U.S. Department of Transportation
National Highway Traffic Safety Administration

ODI RESUME

Investigation: EA 03-022
Prompted By: Fleet Complaint
Date Opened: 11/12/2003 Date Closed: 01/25/2005
Principal Investigator: Nate Seymour
Subject: Strick Wheel-End Failures

Manufacturer: Strick Corporation
Products: 1997-2004 Strick Semi Trailers
Population: 27,958

Problem Description: Semi trailer bearings are failing, which could result in a wheel-end fire or a wheel separation.

FAILURE REPORT SUMMARY

	ODI	Manufacturer	Total
Complaints:	57	52	57
Crashes/Fires:	15	0	15
Injury Incidents:	0	0	0
# Injuries:	0	0	0
Fatality Incidents:	0	0	0
# Fatalities:	0	0	0
Other*:	14	0	14

*Description of Other: Wheel Separations

Action: This EA is closed. A safety related defect trend has not been identified at this time.

Engineer: *Nate Seymour* Date: *01/25/2005*
Div. Chief: *Richard Boyd* Date: *01/25/2005*
Office Dir.: *Kathleen C. DeMeter* Date: *01/25/2005*

Summary: The closing of this investigation does not constitute a finding by NHTSA that no safety-related defect existed or continues to exist. Further use of agency resources does not appear to be warranted. The agency will continue to monitor this problem closely and reserves the right to take further action if warranted by the circumstances.

See attached technical report for full details.

ENGINEERING ANALYSIS REPORT
EA03-022

SUBJECT: Wheel-end fires and/or separations

VEHICLES: 1997-2004 Strick Trailers

ALLEGED DEFECT: The wheel-end system, using semi-fluid grease may not perform satisfactorily due to a lack of adequate lubrication. This may result in some type of thermal event, such as severe overheating, fire at the wheel-end of the axle, or a partial or complete wheel separation.

CORRESPONDENCE:

04 Dec 03	NHTSA EA Information Request letter to Strick
23 Jan 04	Strick Response to EA IR letter
23 Mar 04	NHTSA EA Information Request #2
21 May 04	Strick Response to EA IR #2

DEFINITIONS: This report will discuss wheel ends built with two different types of lubricant: the subject wheel-ends, referred to as "greased wheel-ends," which use semi-fluid grease, and conventional wheel-ends, which use 90 weight gear oil as a lubricant.

Mobil SHC 007; (semi-fluid grease) An NGLI[1] 00 grade grease with polyalphaolefin (PAO) synthetic base fluid with a recommended operation temperature range of –50C to 180 C.

POPULATION: The following table is the subject trailer population by model year. Information is current as of January 19, 2004.

Year	1997	1998	1999	2000	2001	2002	2003	2004	Total
Total	2358	6698	5609	6202	3298	1500	1393	900	27958

BASIS : This investigation was opened based on a fleet complaint, alleging that the fleet's Strick trailers were experiencing bearing failures, thermal events and wheel separations. This fleet had fifty-seven individual trailers experience such events.

Complainant Fleet experience

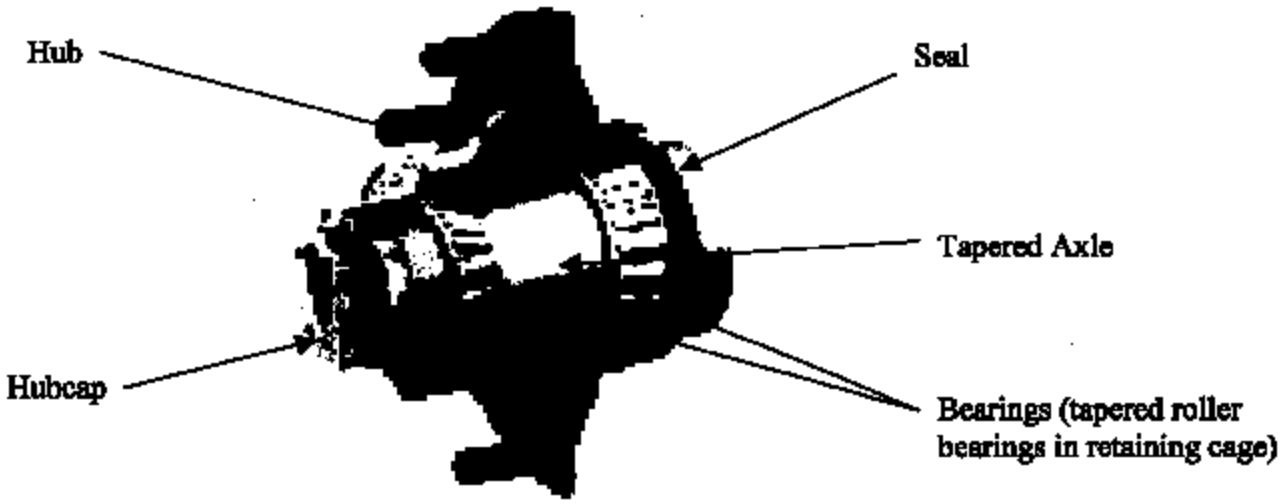
Model Year	Population	Failures	Failure Rate
1997	720	9	1.25%
1998	1,100	13	1.18%
1999	1,660	35	2.11%
2000	150	0	0.00%
Total	3,630	57	1.57%

WHEEL END BACKGROUND INFORMATION: The components of interest are heavy-duty trailer wheel-ends used in a tractor-trailer configuration, typically mounted on axles having a 20,000-

[1] NLGI: National Lubrication Grease Institute; NLGI Number — A scale for comparing the consistency (hardness) range of greases (numbers are in order of increasing consistency). Based on the ASTM D 217 worked penetration at 25°C (77°F).

pound rating. The wheel-end consists of an axle, inner and outer tapered roller bearings, hub, hubcap, seals, lubrication and wheels. The majority of axles in use today are tapered, abbreviated as TN. This means that the outer bearing is smaller in diameter than the inner bearing. The inner bearing is the larger bearing that is installed on the spindle closest to the center of the trailer. The outer bearing is opposite this, being installed last and is closer to the outside of the vehicle. Tapered roller bearings consist of four interdependent components: the cone, or inner ring, the cup, or outer ring, the tapered rollers, or rolling elements, and the cage or roller retainer. The taper angles allow the bearing to handle a combination of radial and thrust loads. Axles that are not tapered are called parallel, abbreviated as TP. Parallel axles use the same diameter inner and outer bearings. Hubs come in many makes and models varying in design and size. The difference between TP and TN axles is relevant to this investigation. In addition to the two distinct bearing sizes, a TN (tapered) axle hub must be smaller in the outer bearing raceway area, therefore requiring less lubrication to achieve the same fill rate as a TP hub. The design of a tapered (TN) hub favors lubrication of the inner bearing as gravity and centrifugal forces "pull" lubrication to the point furthest from the center of the hub. Hubs may be supplied by a variety of manufacturers. Hubs require a different amount of lubrication to accomplish the same fill level. For example a tapered spindle may require 18 ounces to achieve 50% fill, whereas a parallel hub (with larger hub cavity) may require 24 ounces to achieve a 50% fill. This is because internal hub volumes vary between hub manufacturer and between parallel and tapered spindles. There are numerous hubcaps and seals available. These are dependent upon the type of lubrication used. The majority of trailer wheel-ends are lubricated with 90-weight gear oil, a liquid. However, hard grease and semi-fluid grease are also utilized. The function of the lubricant is to separate the rolling contact surfaces at points of high pressure contact and to minimize friction from surface roughness which can lead to higher contact stresses and surface damage. As will be discussed later in the report, the problems reviewed by ODI occurred in tapered (TN) axle wheel ends using Mobil 007 semi-fluid grease. Below is a typical TN wheel end. Close observation will reveal the axle is tapered with the small diameter located to the left in this picture.

Picture 1
Typical 3-D view of TN Wheel-end



Until the 1970s, hard grease (NLGI #2) was the primary lubrication of non-driven (non-powered) wheel-ends. Greased wheel-ends require periodic cleaning and repacking of the bearings as the grease becomes contaminated or breaks down. In the 1970s, many fleets changed to an oil bath hub, as it did not require as much maintenance. Lubrication levels of oil bath hubs are easily verified by looking through a "sight glass" into the inner cavity of the hub. (See picture # 2). Similarly, it is easy to add

lubrication to an oil bath hub through the removable cap in the sight glass. However, there is a concern associated with oil bath hubs, that being, if they leak, oil will contaminate the brake linings.

Leaks are easily detected, as oil will have been sprayed (due to the centrifugal force) all around the rim of the wheel as well as the brake linings. When the brake linings become exposed to oil they need to be replaced, adding to the expense of fixing the leak.

In 1988, Mobil partnered with a fleet to develop the "closed wheel-end system" and introduced it to the trucking industry in the early 1990s. Initially, Mobil supplied this fleet with SCH 007 semi-fluid grease (NLGI Nos."0"and "00"). SCH 007 had originally been developed for use in industrial gearboxes and equipment. It had proven success in reducing leaks in these applications. Mobil theorized that it might have similar results in a wheel-end application. The fleet field-tested and experimented to find the best fill level. By 1994, the fleet had notable success with 007, and other fleets were interested in using the product. Mobil began supplying it to trailer manufacturers as initial fill lubrication. Mobil originally advertised 007 as "Filled for Life" and claimed that their product would extend the service interval of a wheel-end to five years or 500,000 miles. Thus, the greased wheel-end system was marketed as a "low maintenance system." Its components consisted of the same components used in a conventional wheel-end setup, with the exception of the semi-fluid grease and the hubcap. The greased wheel-end had a solid, tamper proof hubcap. (See Pictures Nos. 2 and 3 for Conventional and Semi-fluid wheel end configurations.) This was done to prevent the accidental addition of regular 90-weight gear oil to the semi-fluid grease. The hubcap also prevented easy monitoring of the lubrication level, as in theory the hub was not supposed to need constant monitoring. With an oil lubricated wheel-end the driver will check the lubrication level daily. Detection of a problem is quick and easy with 90-weight oil, not so with semi-fluid grease. With a greased wheel-end the telltale signs of a leak are not easily identified and there is no sight glass to verify that adequate lubrication is present in the hub. Since the lubricant is semi-fluid grease, it will not readily flow or pour, as oil does. Leaking grease will mix with road dust to form a paste like coating on wheel-end parts. Since road dust buildup is expected from normal use, this does not alert one to a possible problem with the lubrication level. Further, the solid hubcap prevents easy daily monitoring by the driver. Adding lubrication to the system is also more complex because the hubcap must be removed if the trailer hubs were not equipped with fill holes. Similarly, inspection by a mechanic requires the hubcap to be removed. Removing the hubcap will normally allow some lubrication to escape, and therefore requires additional lubrication to be added just because the wheel-end was inspected.

Any wheel-end run with insufficient lubrication will eventually fail. There are three basic types of failures, those being: bearing failure, thermal event and wheel separation. A bearing failure is the least severe. This type of failure requires the replacement of the bearings and possibly additional wheel-end components. If a bearing failure goes undetected it will progress into either a thermal event or wheel separation. A thermal event in its most severe state ignites and potentially burns the vehicle. A wheel separation can be deadly. When the bearings are damaged to the extent that they can no longer hold the hub on the axle, the wheel assembly will separate from the vehicle. This condition results in a 600-pound object (wheel and hub assembly) rolling freely and possible loss of control by the driver.

Picture # 2

Conventional Oil Bath Wheel-end
Note the transparent sight glass and the removable center plug (red) used to add lubricating oil.

Picture # 3

Greased Wheel-end
Note the solid hubcap with no provisions for visual inspection or the addition of lubricant.

PROBLEM EXPERIENCE: Strick received and paid warranty claims from four fleets. A paragraph highlighting each fleet's issues follows. ODI is unaware of any vehicle crashes related to this problem.

Minnesota Fleet: On June 6, 2003, ODI and Strick received a complaint from a Minnesota fleet. The fleet purchased 3,630 Strick trailers with greased wheel-ends. Fifty-seven units experienced problems; 28 with bearing failure, 15 with thermal events or fires, and another 14 had partial or complete wheel separation.

Virginia Fleet: The fleet submitted an invoice to Strick on September 6, 2000, for corrective action on 500 new trailers it received that had low levels of lubrication. Strick paid the fleet to inspect and replenish the hubs on every trailer. During the rework, six trailers (of the 500) were found to have damaged seals and bearings, which Strick paid to have replaced. Specific reasons for the low level of lubrication are unknown, however, given that the trailers were almost new, it would appear that the fill level was low from the factory.

Pennsylvania Fleet #1: In 1998, this large national fleet started specifying new trailers from several manufacturers to be equipped with greased wheel-ends. It currently operates approximately 50,000 trailers with greased wheel-ends. The fleet submitted four warranty claims, three on November 24, 1998, and one on March 29, 2000, to Strick for the replacement of axles. All four trailers were built within two months of one another: serial # 427897 built 9/17/97, # 428201 built 11/6/97, # 428163 built 10/23/97, & # 428158 built 11/1/97.

Pennsylvania Fleet #2: This regional carrier, operating approximately 400 trailers with greased wheel-ends, received payment dated July 4, 1997, for the replacement of one axle on a unit built 9/27/96 (serial # 416342)

DESIGN, MATERIAL AND/OR PRODUCTION MODIFICATIONS: Throughout the 1990's Mobil, at numerous times, changed its instructions for inspection intervals and fill level for a greased wheel-end. Strick provided no documentation to ODI of actual fill level modifications. Strick did provide a copy of Mobil's "Instructions for Wheel-end Lubrication," which included dates, service intervals and/or fill levels. Strick claims to have followed Mobil's recommendations but could not produce evidence in the form of work orders, change orders, purchase orders or the like to coincide with Mobil's recommendations. ODI had also asked Strick to describe how changes in fill level were implemented. Strick's response was, that the Engineering Manager e-mails the production managers on the floor with any changes. However, Strick could not produce these records.[2] Strick reported that the pump utilized to fill the hubs was modified to produce a metered reading, thus confirming proper fill. The date the equipment went on line was not reported. And, the equipment did not store actual fill levels. This, along with the Virginia fleet experience, brings into question the procedures followed by Strick to fill the subject vehicles with the recommended levels of 007 during any given time period.

Following are two tables with the changes in chronological order. Table 1: Mobil Greased Wheel-end instructions, summarizes Mobil's greased wheel instructions, made available to the trucking industry, as submitted by Strick to ODI. Table 2: Mobil Documents, summarizes Mobil's actual documents released to the heavy truck/trailer industry. These documents would have been available via Mobil mailings, trade publications, field representatives visiting fleets, and Mobil dealers.

Table 1: Mobil Greased Wheel-end Instructions

Date	Fill Level	Fill Amount	Service Interval
Jan 14, 1994	50% full…can be used successfully at fill levels of 45%-70%	None reported	None reported
Aug 15, 1994	20% full…10%-70% full have worked satisfactorily	Normally require about 1.5 to 2 pints	Only if leakage observed
Dec 6, 1994	20% full, but can be used successfully at fill levels of 10%-60%	Reportedly…1.5 to 2 pints	Only if leakage observed
?	40-50%of the cavity full…static level to bottom of spindle	About 1 pint with TN axle	100k – 200K miles
June 17, 1997	About 20% full, but used successfully 10%-40% full	Reportedly 1.5 to 2 pints	200k – 300k if severe service or rail
Aug 1, 1997	Even with bottom of spindle	None reported	Inspect every 100k miles
April 9, 1998	To the spindle	None reported	200k – 300k miles

[2] PE03-27 Q7, EA03-022 IR#1 Q13, & EA03-022 IR#2 Q5

Table 2: Mobil Documents

Date	Source	Fill Level	Fill Amount	Service Interval
Jan 14, 1994	Tech Topic 1st edition	50% full, but can be used successfully at fill levels of 45%-70%	None	Need only be changed if becomes contaminated…
Aug 15, 1994	Mobil Marketers & Customers	20% is optimum fill…10-70% full have worked satisfactorily	1.5 to 2 pints	Service need only be performed if leakage is evident
Dec 6, 1994	Tech Topic 2nd edition	20% full, but can be used successfully at fill levels of 10-60%	1.5 to 2 pints	Need only be changed if becomes contaminated…
June 17, 1997	Tech Topic 3rd edition	20% full, but can be used successfully at fill levels of 10-40%	1.5 to 2 pints	Need only be changed if becomes contaminated…
Aug 1997	Technical Product Application Advice	Recommend even with the bottom of the spindle. May also be necessary to keep the hubcap 1/3 full.	None	Recommend removing the hubcap or using an inspection hole every 100k miles to verify the outer bearing is getting grease.
May 1998	For Wheel-Ends Using Mobilith SHC 007	Maximum of 50% fill. "All current wheel-ends will work well with the hub about 40% full and the designs with the smaller outer bearing should have a grease level up to the bottom of the spindle."	As a general guideline larger hubs will require 1.5-2 pints and smaller hubs will require 1 pint	"We recommend following hub manufacturer's recommendations" "… we recommend some type of follow-up inspection between 100k an 200k miles to insure the outer bearing is getting lubricated and that there is enough grease in the hub."
June 10, 1998	For Wheel-Ends Using Mobilith SHC 007	Maximum of 50% fill. "All current wheel-ends will work well with the hub about 40% full and the designs with the smaller outer bearing should have a grease level up to the bottom of the spindle."	As a general guideline larger hubs will require 1.5-2 pints and smaller hubs will require 1 pint	"We recommend following hub manufacturer's recommendations" "… we recommend some type of follow-up inspection between 100k an 200k miles to insure the outer bearing is getting lubricated and that there is enough grease in the hub."

June 17, 1998	For Wheel-Ends Using Mobilith SHC 007	Maximum of 50% fill. "All current wheel-ends will work well with the hub about 40% full and the designs with the smaller outer bearing should have a grease level up to the bottom of the spindle."	As a general guideline larger hubs will require 1.5-2 pints and smaller hubs will require 1 pint	"We recommend following hub manufacturer's recommendations" "... we recommend some type of follow-up inspection between 100k an 200k miles to insure the outer bearing is getting lubricated and that there is enough grease in the hub."
Nov 12, 1998	For Wheel-Ends Using Mobilith SHC 007	Maximum of 50% fill...we endorse adding about 4 ounces to hubcaps that have a non-clog vent. "All current wheel-ends will work well with the hub about 40% full and the designs with the smaller outer bearing should have a grease level up to the bottom of the spindle."	As a general guideline larger hubs will require 1.5-2 pints and smaller hubs will require 1 pint	"We recommend following hub manufacturer's recommendations" "... we recommend some type of follow-up inspection between 100k an 200k miles to insure the outer bearing is getting lubricated and that there is enough grease in the hub."
Mar 31, 1999	Tech Topic 4th edition	40-50% full and fill 1/3 hubcap if approved by hubcap supplier	1.5 to 2 pints	Service need only be performed if leakage is evident
Nov 30, 1999	Press Release	Half full	None	"..extends service intervals to at least 350,000 miles.." "Every 100,000 miles or so, you should check to see that the bearings are properly adjusted, and that the hubs have enough grease in them – a precautionary measure to make sure enough grease was put in to begin with."
Dec 1999	Tech Topic 5th edition	50% fill	Larger hubs will require 1.5 to 2 pints while smaller hubs will about 1 pint	"Service need only be performed if leakage, bearing starvation, or excessive endplay is evident upon inspection." "...it will be necessary to perform outer bearing inspection at least every 100k miles..."

The April 9, 1998, entry in Table 1 was referenced as a memo from Mobil. This was the last communication that Strick reported as having received from Mobil. However, Mobil issued seven additional releases to the heavy truck/trailer industry between May 1998 and December 1999. These releases did show consistency on the recommended fill level and quantity. However, the service intervals still showed conflicts. Richard Marrow, Application Engineer, from Mobil was quoted in a press release, dated November 30, 1999, as saying that SHC 007 would extend service intervals to at least 350,000 miles. But, then two paragraphs later he states that "it should be checked every 100,000 miles or so." As ODI has stated previously, inspecting 007 is much more involved than inspecting an oil hub. Essentially, to inspect a hub lubricated with 007 means that the hub must be serviced. Removal of the hubcap and outer bearing are required to properly inspect the level and quality of 007.

In 1998, Mobil made an attempt to communicate to the trucking industry the requirements for successful application of Mobil 007. Mobil issued a document titled "For Wheel-Ends Using Mobilith SHC 007 Synthetic Semi-Fluid Grease" to the heavy trucking industry in May 1998. Mobil then re-issued the requirements three more times, on June 10, August 17, and November 12, 1998. Each release recommended "...some type of follow-up inspection between 100k and 200k miles to insure the outer bearing is getting lubricated and that there is enough grease in the hub." Mobil also stated that the hub manufacturer should be consulted for the proper amount of lubrication, but offered the general guideline of 1.5 to 2 pints for larger hubs and 1 pint for smaller hubs, which should yield a maximum fill level of 50%. The last communication, issued in November 1998, stated that Mobil endorsed adding four ounces of 007 to the hubcap if it had a non-clogging vent.

Four months later, in March 1999, Mobil issued Tech Topic: 4th edition. In the release, Mobil stated 40-50% percent fill with 1.5 to 2 pints of lubricant was recommended, which was consistent with the "For Wheel-Ends Using Mobility SHC 007 Synthetic Semi-Fluid Grease" document. Conversely, in the 4th edition Mobil stated that service was only needed if leakage was evident.

First appearing in the Tech Topic 3rd edition, was a recommendation to check bearing endplay every 200,000 to 300,000 miles. During Mobil's presentation to ODI on October 21, 2004, Mobil indicated that this requirement to check endplay was intended to alert the trucking industry that the hubs needed to be inspected for proper lubrication as well. The most accurate method to check endplay is to use a dial indicator. Normally after a mechanic assembles a wheel-end he will position the dial indicator on the end of the axle to measure endplay. However, this is not the only method to measure endplay with a dial indicator. During ISO (International Organization for Standardization) audits, inspectors will typically position the dial indicator such that it contacts the back of the hub and uses the axle shaft as the reference point. This method is equally accurate and does not require the hubcap to be removed, therefore making it possible to check endplay, as recommended, but to not check the lubrication as intended by Mobil.

During 1998, after multiple fleets experienced failures, including wheel separations, the trucking industry (fleets, suppliers, component manufactures and OEM's) initiated several meetings throughout the country to determine what actions should be taken. Strick was present at many of these meetings, including one in St. Louis, MO, on August 11, 1998.

Xtra Corporation, a Strick customer, initiated the St. Louis meeting. A task group was formed to devise an installation, inspection, and maintenance plan for greased wheel-ends. Xtra Corporation and other fleets have used the plan successfully. The procedure devised is given verbatim as follows:

> This inspection should be completed immediately and repeated at the 100,000-mile interval. If the wheel-end has proper lubrication at the 100,000-mile inspection, extend the inspection interval [exact length of extension is not stipulated].

1. Set spring brakes
2. Jack up Vehicle
3. Look for leaking seals
4. Remove the hubcap and inspect vent. If it's clogged replace the hubcap.
5. Release spring brakes
6. Check endplay
7. Re-apply spring brakes
8. Remove spindle nuts, remove outer bearing.
9. Inspect outer bearing

If evidence of soft/liquid grease in the outer bearing
a. pump in more grease on top of spindle (as much as possible)
b. pack outer bearing
c. re-assemble per TMC RP618
d. lightly coat nuts with lubrication

If evidence of dry, hard, or no grease or a leaking seal, then;
a. remove hub assembly and clean with solvent
b. replace and pack bearing and seal components per TMC RP622
c. fill with as much grease as possible
d. re-assemble per TMC RP618
e. lightly coat nuts with lubrication.

Similarly, The American Trucking Associations (ATA) Technology & Maintenance Council (TMC)[3] updated their Recommended Practice (RP-631) Recommendations for Wheel-end Lubrication in November 1999, to include semi-fluid grease recommendations. The revision reflected a 50% fill level, and recommends a four level inspection process given verbatim as follows:

> -Level one is a simple pre-trip/in-service inspection for obvious signs of lubricant leakage.
>
> -Level two is a detailed external inspection to be conducted at least annually. This involves a level one inspection plus jacking up the vehicle and checking for smooth rolling of the wheels, but does not involve removal of the hubcap.
>
> -Level three is a lubrication level inspection, per OEM recommended interval. This inspection requires removing the hubcap, as the only way to accurately check the lubricant level of a semi-fluid grease is to remove the outer bearing.
>
> -Level four is a wheel-end disassembly inspection and is used if a level 1, 2, or 3 inspection gives reason to warrant further inspection, or to change the lubricant as per the interval determined by the OEM.

Strick does not claim to be a lubrication expert and therefore directs owners to TMC and lubrication suppliers in its Trailer Care and Maintenance Manual. However, as noted above, the TMC refers owners to OEM specifications for more detailed recommendations. This creates a lack of instruction and allows for confusion and misinterpretation. In Strick's Trailer Care and Maintenance Manual (updated 3-3-03) it states, in Section 5.1.3, "Wheel ends lubricated by synthetic grease require inspections annually, or at no more than 100,000 mile intervals. This inspection must be done with the hubcap and outer bearing removed to determine the grease level inside of the hub. Refer to the lubrication supplier's recommendations."

[3] TMC's mission is to provide maintenance and technology solutions to the trucking industry

SERVICE BULLETINS and CUSTOMER COMMUNICATIONS: In June 1998, Strick sent a letter to its customers addressing the issue of Mobil SCH 007 semi-fluid grease in wheel-ends. The letter made three statements. First, Strick had reviewed its processes and determined that they had followed all Mobil recommendations. Second, Strick believed that some customers were not checking lubrication levels. Strick advised that Mobil had published service and inspection intervals, but offered little detail or direction to assist customers in finding this information. Finally, the letter stated that Strick does not recommend "grease" (Mobil SCH007) as a wheel-end lubricant and if customers wanted to order trailers equipped with greased wheel-ends they would have to provide written direction as to how much lubrication to install. This letter lacked technical information concerning the proper maintenance of the hubs and failed to ensure that customers had all the available knowledge to ensure safe and continued operation of their Strick trailers. A copy of the letter is attached to this report as **ATTACHMENT 1.**

Again in December 1999, Strick sent a letter to customers informing them of the increased maintenance requirements of this wheel-end system. However, again Strick failed to provide adequate technical information, as discussed below. By December 1999, the St. Louis meeting had taken place and TMC had updated its Recommended Practice: Wheel-end Lubrication (RP-631). TMC makes several references to OEM requirements in RP-631. Strick does state in their Trailer Care and Maintenance Manual (updated 3-3-2003) that to inspect a greased wheel-end the hubcap and outer bearing must be removed to determine the lubrication level. However, neither the June 1998 nor the December 1999 letter to its customers references this requirement or directs customers to the Trailer Care and Maintenance Manual. The letter does mention that Mobil and TMC recommended a 100,000 miles or annual inspection interval, but Strick fails to specifically spell out what an inspection consists of in either of these letters. TMC recommends a level two inspection annually, which is only an external inspection. TMC defers the level three-inspection interval to the OEM. Strick's Trailer Care and Maintenance Manual implies the equivalent of a level three TMC inspection, but the two letters did not state that a level three needed to be performed each year. Finally, Strick provides no direction as to when a level four wheel-end disassembly inspection (Complete System Tear-Down) needs to be done, which TMC leaves to the discretion of the OEM.

VRTC/ODI TESTING: VRTC and ODI conducted testing to determine the reason that the bearings failed. Metallurgy and hardness tests were preformed on a set of bearings removed from a failed wheel-end, and the grease was analyzed. This bearing set had been in service for 68 months prior to failure. Thirty-four (34) months prior to failure, the wheel-ends had 007 lubrication added. The grain structure[4] of the failed bearings appeared to be similar to that of a new bearing when compared through the metallograph at high magnification. An analysis by Timken (bearing manufacturer), revealed the grease had between 3 and 5 percent iron in it and that it had reached the end of its useful life. The percent of iron normally would be almost non-detectable. When the cages and rollers (See Picture 1 for "cages & rollers") were removed from the cones, fairly extensive damage to the surface of the raceway was visible. Most of the damage appeared to be from embedding of the loose particles, and there was some fretting and spalling on the cones. Fretting is wear, characterized by the removal of fine particles from the mating surfaces. Spalling is the result of subsurface cracks caused by the material collapse at the subsurface.

FIELD WORK: ODI visited the Minnesota fleet that first brought the issue to ODI's attention. ODI met with the Vice President of Operations, the Director of Facilities, the Technical Training Manager, and visited the maintenance shop. The fleet was in the process of converting all its Strick trailers with greased wheel ends to oil bath wheel ends. The fleet had experienced several failures and was concerned about safety and liability. ODI observed two hubs torn down and rebuilt with oil bath

[4] Grain structure is the arrangement of grains in a metal, with a grain having a particular crystal structure

wheel ends. ODI also inspected numerous parts that had been saved by the fleet during this replacement campaign. Various signs of deterioration were evident. Some bearings showed signs of over heating and pitting of the roller and/or raceways. The fleet produced sample maintenance records. The records indicated that the wheel ends had been inspected every 90 days. This is the typical industry practice for trailer Preventative Maintenance cycles with oil bath wheel ends. Therefore, the fleet carried this practice over to trailers with greased wheel-ends. Similar to oil bath, their inspection consisted of jacking the trailer up and spinning the wheel, which is a level 2 TMC inspection (see TMC recommendations, above). The company officers claimed that the wheel-ends had been opened annually, however the maintenance records did not indicate the level of inspection.

STRICK EVALUATION of ALLEGED DEFECT: Strick offered the following evaluation in the May 21, 2004, response to ODI:

> "The contributing factors are not enough lubrication remaining in the hub to properly lubricate the bearing surface.
>
> The failure mechanism could well result from improper inspections or failure to conduct inspections as required of wheel-ends to maintain appropriate lubrication levels. Oil seals which leak and are not detected as a result of the lack of maintenance and accompanying inspections could lead to failure.
>
> Leaking seals are to be expected and anticipated while equipment is in service. Accordingly, if not properly serviced, grease levels become very low and will not properly lubricate the bearing as required.
>
> Improperly lubricated wheel-ends can cause bearing failure and a possible wheel-end separation from the axle.
>
> A warning sign would be leaking seals, and during the annual or 100 K mile inspection of the wheel-ends or the presence of low grease levels upon removing the outer bearing for inspection.
>
> Warning signs for other vehicles when operating in the vicinity would be possible smoke coming from the over heated wheel-end. They may detect wobble or signs of the wheel-end being loose."

OBSERVATONS: This closing report summarizes the investigation EA03-022 activity that ODI has conducted concerning "greased wheel-end" failures on Strick trailers. ODI's investigation has been hampered by a lack of detailed historical information from Strick. Strick did not maintain production records of specific fill levels for the axle ends of semi-grease built trailers.

It appears that the problems experienced by the Minnesota fleet were caused by the same issues as those experienced by the Virginia fleet (September 2000), that being low fill rates during assembly of the wheel-ends. Strick paid for the inspection, replacement and addition of lubricate of the Virginia fleet.

At this time, the Minnesota fleet has replaced all semi-fluid grease in the subject trailers with 90-weight oil, therefore the vehicles have been remedied. As the vehicle manufacturer, Strick had an obligation to pass on all fill recommendations brought to their attention by their suppliers. Apparently Strick did not do this. During the investigation ODI asked for specific information sent to each customer. Strick responded with a list of twenty-nine companies to whom they sent the June 19, 1998,

and December 16, 1999, letters (see Attachment 1). Strick submitted no other Strick communications in response to this question. All of the Minnesota fleet's failures occurred after 1998, and since the Minnesota fleet was not provided with detailed and updated maintenance procedures, Strick bears some responsibility.

The following findings are a summary of practices ascertained during this investigation that may have contributed to the wheel-end failures on Strick trailers.

1. Inadequate and/or inconsistent fill levels of Mobil 007 semi-fluid grease during production;
2. Inconsistent recommendations to the trailer owner concerning the frequency of maintenance when using greased wheel-ends;
3. Inconsistent and untimely instruction to end users by Strick, as new information was learned from the industry about greased wheel-end lubrication performance.

Based on ODI's investigation in the area of wheel-end failures, ODI has found that Strick relied extensively on the individual suppliers of wheel-end components and lubrication (e.g., wheels, axles, hubs, bearings and grease) for guidance and direction to deal with this issue. ODI believes that the individual suppliers are likely to provide useful technical information and recommendations, but because they may lack information about other components and about the trailer manufacturer's assembly practices, it is appropriate for the trailer manufacture to validate acceptability of the components, assuring the compatibility of design (i.e., the "wheel-end system") received from various suppliers. The vehicle manufacturer integrates the individual components and technical recommendations and assembles them into a wheel system and is in the best position to understand the parts compatibility inter-relationships, trade-offs and performance requirements of the application.

CONCLUSION: At this time, with the greased wheel-end replacement program put in place by the Minnesota fleet and the apparent maintenance changes incorporated by other fleets using Mobil 007, the problem of wheel-end failures seems to have peaked and apparently has been resolved. Therefore, it is not practical to further pursue this matter, given the facts as we currently understand them. However, ODI will continue to closely monitor this entire arena and will require periodic complaint updates from Strick for the next twelve months.

The closing of this investigation does not constitute a finding by NHTSA that no safety-related defect existed. Further use of agency resources does not appear to be warranted. The agency reserves the right to take further action if warranted by the circumstances.

Nate Summ
Safety Defects Engineer — 1/25/05 Date

I Concur:

Richard Boyd
Chief, Medium & Heavy Duty Truck Division — 1/25/05 Date

Director, Office Of Defects Investigation — 1/25/05 Date

STRICK

STRICK CORPORATION
STRICK FINANCE CO.

225 Lincoln Highway
Fairless Hills
Pennsylvania, USA
19030.0009
215.949.3600

VAN DIVISION

301 North Polk Street
Monroe, Indiana
46772.0277
219.692.6121
Fax 219.692.6622

June 19, 1998

Dear Valued Customer:

In the past few months, several of our customers have reported unexpected problems with wheel ends using Mobilith SHC007 synthetic grease. We have become aware of instances where an inadequate amount of grease reaching the bearings has apparently led to bearing failure. The purpose of this letter is to share some information with you and to request your attention to this matter in order to prevent problems with your wheel ends.

1. When the matter was first brought to our attention we reviewed our processes to confirm that we have been installing a consistent amount of grease in accordance with the manufacturer's recommendations. Our review disclosed that we have at least eight different documents on file from Mobil each of which has slightly different instructions. In view of this, while we believe that we have followed the manufacturer's recommendations, we must note that these recommendations have changed over time. We also wish to note that our standard axle manufacturer has different installation instructions than Mobil recommends.

2. In the course of investigating this situation, we came to understand that some customers have not been checking lubricant levels in their wheel ends. We want to advise you that Mobil has now published service and inspection intervals and procedures for wheel ends using their product that must be followed. We understand that they require inspection about every 100,000 miles. We also note that there is evidence that some components of the product dissipate to some degree.

3. While we want to attempt to meet the requirements of our customers and recognize that changes can be positive, we do not recommend and have not recommended grease as a wheel end lubricant in the production of new trailers. We recommend 90 weight gear oil for wheel end lubrication, which is the Strick standard and has been for many years. In view of the growing evidence that Mobilith SHC 007 will not meet our customer's expectations, if you wish us to continue to use this product, or other synthetic lubricants, on new production we will need written direction from you as to how much lubrication to install. We do not want to hold ourselves out as experts.

We intend to continue to support all our customers' efforts to learn more about this and other new lubrication products that are available on the market. If you have comments or questions regarding this issue please let us know and we will try to help you find expert answers.

Sincerely,

Ronald L. Zubko

Ronald L. Zubko

December 16, 1999

«Name»
«Company»
«Address1»
«csz»

Dear «Dear»:

Enclosed is a copy of our letter of June 19, 1998 sent to purchasers prior to that time concerning wheel end lubrication of your equipment. It has come to our attention that there are vehicles being operated without inspections performed at every 100,000 miles or one year intervals as now recommended by Mobil and The Maintenance Council RP-631.

We have received reports of wheel end failures in the form of bearing seizure which we expect could have been avoided if the annual or 100,000 mile inspection and refill process now required had been performed.

It is very important that this preventive maintenance procedure be completely and consistently followed.

We have attached a copy of the recommended procedure and process to be utilized when doing this inspection.

Sincerely,

Ron Zubko
Vice President
Research & Development