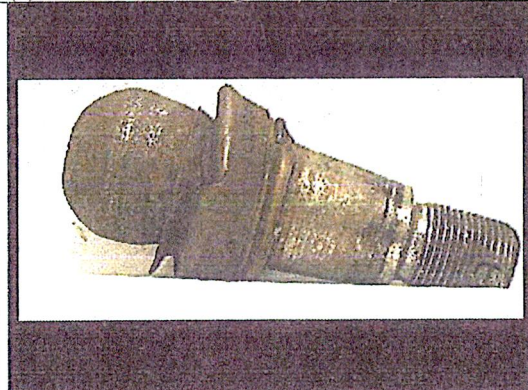
Figure 1: Photographs of drag links as received



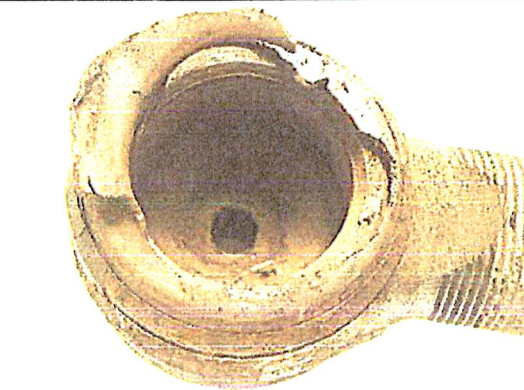
(a) 544,000 mile drag link assembly as received



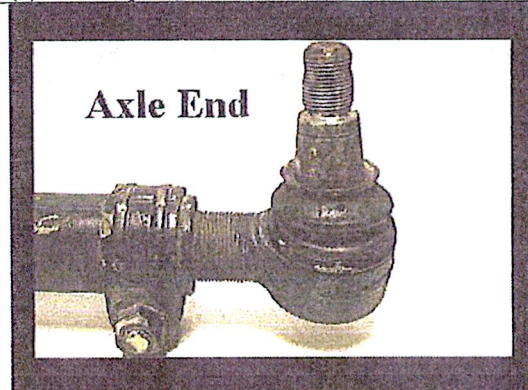
(b) Separated ball stud and socket



(c) Close up view of ball stud



(d) Close up view of socket housing



(e) Axle end of 102,700 mile drag link



(f) Other end of 102,700 mile drag link

Figure 2: Photographs of ball stud and socket after cleaning

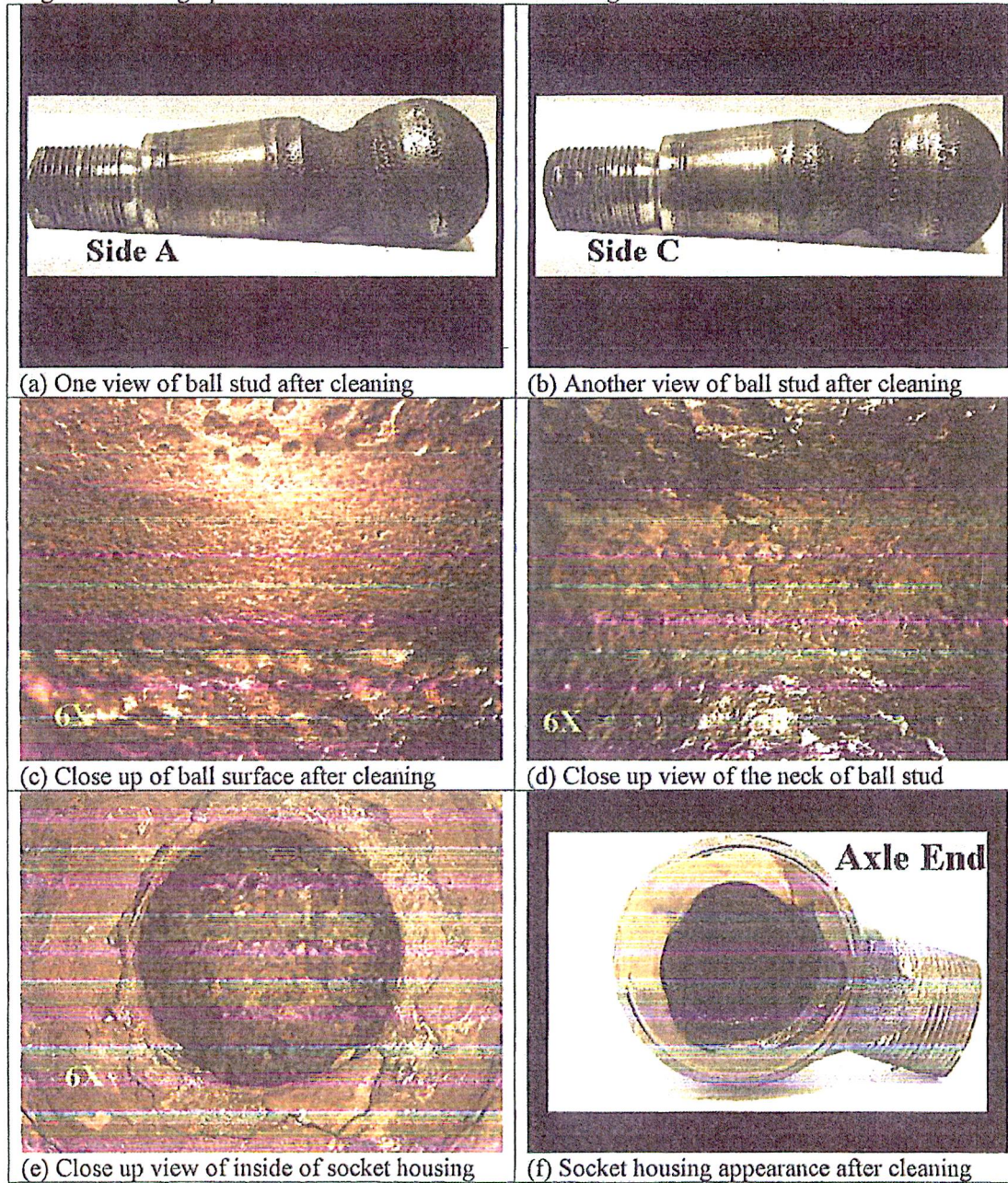
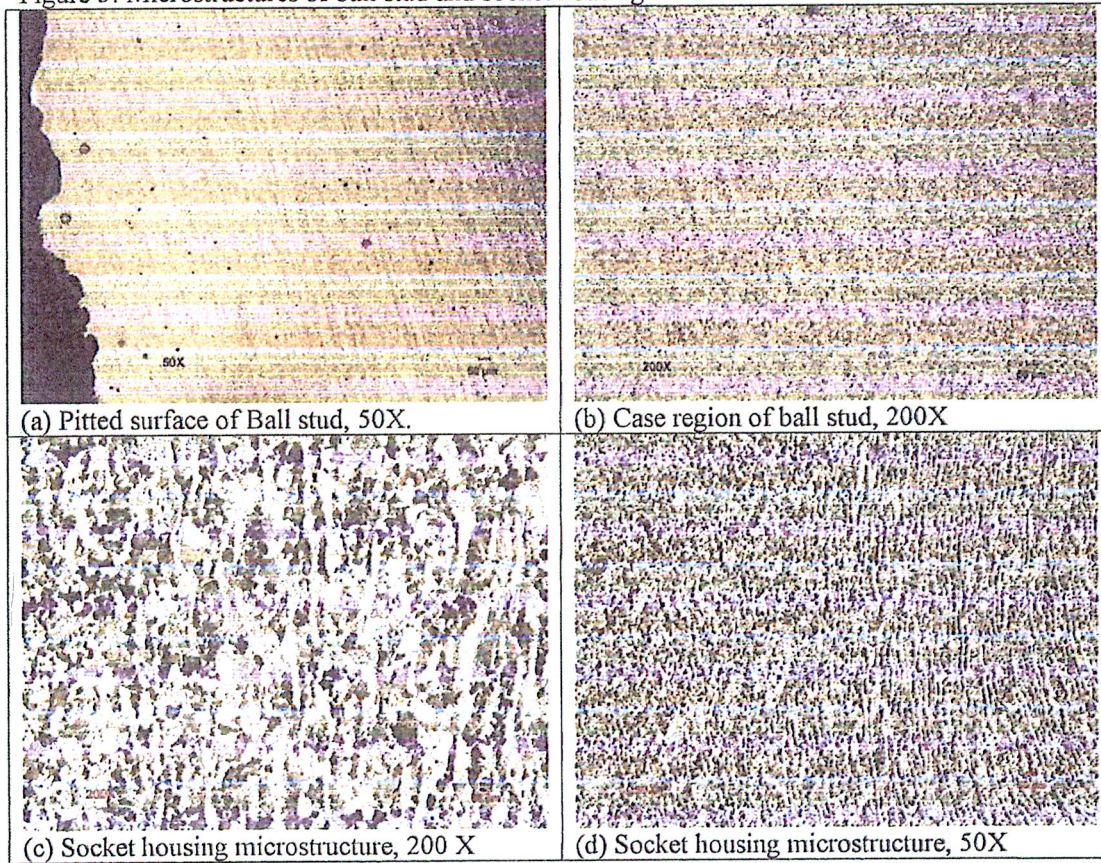


Figure 3: Microstructures of ball stud and socket housing





TRW Fahrwerkssysteme

8 D_(isziplin) Report

Werk Düsseldorf
SAP-Nr. -
Rekl.-Nr. 274-2000

0. Issue: Separation of ball joint of RUAN Drag Link

TRW Z.Nr.: 035-0231-936-454
Kunden Z.Nr.: 8 079 526

1. Teammembers:

Name	Dep.	Function
Wellin	KQ	Plant Quality
Thiel	QS	Central Quality
Teubert	CS	Techn. Sales
Romahn	KNP	Ind. Engineering

2. Description of Problem:

The customer complaint

1. separation of a ball pin. (History: Part No. 8079525; In service date: 5-8-99; Chassis N760518; Ruan unit # R86588; mileage: 519066 mls; Conventional Tandem Axle Sleeper Tractor).

2. Scoring (see 8D_Ruan DL Scoring 081200)

3. Interim Action:

none, see 4.

4. Root Cause:

We were sent 4 photos of the adjustable end of the drag link.

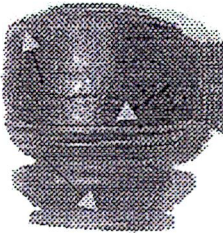


Photo 1: Housing and sealing from beside

The photo shows an okay positioning of the sealing via Z-ring assembly and no damage on the visible side of the sealing. The ball pin and the clamp ring (on the sealing) are missing. Assembly marks in the sealing groove (information by TRW Portland) give evidence for an originally present clamp ring in the right position. The rolling on the top of the housing shows no damage or potential leakage. There is surface-corrosion due to missing paint on the top-left side of the housing (see photo orientation).

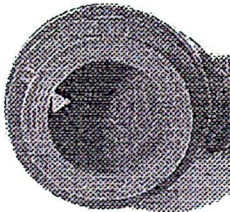


Photo 2: Housing and sealing from taper side

The gaiter mouth (sealing) shows corrosion particles in the contact area with the pitman-arm.



Photo 3: Housing with disassembled sealing

No corrosion marks or hints for a misfunction of the sealing assembly / Z-ring against the housing are visible. It seems that there is some grease rest visible in the hole of the upper ball seat. The inner side of the housing is completely corroded.

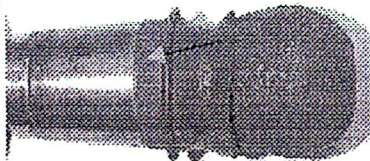


Photo 4: Separated ball pin with sealing support

The ball is completely corroded and out of diameter / form. The taper of the ball pin shows complete corrosion of the contact area of ball pin with sealing-labyrinth. The support ring is damaged and worn out.



TRW Fahrwerksysteme

8 D (isziplinen) Report

Werk Düsseldorf

SAP-Nr. -

Rekl.-Nr. 274-2000

4. Root Cause (continue):

The single parts of the joint give the following impression of the separation process:

1. The corrosion of the contact area of the sealing with the pitman-arm (photo 2, gaiter mouth) led to corrosion of the ball pin's taper as a result of abrasion of the gaiter mouth and fading of sealing function. The corrosion as a matter of surface-process migrated beneath sealing and taper into the inner joint. The corrosion of the ball and the housing led to excessive wear due to the rough surface. A result of this is the decreasing diameter of the ball and the encreasing diameter of the aperture. The falling of the ball pin's diameter below the aperture-diameter resulted in the separation of the ball out of the housing.
2. The corrosion status of the ball pin is not normal and will not occur during life time of the joints. Nevertheless massiv damages of the sealing or mistreatment of the joint could lead to massiv water ingress into the housing, which will result in corrosion of the ball and lower ball seat. Excessiv wear could lead to the a.m. effect.

Corrosion effects like this (with artificial water ingress for testing) were simulated. The corrosion process runs for several months. Therefore technical inspection of the drag link should immediately detect corrosion of the ball due to the encreased play. Additionally the knocking noise (due to the missing contact) has to be heard during steering and driving.

5. Determination of Containment Action: (Zuständig/Verantwortlich; Termin)

- Check of Design-FMEA (Team; done and okay 11th, Dec 2000)
- Check of greasing-process (Plant; done and okay 08th Dec 2000)
- Controlling of sealing test (temperature -30°C - +50°C; articulation, rotation, water-jet; test VR-338-96: okay)

6. Implementation of Containment Action: (Zuständig/Verantwortlich; Termin)

none

7. Verification of Effectiveness: (Verantwortlich(Name)/Abt. Termin)

none

8. Final:

The complaint parts show corrosion as the root cause for abrasion, excessive wear and therefore separation of the ball pin from the housing. The corrosion status of the housing (no evidence for water ingress over roll over or z-ring sealing assembly) and the ball pin give us the impression of a corrosion process from the pitman-arm over the ball-pin taper into the joint. The Prod. Date of the drag link, the mileage of the truck and the In-Service date let us conclude that the complaint drag link is a spare part, which was assembled into a corroded pitman-arm.

The corrosion-process inside the joint should have been detected during technical inspection due to excessive wear and free play as it is no short-time process. Additionally the occuring knocking noise of the drag link should have been noticed during service.

Date: 11th, Dec 2000

Name: Thiel Dep.: QS Signature:

Distribution: TRW Portland Plant; Team

Date: 11th Dec 2000

Name: Thiel Dep.: QS Signature:

0. Issue: Separated Ball Pin of Customer ROLLINS
RO# 528-19580

mileage: 305.000 miles

TRW Z.Nr.: 035-0231-936-454

Kunden Z-Nr.: 8079525

Prod. Date of the drag link: October 1997

1. Teammembers:

Name	Dep.	Function
Thiel	QS	Zentrale Qualität

2. Description of Problem: Customer complains a separated ball pin from a.m. ball joint (see foto 1). This separation resulted in misfunction of the truck steering. The complaint drag link was cutted (for transportation) and sent to TRW Chassis Systems Germany for analysis. The screw-in side shows the separation (*only the housing was reshipped*), the press-in side shows corrosion on the ball pin and a disassembled sealing (foto 2).

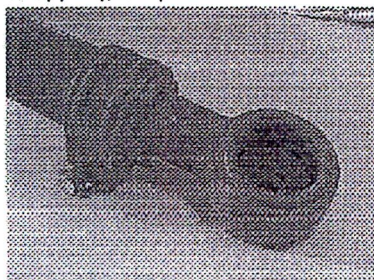


Foto 1: screw-in side of drag link.

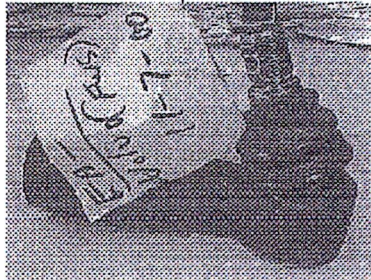


Foto 2: press-in side with disassembled sealing

3. Interim Action:

None, because no direct TRW fault is visible.

4. Root Cause:

Screw-in side: due to the missing ball pin (and sealing) it is not possible to analyse the joint for failure root cause. The reason for the separation is corrosion of the ball pin. This means excessive wear of the socket, the housing and the ball pin due to abrasion (*rough surface of the ball pin*). As the diameter of the ball pin is too small it wont be surrounded by the housing any longer. The reason for the corrosion can not be analysed without the ball pin and the sealing.

Press-in side: The ball pin is also corroded. The reason for the corrosion is a leakage of the sealing. There is no misfunction of the sealing on the cone side visible as there are no continuous corrosion marks beneath the sealing. But there are several leaks due to force on the sealing and the joint. Proofs of this are the damagings of the (metallic) housing (foto 3+4), the character of the leakage of the sealing (foto 5) and the deformation of the metallic sealing ring (foto 6) on the opposite side of the leakage of the sealing.

Therefore there is no misfunction of the sealing or the assembly but a mistreatment of the joint which resulted in corrosion and (as a matter of abrasion) in separation of the ball pin from the housing.



Foto 3+4: Damages and deformations of the housing. Foto 4 introduces high forces on the housing-border which also means a damaging of the sealing as visible in foto 5.



Foto 5: Cut and leakage of the sealing due to outer force. This will result in high water ingress into the joint.



Foto 6: Damaging of the metallic sealing ring on the opposite side of the damagings in foto 5.

5. Determination of Containment Action: (Zuständig/Verantwortlich; Termin)

A mistreatment of the joint as visible above is not under TRW responsibility and can not be avoided by TRW actions.

6. Implementation of Containment Action: (Zuständig/Verantwortlich; Termin)

7. Verification of Effectiveness:

(Verantwortlich(Name/Abt.Termin)

8. Final, congratulate the team:

The a.m. analyse shows a mistreatment of the joint due to damaging of the housing and the sealing system, which resulted in water ingress and corrosion of the joint. The separation was the result of an excessive abrasion of the ball pin and the housing.

Date: 29th, Nov 2000

Name: Thiel Dep.: QS Signature:

Distribution: Customer, TRW US, Team, CS

Date: 29th, Nov 2000

Name: Thiel Dep.: QS Signature:

TRW Engineering Analysis Report

Commercial Steering Systems, Portland Plant



TRW Project #: **EA-27-03**

Customer Information

Customer:

Customer Contact:

OEM:

Volvo Trucks North America

OEM Contact:

Mike Brumley, Mack/Volvo NA
Field Support

Customer Part Number:

8079525

TRW FWS Part No.:

035- 0231-936-454

Part and Vehicle Information

Mileage:

Service Mileage Unknown

Model:

Volvo VNL 64T

Part In-Service Dates:

Not Provided

Reason for Return

Fleet request for analysis of TRW FWS draglinks due to reported excessive wear on the adjustable end. In addition requested TRW to provide a cut-away socket for viewing purposes.

Report Distribution

Mike Brumley, Mack/Volvo NA

Dave Snitgen, TRW Chief Eng., Global Linkage

Urs Teubert, TRW FWS Application Engineer

Ken Turner, TRW Portland Plant Product Engineer

Dave Hobson, TRW, Manager Quality Systems

Carl Bandy, TRW CSS Sales Representative

Brian Shivley, TRW Portland Plant Quality Manager

Mike Dunmire, TRW CSS Sales Account Manager

Robert Grimes, TRW CSS Technical Support

Buzz Hazen, TRW CSS Field Service Support

Analysis

As Received:

Fifteen TRW Fahrwerksysteme draglinks were returned to TRW Portland, Michigan facility on 11/17/03. The parts were returned from recent vehicle inspections performed by Ryder customers, IR, Melroe and Praxair. The parts returned are believed to be service parts as the vehicle in-service dates range from 3/10/1999 to 2/12/2001 with vehicle mileages ranging from 304,545 to 811,097. The part in-service dates and mileages were not reported to TRW.

Analysis:

The visual analysis of the drag link ends included the seal, the ball stud and grease. The functional analysis included radial lash and axial compliance where warranted.

The adjustable end of the draglink experienced higher levels of wear when compared to the non-adjustable ends. The non-adjustable end axial compliance indicates that the parts were not worn to a level recommended for removal. However, upon inspection of the seals, five were found to be damaged and in one case the seal was not returned. Due to the difficulty in determining the cause of the seal damage, the condition of the grease was taken into consideration. There is grease degradation in 10 of the 15 non-adjustable drag link ends, indicating contamination in the socket for an undetermined period of time.

On the adjustable end, 11 of the 15 axial compliance results warranted removal. The axial compliance results range from .042-.180 inches. TRW's inspection criteria for draglink removal and replacement is wear at or greater than .060 inches. In addition, 3 of the 4 draglinks with acceptable axial compliance, had damaged seals and/or notable contamination. In all cases, there was grease degradation.

Photos are provided at the end of this report.

Prepared By: Sheila Pulling, Technical Services

Date: 12/10/03

Page 1 of 3

TRW Engineering Analysis Report

Commercial Steering Systems, Portland Plant

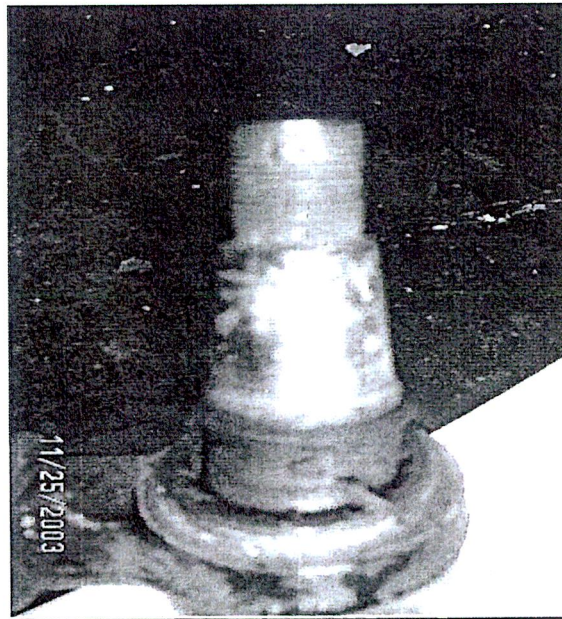


Results Summary

1. TRW recommends a review of maintenance procedures and intervals to ensure timely wear detection and proper seal inspections.
2. The socket wear is due to contamination from a variety of environmental factors combined with the inability to purge contamination from the socket. The rate of wear is increased when contamination is introduced in the socket cavity.

Photos

Photo: (738:C) UNIT: 348053



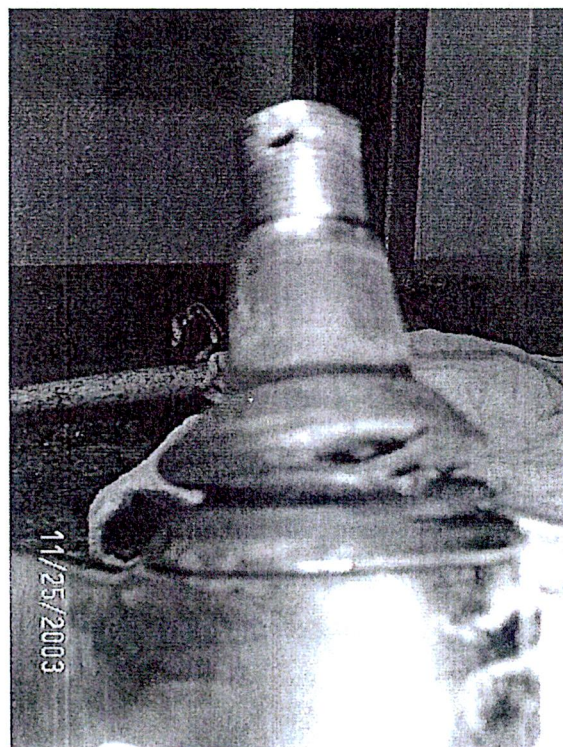
TRW Engineering Analysis Report
Commercial Steering Systems, Portland Plant



Photo (739:N) UNIT 766313:



Photo (739:N) UNIT 766313:





January 24, 2007

Volvo Trucks N.A.
Dean Luttrell
Steve Matteson

Gentlemen,

You are both aware of the failure of Double D Express unit #586, VIN [REDACTED] mileage 381,019. The draglink had come apart, separating at the rear socket joint. The truck went off the road, sustaining a good deal of damage to the axles and suspensions of the truck, as well as damage to the trailer and cargo. The driver was off for several weeks with injuries, but fortunately there were no other vehicles or drivers involved in the accident.

Dean has viewed the draglink, and met with Brad Berg of Double D Express. He indicated that although the component is a non-greasable joint, from his knowledge the failure would have to still be considered a maintenance issue. He instructed Brad, as he did with our CIT personnel, that the boots need to be inspected regularly, as well as the play of the joints during regular inspections. Excess movement of the link would indicate a need to replace this component, as well as any outward indication of rust as a result of water getting past the boots.

This obviously has created a big problem, since CIT maintains all of the over-the-road units for Double D Express, including #586. They are now looking for us to reimburse them for all costs associated with this accident.

As a random check of similar units, we grabbed their unit #590, VIN [REDACTED] mileage 341,522. Using a dial indicator for measurement of play, the movement on the front joint was .001", and the rear was .020". The boot appeared to be intact. After taking it apart, we discovered this rear joint had no grease left, and rust had eroded the ball surface to the point it look very much like the failed component. To be able to compare the tolerance of .020" to that of a new component, we pulled in the repaired unit #586. The movement on that new draglink was .003", and we discovered that this new draglink had a different internal design that included a rubber-type bushing, and a pressed in assembly. Of the 3 draglinks we were looking at, all had different manufacturers for the boots, and were stamped with different countries of origin. The finding: The draglink on #590, with movement of less than the thickness of 3 business cards, and with boots that seemed to be intact, could have failed just like the one on #586.

Because of possible liability for any future failures, we are in the process of changing out all of the non-greasable draglinks, which are the Volvo standard equipment, on all of the 26 other units we maintain. For the same reason, Double D is also going thru their entire daycab fleet and doing the same, involving 57 units. We will be using the same procedure to document the findings on all replaced draglinks.

The Board of Directors of Double D, as well as former owner Gary Dahl, met with me this week to discuss the failure. I was flatly told that their feeling is that Double D Express is not at fault. Whether it is the failure of a standard, non-maintenance component that didn't perform as intended, or that our maintenance program is at fault, this should not be an issue with them. Either they will find another dealer or truck manufacturer.

Gary Dahl also stated that he is disappointed with Volvo. He switched his entire fleet to the Volvo product, and one of the primary reasons was the safety features of the Volvo VN. If most other Class 8 truck manufacturers use greasable draglinks, why would Volvo go with a non-greasable type if they knew it could fail? This component doesn't live up to his expectations.

I have forwarded a zip file that contains the photos of the parts discussed. We had a draglink with only 168,000 miles on it that had been replaced because of too much play earlier. Dean saw that, and we were instructed to send it in for an inspection. We were notified that UPS lost the package last week. It was never delivered. So that process hasn't begun.

They have requested a meeting to discuss this failure. I feel it needs to include upper Volvo management. Call me with your thoughts.

Steve Aubry
Central Illinois Trucks, Inc. - 5597D

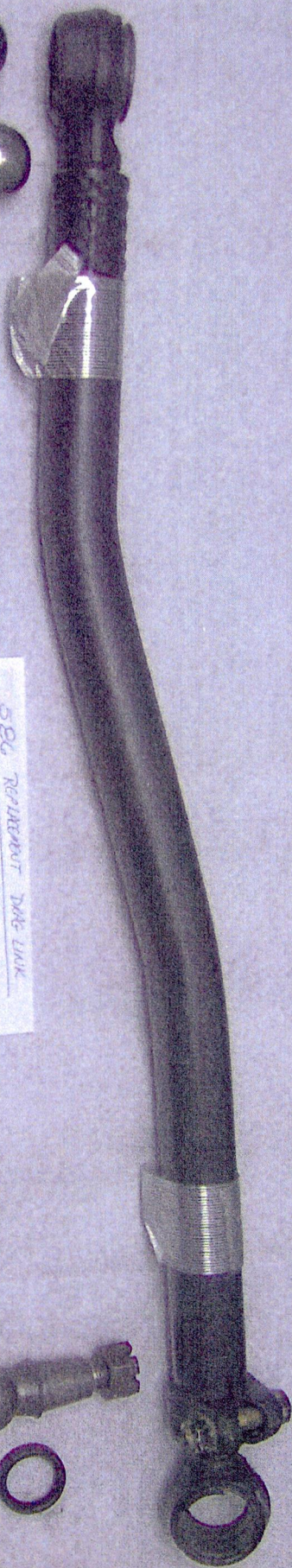
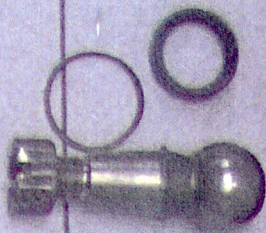
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03 VOL	VNL610	4V4NC9GH63N	582
03 VOL	VNL 610	4V4NC9GH43N	584
04 VOL	VNL64T630	4V4NC9GH54N	586
04 VOL	VNL64T630	4V4NC9GH74N	588
04 VOL	VNL64T630	4V4NC9GH94N	590
04 VOL	VNL64T630	4V4NC9GH04N	592
04 VOL	VNL64T630	4V4NC9GH24N	594
04 VOL	VNL64T630	4V4NC9GH44N	596
04 VOL	VNL64T630	4V4NC9GH64N	598
04 VOL	VNL64T630	4V4NC9GH84N	600
05 VOL	VNL630	4V4NC9GH95N	602
05 VOL	VNL64T	4V4NC9GHX5N	604
05 VOL	VNL630	4V4NC9GH65N	606
05 VOL	VNL630	4V4NC9GH85N	608
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05 VOL	VNL630	4V4NC9GH25N	618
05 VOL	VNL630	4V4NC9GH45N	620
07 VOL	VNL630	4V4NC9GH47N	632
07 VOL	VNL630	4V4NC9GH97N	634
07 VOL	VNL630	4V4NC9GH07N	636
07 VOL	VNL64T	4V4NC9GH67N	638
07 VOL	VNL64T	4V4NC9GH27N	640

586 REPLACEMENT DRAG LINK

.003 REAR PLAY

.001 FRONT PLAY

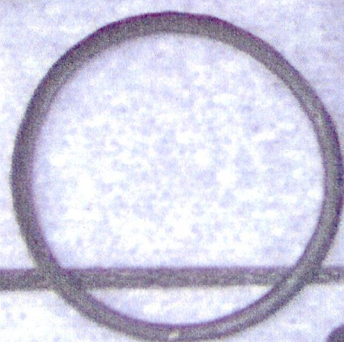
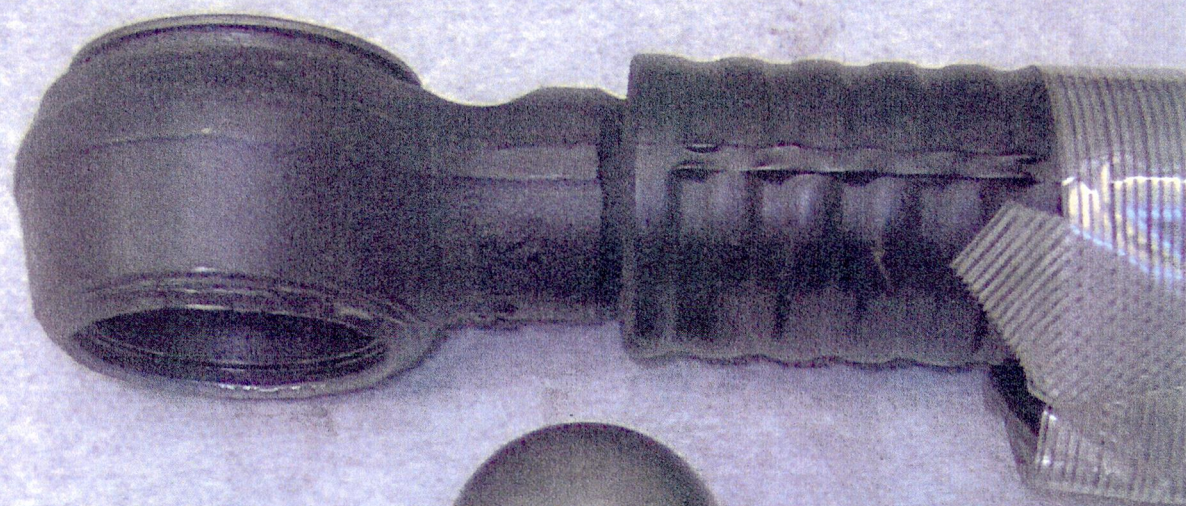
NEW DESIGN WITH RUBBER SHAFTS



SBC REPLACEMENT TIE LINK
1003 TRAIL PLAY
1001 FRONT PLAY
NEW DESIGN WITH RUBBER SHOCKS













#590

340,522/mis

.020 REAR PLAY

.001 FRONT PLAY

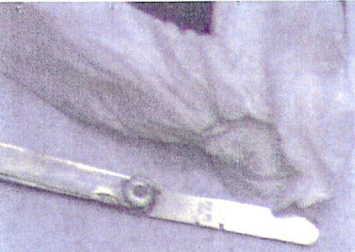
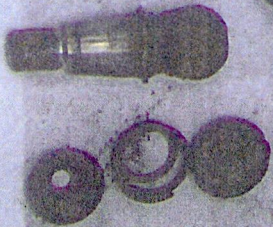
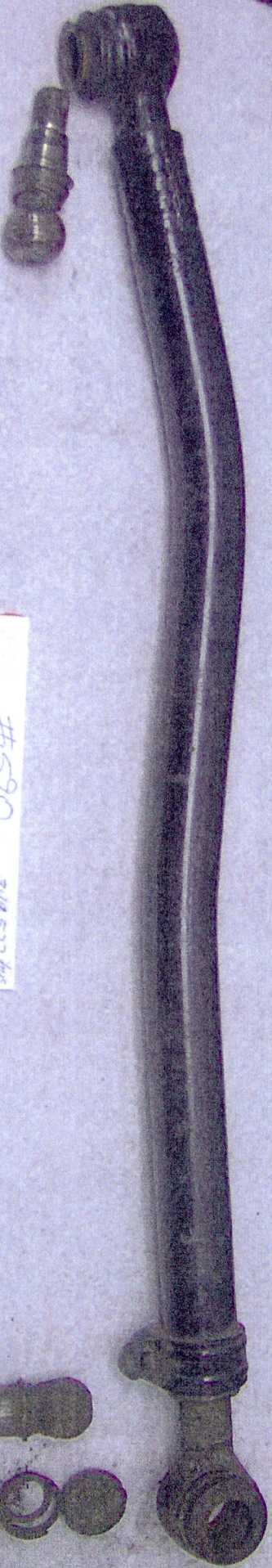
- NO RUBBER BUSHING

- DIFFERENTIAL BOOT

- NO GREASE / REAR

- RUSTING / REAR

#590 348,522/MS
- 0.20 REAR PLAY
- .001 FRONT PLAY
- NO RUBBER BUSHING
- DIFFERENTIAL BEAT
- NO GREASE / REAR
- RUSTING / REAR



RIMS0180
 NEGATIVE:
 MODEL :
 BOM NO 1 BOM NO 2 BOM NO 3 BOM NO 4 BOM NO 5
 3762R-N10013
 VOLVO TRUCKS NORTH AMERICA, INC.
 BOM TO TRUCK ORDER - WHERE-USED
 10:08:18 08/10/31
 PRINTER: QUST0900

WEEK	ORDER	MODEL	PLT	LOC	QTY	CUSTOMER NAME	ORD	STA	SOURCE	LOT	MFG
08-12-15	264253	VNL64T	003	003	12	KRAFT FOODS	A	7		0813	
08-11-10	264265	VNL64T	003	003	14	KRAFT FOODS	R	3		0812	
08-09-22	264409	VNL64T	003	003	1	MCCORMICK TRUCKING	C	3		0810	
08-09-15	266676	VNL64T	003	003	7	HIGHWAY TRANSPORT IN	C	3		0810	
08-11-17	268100	VNL64T	003	003	1	KENTUCKIANA'S PREMIE	R	3		0812	
08-11-24	269293	VNL64T	003	003	1	N W VOLVO TRUCKS	R	3		0812	
08-09-22	269296	VNL64T	003	003	1	N W VOLVO TRUCKS	C	3		0810	
08-11-24	269298	VNL64T	003	003	1	N W VOLVO TRUCKS	R	3		0812	
08-11-10	269481	VNL64T	003	003	1	MVPROBERTS TRUCK CEN	R	3		0812	
08-11-03	270219	VNL42T	003	003	1	STEINMAN TRANSPORTAT	R	3		0811	
08-11-10	270220	VNL42T	003	003	2	STEINMAN TRANSPORTAT	R	3		0812	
08-08-11	271047	VNL64T	003	003	1	FOOD LION INC.	C	3		0808	

TRANS: C61114
 PF1-HLP PF2=MNU PF3=GB PF4=PRT
 PF8=FW
 PF12=OFF







586 FAILED

- BOOT INTACT

- RUST FILLED

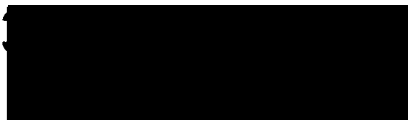
- NO GREASE

- OLD DESIGN - NO RUBBER
SEAL





Section 7
Information on
4V4NC9TH65N



VIN
4V4NC9TH65N

Parent/Headquarter Name
AB VOLVO

Parent/Headquarter Address
S-405 0

Par/Hdq City
GOTEBORG

P/H St
P/H ZIP FSA Code

Registration Name

Registration Address

VOLVO COMMERCIAL FINA ADDRESS NOT AVAILABLE

Reg. City
GREENSBORO NC

Reg ZIP FSA Code

Make
2005 VOLVO