EA04-019 Closing Report

Wheel Separations in Model Year 2002 -2004 Jayco Travel Trailer and Fifth Wheel Recreational Vehicles (RVs)

CONTENTS

(1) Subject

This report addresses the wheel mounting and retention system in travel trailer and fifth wheel trailers manufactured by Jayco, Inc. ("Jayco") beginning with model year 2002 through model year 2004. The following photograph depicts a representative Jayco Travel Trailer "towable" vehicle.

Jayco Model "Designer" Travel Trailer Source: Jayco Website

Definitions –

Term	Definition
Fifth Wheel Trailers	Trailers designed to connect to a towing vehicle through a fifth wheel towing system. In general, fifth wheel connections allow a greater articulation at the connection point allowing for greater maneuverability than a ball stud trailer hitch mount.
Travel trailers	Trailers designed to connect to a towing vehicle through a ball stud mounted to a rear mounted trailer hitch.
"Six Lug" and "Eight Lug" Wheel Systems	The RV industry frequently uses the term "lug nuts" to describe wheel-mounting nuts. ODI has generally used the term "wheel mounting nuts" in this report, but has occasionally used the term "lug nuts" when quoting or paraphrasing a source that has used this terminology. ODI recognizes that there are numerous technically-specific characteristics and properties associated with each of the wheel, stud, nut, and hub configurations such as the geometric characteristics of each of the wheel end system components, their rigidity, contact area, etc. within each if these product family groupings. For purposes of this report, ODI has adopted the terminology frequently used in the RV industry and referred to either six or eight "lug" wheels to describe the major relevant family groupings for the various wheel end configurations since ODI did not found it necessary to pursue a more in-depth investigation of the many design and manufacturing factors that could contribute to wheel end loosening and separations.

In order to protect the privacy of the affected vehicle owners, ODI has redacted all VIN numbers (deleted the final six digits of the VIN) identified in this report.

ODI has conducted, or is in the process of conducting, investigations of wheel separations in similar "towable" recreational vehicles manufactured by:

Manufacturer	Investigation	Status
Fleetwood	EA04-009	Completed, Campaign 04V-364
Keystone	EA04-032	Active
Pace American	EA04-058	Active
Haulmark	EA04-059	Active

ODI has also participated in discussions with vehicle owners, vehicle manufacturers, suppliers, and affected trade organizations such as the Recreational Vehicle Industry Association (RVIA), the National Association of Trailer Manufacturers (NATM), the National Marine Manufacturers Association (NMMA), and the newly created Trailer Safety Industry Coalition (TSIC) about the issue of wheel separations in the recreational, cargo, and marine trailer vehicles.

ODI has been investigating wheel separation from "towable" vehicles since late 2003. During these early investigation activities, ODI made certain observations and recommendations that were published in Appendix C of ODI's closing report EA04-009 (Fleetwood) issued on November 24, 2004. To make these recommendations available to the broadest number of manufacturers, ODI has included this summary of "areas for improvement" in Appendix C of this report.

On December 20, 2004, the recently formed Trailer Safety Industry Coalition (TSIC) issued a bulletin outlining certain "recommended practices" intended to improve the quality and reliability of wheel mounting and retention systems in towable equipment. To assist TSIC in making this information available to the broadest number of manufacturers, ODI has attached a copy of these recommendations in Appendix D of this report.

(2) Background

In November 2003, as part of investigation EA04-009 (Fleetwood Enterprises), ODI made informal phone inquiries at Jayco and several manufacturers of "towable" Recreational Vehicles (RVs) and cargo trailers to determine the extent to which wheel separations had occurred, or were occurring, in vehicles manufactured by these companies.

On December 10, 2003, in response to ODI's inquiry, Jayco provided a summary that identified 46 incidents in which "six lug" wheels and nine incidents in which "eight lug" wheels had separated (rolled free) from the vehicle. Appendix A provides a summary of these incidents.

On February 18, 2004, ODI opened Preliminary Evaluation PE04-016 (Jayco).

On March 9, 2004, ODI requested information from Jayco. Jayco provided a partial response on May 11, 2004, and the balance of the information on June 1, 2004, with the request that ODI treat the information provided on June 1, 2004, as confidential.

On June 30, 2004, ODI and VRTC inspected a Jayco vehicle in Mitchell, South Dakota, that experienced a recent wheel separation. On July 7, 2004, VRTC inspected a Jayco vehicle in Pigeon Forge, Tennessee, that had experienced a recent wheel separation. ODI invited Jayco to participate in both inspections and Jayco responded by sending one or more representatives to each inspection. ODI has provided summaries of these inspections later in the report and further details are summarized in Appendix B.

On July 20, 2004, Jayco issued Recall Notice 04V-364 addressing "742 travel and fifth wheel trailers manufactured with six (6) lug aluminum wheels between May 30, 2001 and December 7, 2002."

On February 15, 2005, ODI and VRTC personnel visited Jayco's manufacturing site in Middlebury, Indiana, to review Jayco's wheel assembly methods and associated quality practices.

Following is a summary of the significant investigation activities:

Date	Activity
10/03	ODI makes an informal (phone) inquiry of Jayco (among other manufacturers) regarding wheel separations.
12/10/03	Jayco provides a list of 55 wheel separation or loosening incidents. (See Appendix A.)
2/18/04	ODI initiates PE04-016.
3/9/04	ODI requests information from Jayco.
5/11/04	Jayco provides ODI with partial information and requests that the April 30, 2004, deadline for the balance of the requested information be extended to May 31, 2004.
5/14/04	ODI grants the requested extension and confirms ODI's request that Jayco inform ODI of "newly reported" wheel separation incidents. (ODI has summarized the "newly-reported incidents" in Section 6 of this report, "ODI Investigation.")
6/1/04	Jayco provides the balance of the requested information and requests that ODI treat the information as confidential.
6/30/04	ODI and VRTC inspect VIN 1UJCJ02R521XXXXXX in Mitchell, South Dakota.
7/2/04	ODI initiates Engineering Analysis, EA04-019. (ODI did not request additional information from Jayco during the EA since the issue was resolved at meeting that Jayco conducted with ODI on July 16, 2004.)
7/7/04	VRTC inspects vehicle in VIN 1UJCJ02R731XXXXXX in Pigeon Forge, Tennessee.
7/16/04	Jayco representatives visit ODI and propose a corrective action.
7/20/04	Jayco files Defect Notice 04V-364 (Jayco # 9901054) pertaining to vehicles equipped with "six lug" aluminum wheels.
2/15/05	ODI-VRTC Inspection Visit to Jayco's manufacturing facility in Middlebury, Indiana

(3) Population

On February 23, 2004, Jayco provided production information and wheel separation incident information to ODI. Based on the information provided and ODI's analysis which follows, the subject population consists of 3,433 Jayco vehicles manufactured between January 1, 2000 and March 31, 2004 that are equipped with six or eight "lug" aluminum wheels. See the following Production Tables A-1 and B-1 for further details.

Analysis

ODI has summarized the population, incident count, and incident rate information to compare the wheel separation performance of Jayco vehicles equipped with steel wheels with Jayco vehicles equipped with aluminum wheels mounted on six wheel mounting studs and Jayco vehicles equipped with aluminum wheels mounted on eight wheel-mounting studs.

Table A-1 - Jayco Vehicle Production

Jayco Production of Fifth Wheel and Travel Trailer vehicles
between January 1, 2000 through March 31, 2004

Vehicle Configuration

Type of Wheel Installed	Fifth Wheel	Travel Trailer	Total
Aluminum	3218	215	3433
Steel	15402	39078	54480
Total	18620	39293	57913

Source: Data provided by Jayco on May 11, 2004

Table A-2 - Jayco Wheel Separation Incidents

Wheel Separation Incidents comparing vehicles equipped with aluminum wheels to vehicles equipped with steel wheels for Jayco Fifth Wheel and Travel Trailer vehicles manufactured between January 1, 2000 through March 31, 2004

	Vehicle Type		
Type of Wheel Installed	Fifth Wheel	Travel Trailer	Total
Aluminum	55	3	58
Steel	10	10	20
Total	65	13	78

Source: Data provided by Jayco on June 1, 2004.

The incident count data summarized in Table A-2 above indicates that Jayco Fifth Wheel and Travel Trailers equipped with aluminum wheels account for a significant majority of the wheel separation incidents reported (58 / 78 = 74 %).

Table A-3 - Jayco Wheel Separation Incident Rates

Wheel Separation Incident Rate (stated as Incidents per 100,000 Vehicles) comparing vehicles equipped with aluminum wheels to vehicles equipped with steel wheels for Jayco Fifth Wheel and Travel Trailer vehicles manufactured between January 1, 2000 through March 31, 2004

	Vehicle Type		
Type of Wheel Installed	Fifth Wheel	Travel Trailer	Overall Rate
Aluminum	1709	1395	1689
Steel	65	25	37
Overall Rate	349	33	135

Source: The incident rates are calculated from the data summarized in the preceding two tables, A-1 and A-2.

The incident rate data summarized above indicates that wheel separations from Jayco Fifth wheel and Travel Trailers equipped with aluminum wheels is approximately 45 times (1689/37) the incident rate of wheel separations for fifth wheel and travel trailers equipped with steel wheels.

Although ODI is concerned about wheel separations that occur even in small numbers and at low incident rates, based on the above analysis, ODI has focused this investigation on Jayco vehicles equipped with aluminum wheels.

Jayco installed aluminum wheels with either six or eight wheel-mounting studs. The following tables summarize the (1) production, (2) incident count and (3) incident rate experience of wheel separations in Jayco vehicles equipped with aluminum wheels mounted with (a) six or (b) eight wheel-mounting studs.

Table B-1 - Jayco Production of Vehicles Equipped with Aluminum Wheels

Jayco Production of Fifth Wheel and Travel Trailers equipped with aluminum wheels between January 1, 2000 through March 31, 2004 by number of wheel-mounting studs

	Vehicle Type		
Number of Wheel Mounting Studs (per wheel)	Fifth Wheel	Travel Trailer	Total
Six	587	155	742
Eight	2631	60	2691
Total	3218	215	3433

Source: Data provided by Jayco on May 11, 2004

Table B-2 - Wheel Separation Incidents Affecting Jayco Vehicles Equipped with Aluminum Wheels

Wheel Separation Incidents comparing Jayco Fifth Wheel and Travel Trailer Vehicles equipped with aluminum wheels mounted with six wheel-mounting studs to vehicles equipped with aluminum wheels mounted with eight wheel-mounting studs manufactured between January 1, 2000, through March 31, 2004

	Vehicle Type		
Number of Wheel Mounting Studs (per wheel)	Fifth Wheel	Travel Trailer	Total
Six	46	3	49
Eight	9	9	18
Total	55	12	67

Source: Data provided by Jayco on June 1, 2004

Table B-3 - Wheel Separation Incident Rates for Jayco Vehicles Equipped with Aluminum Wheels

Jayco Wheel Separation Incident Rate (stated as Incidents per 100,000 Vehicles) comparing Jayco Fifth Wheel and Travel Trailer Vehicles equipped with aluminum wheels mounted with six wheel-mounting studs to vehicles equipped with aluminum wheels mounted with eight wheel-mounting studs manufactured between January 1, 2000 through March 31, 2004

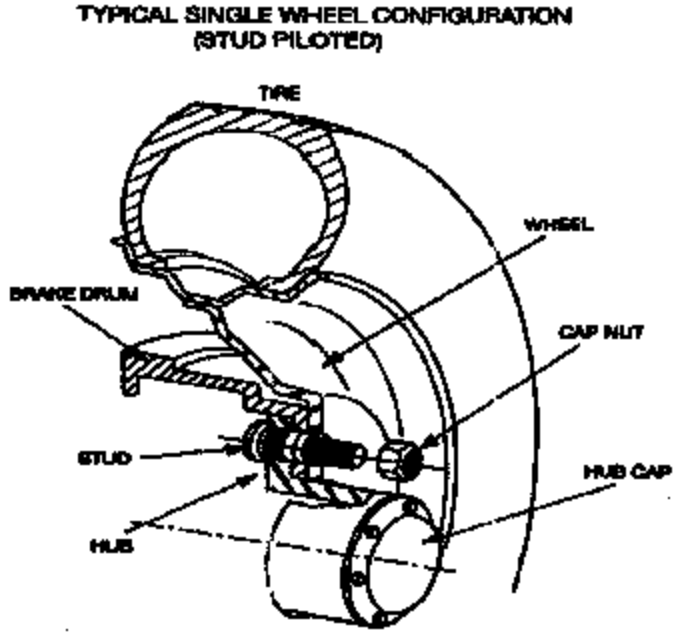
	Vehicle Type		
Number of Wheel Mounting Studs (per wheel)	Fifth Wheel	Travel Trailer	Overall Rate
Six	7836	1935	6604
Eight	342	15000	669
Overall Rate	1709	5581	1952

Source: The incident rates are calculated from the data summarized in the preceding two tables B-1 and B-2.

(4) Description - Wheel Mounting and Retention System

The tire and wheel assembly is mounted and retained to the axle hub by the wheel-mounting nuts installed on the wheel-mounting studs installed in the axle hub. The torque applied to the wheel-mounting nuts provides the clamp that retains the wheel in position securely against the hub mounting face.

During 2000-2004 Jayco installed aluminum wheels on either six or eight wheel-mounting studs. Based on ODI observations, the significant majority (if not all) of the wheels are equipped with tapered (120 degree included angle) wheel-mounting nuts that thread on to the wheel-mounting studs and seat in a hole machined into the aluminum wheel. The holes that are machined in the wheel have a tapered bore intended to center the wheel on the stud circle. (See diagram below.)



Representative Wheel Mounting System

The sketch is provided for general reference purposes. The sketch differs from the specific wheel-mounting system in Jayco vehicles equipped with aluminum wheels in that Jayco installs a tapered wheel-mounting nut that seats into a mating tapered bore in the wheel (rather than the conical nut as depicted) and Jayco installs a non-functional decorative wheel hub cap mounted through the wheel center bore (rather than leaving the functional hub cap exposed as depicted).

(5) Product Changes

Following is a table that summarizes the modifications or changes in the assembly of the wheels that Jayco identified in response to ODI's request.

August, 2002	Purchased new torque equipment for production line
September, 2002	Implemented new visual aids to assist with installation and torque requirements on the production line, revised quality control standards to reflect existing engineering specifications.
September, 2002	Issued new guidance to transportation carrier regarding torquing procedures.
March, 2003	Implemented new torquing procedure to include 3 torque checks during production process.

(6) ODI Investigation

ODI conducted the following investigation activities:

(A) ODI reviewed the preliminary information that Jayco provided on December 10, 2003; the partial information that Jayco provided on May 11, 2004; and the completed information that Jayco provided on June 1, 2004.

(B) ODI and/or VRTC conducted a number of discussions with Jayco representatives and interviewed a number of owners of Jayco vehicles that had experienced a wheel separation. Owner interviews were intended to verify the incident and to obtain further details about the history of vehicle use (mileage, routes, circumstances) including the level of attention to wheel end maintenance that preceded the separation.

In general, these sources indicated that wheel separations in Jayco vehicles frequently occurred relatively early in the vehicle life, typically en route to the selling dealer or within the first 1000 miles of use, that owners often did not experience a change in vehicle handling, and hence were frequently not aware when a wheel had separated from the vehicle.

(C) ODI requested Jayco to inform ODI after becoming aware of any "newly occurring incidents" (whether or not confirmed) within 48 hours so that ODI would have the opportunity to evaluate the components and attempt to identify the factors that may have caused or contributed to the incident. (This time period for this reporting requirement had originally been in effect until March 2005 but has been extended to September 2005.)

Following are summaries of the "newly reported" wheel separation incidents reported by Jayco.

Newly Reported Incidents Reported to ODI by Jayco
between December 2003 (ODI's Initial Inquiry)
and July 2004 (Campaign 04V-364)

ODI Incident Number	Vehicle - VIN	Location	Wheel Type	Vehicle Build Date	Vehicle Purchase Date	Incident Date	Date Reported
1	1UJCJ0 2R731X XXXXX	Shertz, TX	Aluminum 6-lug wheel	8/20/02	10/15/03	Unknown	3/9/04
2	1UJCJ0 2R521X XXXXX	Mitchell, SD	Aluminum 6-lug wheel	11/14/01	4/26/03	6/11/04	6/11/04
3	1UJCJ02 R4Y1XX XXXX	Marne, Maine	Steel 6-lug wheel	3/28/00	4/14/00	6/13/04	6/16/04
4	1UJCJU 2R731X XXXXX	Residence: Lincolnton, NC; inspection at Pigeon Forge, TN	Aluminum 6-lug wheel	8/22/03	9/20/03	7/xx/04	7/xx/04

ODI and/or VRTC inspected incidents No (2) Mitchell, South Dakota, and (3) Pigeon Forge, Tennessee. Jayco representatives were invited and attended both inspections.

"Newly Reported" Incidents Reported to ODI by Jayco since July 2004
(after Jayco filed the NHTSA Defect Notice for Campaign 04V-364)

ODI Incident Number	Vehicle - VIN	Location	Wheel Type	Vehicle Build Date	Vehicle Purchase Date	Incident Date	Date Reported
1	1UJCJ0 2R731X XXXXX	Churchville, MD	Aluminum 6-lug wheel	7/26/02	9/18/02	8/19/04	9/17/04

2	1UJCJ0 2R931X XXXXX	Thorton, TX	Aluminum 6-lug wheel	8/29/02	9/18/02	9/25/04	9/27/04
3	1UJCJ0 2RX31X XXXXX	Burleson, TX	Aluminum 8-lug wheel	12/16/02	8/14/03	10/xx/04	1/12/05
4	1UJCJ0 2R631X XXXXX	Saddlebrooke AX [sic]	Aluminum 8-lug	12/5/02	8/9/04	9/18/04	1/31/05 (*)
5	1UJCJ0 2P731X XXXXX	Springfield, IL	Aluminum 6-lug	8/14/02	5/8/03	approx 8/03 (**)	1/31/05 (*)
6	1UJCJ0 2R031X XXXXX	Cawood, KY	Aluminum 8-lug	12/4/02	5/30/03	6/1/04	3/14/05
7	1UJCJ0 2R051X XXXXX	Olive Branch, MS	Aluminum 8-lug	6/21/04	3/15/05	3/18/05	3/23/05
8	1UJCJ0 2RX41X XXXXX	North Mankato, MN	Aluminum 8-lug	11/19/03	2/18/04	1/25/2005 (Date Reported to Jayco)	3/28/05

Shaded cells identify the five "newly reported" incidents in which vehicles equipped with "eight-lug" aluminum wheels experienced a separation.

(*) On January 4, 2005, ODI noted that Jayco had not provided any reports for approximately three months. ODI inquired whether the absence of reports was due to absence of incidents or a lapse in reporting. On January 31, 2005, Jayco informed ODI that they had researched the issue and discovered two wheel separation incidents (numbered 4 and 5 above) that had occurred during the period in question and had not been reported as requested.

(**) The August, 2003 incident date is based on ODI's interview with the vehicle owner. Jayco's initial report incorrectly stated that this incident occurred on October 1, 2004.

(D) Based on the information obtained through newly reported incidents summarized in (C) above, ODI and/or VRTC [with Jayco representative(s) attending] inspected two vehicles that had experienced recent wheel separations with particular focus on examining the condition of the wheel end retention systems.

The following provides a summary of the inspection findings. Based on these inspections, ODI observed that paint, coatings, and/or other foreign material present in the clamp surface were most likely the principle factors that compromised the clamping capability of the inspected wheel assembly systems.

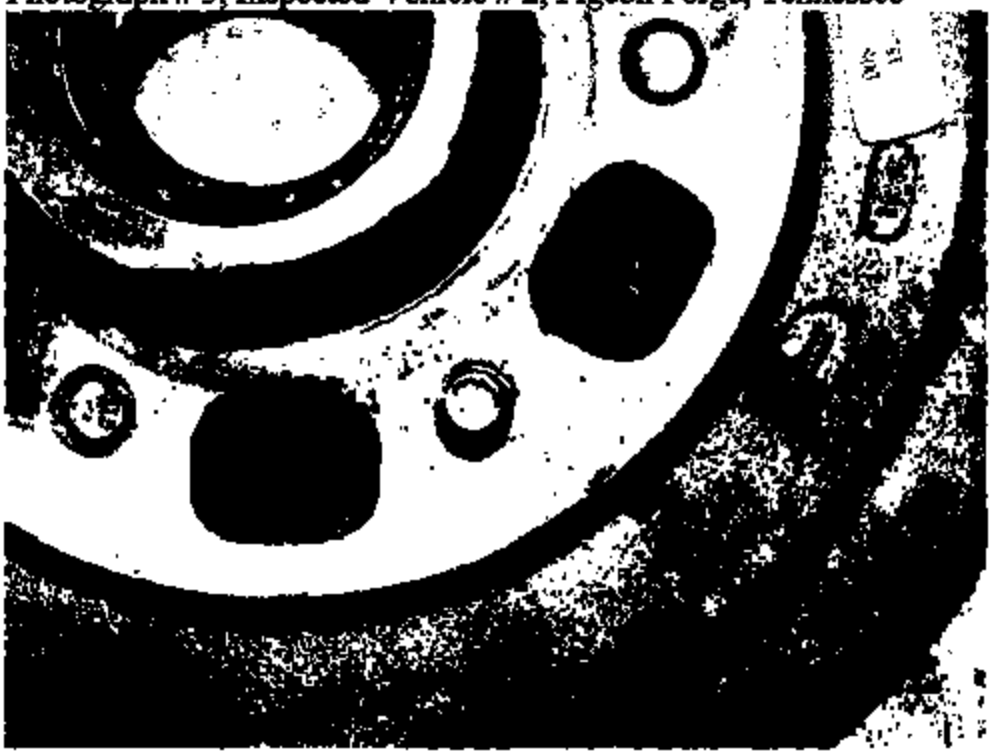
Photograph # 1, Inspected Vehicle # 1, Mitchell, South Dakota

Left forward hub indicating the presence of paint on the mounting face.

Photograph # 2, Inspected Vehicle # 1, Mitchell, South Dakota

Mounting face of the right forward six mounting hole, aluminum wheel indicating paint has transferred from the painted hub mounting face to the unpainted wheel mounting face.

Photograph # 3, Inspected Vehicle # 2, Pigeon Forge, Tennessee



View of driver's side rear hub mounting face. The wheel had separated from this hub. Note one broken stud (at left of photograph) and one intact stud (in center of photograph). Two unbroken studs installed in this hub indicate that the nuts backed off these studs whereas the other four studs had fractured. Bearing grease is evident (center of photograph) in the recess of the hub mounting face proximate to the wheel-mounting studs.

(7) ODI Assessment

ODI's investigation has indicated the following issues:

(A) Based on incidents and incident rates summarized in Section 3 of this report, "Population," a significant 74% majority (58 of 78) of the reported wheel separations have occurred in Jayco vehicles equipped with aluminum wheels.

(B) Based on ODI's inspections of two Jayco vehicles that experienced wheel separations, inspections conducted on wheel ends of vehicles manufactured by peer manufacturers, and general engineering recommended practices, ODI believes that the presence of paints, coatings, grease, and/or other foreign substances in the clamp joint is a significant causal or contributing factor that can reduce the clamp strength of the affected wheel end and cause or contribute to loosening of the wheel-mounting joint.

Diminished clamp can allow the affected wheel to displace circumferentially (loosen) relative to the hub and subject the wheel-mounting studs to bending and shear loads rather than the "pure" tensile loads intended in the "stud piloted" wheel mounting design. Wheel studs that are subjected to stresses that exceed the endurance limit of the stud material will be subjected to cumulative damage with each load application. Since the resultant forces impose reverse bending loads to each stud each time that the affected wheel rotates, the studs will begin to progressively crack, and probably fracture, within a short driving distance.

(C) The overall incident rate of Jayco vehicles equipped with aluminum wheels is approximately 45 times that of Jayco vehicles equipped with steel wheels (See Table A-3 in Section 3, "Population.").

Assuming that Jayco installs aluminum wheels with the same quality and consistency as steel wheels, this data indicates the aluminum wheel retention system is more susceptible to loosening and separation than the steel wheel retention system.

In addition to the above, all eleven of the newly reported incidents since December 2003, have occurred in vehicles equipped with aluminum wheels. (See Section 6, "ODI Investigation for a summary.)

With the exception of a single incident reported in June 2004, pertaining to a 2000 model year vehicle, Jayco has not reported any new incidents of separations of steel wheels since this investigation began in December 2003. ODI has not focused further investigation on Jayco vehicles equipped with steel wheels because there is one known incident reported within the last fifteen months. This incident occurred in a model year 2000 vehicle, four to five years after the vehicle was purchased during which there is a high likelihood that the wheel had been removed for some type of wheel end servicing. Since this is the sole recent separation of a steel wheel, ODI has concluded that there is no trend indicated and negligible risk associated with Jayco vehicles equipped with steel wheels.

(D) The majority of the reported wheel separations have occurred very early in the vehicle life. Based on the initial data that Jayco provided to ODI in December 2003 (Appendix A), a majority (32 of 55 --- 58%) of the separations occurred while in transport to the selling dealer. A number of the other listed incidents occurred within the first approximately 1000 miles of vehicle service.

Various manufacturers of RV and cargo trailers have informed ODI that wheel separations are due to vehicle owners who are inattentive to following the recommended wheel nut retorquing procedures. On May 14, 2004, Jayco responded to ODI's inquiry stating that,

"Testing by on or behalf of Jayco and its suppliers indicates that the primary causal factor for these wheel separations is improper seating of the wheel lugs due to an improperly maintained torque at the recommended checks."

"Jayco provides numerous warnings to trailer owners concerning the importance of proper torque maintenance. Owner manuals accompanying each trailer contain several warnings concerning proper torquing ... The importance of proper torque maintenance on Travel Trailers is also commonly known and understood in the industry."

ODI has interviewed a number of RV owners, including owners of Jayco vehicles and found that the torquing responsibility is not as "commonly known" as suggested by Jayco's response stated above. [For example, ODI's pre-inspection interviews with owners of two vehicles (summaries

provided in Appendix B) do not indicate that these owners were aware of the "commonly known" torquing requirement.]

The wheel separation incident information (Appendix A) does not support the contention that separations are due to inattentive maintenance by the vehicle purchaser since the majority of these incidents occurred while the vehicles were "en route" to the selling dealer before the owners had even taken possession of these vehicles.

(E) Based on the data that Jayco provided to ODI in December 2004 (Appendix A), five vehicles of the 55 listed (9%) exhibited a separation of a second wheel simultaneously or soon after the initial wheel separation.

Although it is not evident in the data reported in Appendix A, ODI has interviewed a number of Jayco owners and owners of peer vehicles, and found that, if a second separation occurs, it occurs to the single wheel supporting the vehicle on the same side of the vehicle as the initial separation. This is because the remaining attached wheel must support all of the weight of the affected side of the vehicle after a wheel separation. Under this overloaded condition, tire failure, loosening of the clamp, stud breakage, and separation of the sole supporting wheel end is likely and vehicle control issues could occur.

ODI is aware of several incidents in which the operator had been traveling at highway speeds and was not aware that a wheel had separated until the second (same side) wheel also separated or the (same side) tire had failed and the owner maneuvered the vehicle — one side of which was without wheel and tire support --- to a stop.

ODI recommends that owners exercise caution when moving a vehicle that has experienced a wheel separation. Owners should limit any operation of a tandem vehicle supported by a single wheel to limited distance emergency towing sufficient to remove the vehicle from the highway so that it does not pose a safety hazard to other vehicles and/or to a location where temporary repairs can be made.

ODI also recommends that following a wheel separation event, all vehicle wheels but especially the wheel from the same (separated wheel) side of the

vehicle be removed, inspected for damage, and, if necessary, replaced.

(F) ODI found that wheels that separated are seldom available for inspection. Separated wheels are frequently lost and never recovered.

Owners frequently reported that they were unaware of any change in vehicle handling after a wheel separated from their vehicle and, therefore, continued the tow the vehicle, one side of which is being supported by a single wheel.

In many cases after an owner became aware of a wheel loss, he made no effort to find the separated wheel. In those cases when an owner attempted to search the general area where the wheel was suspected to have separated, he was not able to find the wheel. In the few instances when the wheels have been recovered, these wheels have frequently been reinstalled in the vehicle.

The broken studs and attached nuts are lost on the roadway and the ends of the broken studs that remain in the hub nuts are usually discarded during the repair servicing.

Due to the difficulty in locating and preserving potentially useful evidence, ODI will continue to request prompt notification for recent wheel separation events for this and similar investigations because it is has proven necessary to take prompt action to locate and preserve the relevant parts so that a meaningful inspection and investigation of a components is possible.

Safety Risk Posed by a Separated Wheel

A wheel end joint that loosens can quickly fracture the wheel-mounting studs and lead to a wheel separation. Wheel separations pose two risks:

(1) A wheel and tire assembly that separates at highway speeds poses a risk of property damage, personal injury, and possibly death to other users of the roadway.

(2) The affected vehicle may lose stability.

(8) Jayco's Actions

On July 20, 2004, Jayco issued a Defect Notice, 04V-364, advising ODI of Jayco's intention to conduct a Product Safety Campaign notifying 742 owners of 2001-2003 model year Jayco "Legacy" and 2002-2003 "Designer" fifth wheel and travel trailer ["towable"] RVs "that will involve [removal of the wheels], an inspection of all wheels, lugs, studs, and mating surfaces; removal of the paint from the mating surfaces of the wheel and hub, [reinstallation of the wheels] and educational instruction provision to all customers."

ODI expressed concern that the Campaign instructions required the owner to perform re-torquing of wheel nuts during the break-in (embedment period) of vehicle use following the Campaign-directed wheel end removal and re-installation. Jayco agreed to report any newly reported wheel end separation incidents to ODI until March 2005 so that the Agency could assess whether the portion of Jayco's repair procedure that asks the owners to perform the final torque checks is effective and/or appropriate.

Jayco also advised ODI that Jayco believes that vehicles equipped with "eight-lug" aluminum wheels do not require corrective action "due to their low incident rate." ODI remains concerned about separations of aluminum wheels mounted with eight wheel-mounting studs because these incidents have occurred and continue to occur at a low, but persistent, rate.

Since Jayco has reported five separations of "eight lug" aluminum wheels that have occurred since July 2004, ODI has decided to open a Recall Query to further monitor and investigate the issue of aluminum wheels mounted with eight wheel-mounting studs in Jayco vehicles.

(9) Conclusion

This investigation is closed.

Jayco has taken action to address one significant factor (paint, coatings, etc.) that has caused or contributed to wheel loosening and/or separations in vehicles equipped with "six lug" aluminum wheels.

ODI remains concerned about (1) the efficacy of Campaign 04V-364 that delegates the final wheel nut checks or re-torquing to the vehicle owner and (2) whether Jayco should be requested to conduct a program to correct vehicles equipped with aluminum wheels mounted with eight wheel-mounting studs since these vehicles have exhibited, and continue to exhibit, a low but persistent number of wheel separations.

In order to address these issues, ODI is initiating a Recall Query (RQ).

G. T. Bowman, Safety Defects Engineer — Date 5/19/05

I Concur:
Chief, Medium & Heavy Duty Truck Division — Date 5/19/05

Director, Office of Defects Investigation — Date 5-19-05

EA04-019
Appendix A
Sheet 1 of 2

Wheel Separation Incident Information provided by Jayco on December 10, 2003

Serial No.	Production Date	Purchase Date	Report Date	Reported Issue	Comments	Number of "Lugs"
11K70061	10/6/2000	10/29/2001	11/28/2001	STUD/NUT	CUSTOMER	6
21K60123	8/23/2001	4/17/2002	7/8/2003	2 WHEEL OFF	CUSTOMER	6
21K60252	1/29/2002	3/23/2002	7/9/2002	WHEEL OFF	CUSTOMER	6
21K60270	1/31/2002	2/21/2002	7/18/2002	WHEEL OFF	CUSTOMER	6
21K60278	3/8/2002	N/A	5/15/2002	WHEEL OFF	TRANSPORT	6
21K60279	4/2/2002	4/8/2002	8/4/2002	WHEEL OFF	CUSTOMER	6
21K60293	3/11/2002	N/A	4/2/2002	STUD/NUT	TRANSPORT	6
21K60303	3/19/2002	5/4/2002	7/29/2003	WHEEL OFF	CUSTOMER	6
21KL0088	3/7/2002	4/2/2002	5/23/2002	WHEEL OFF	CUSTOMER	6
21KM0133	12/11/2001	9/10/2002	6/13/2003	WHEEL OFF	CUSTOMER	6
21KM0138	12/12/2001	N/A	10/10/2002	WHEEL OFF	TRANSPORT	6
21KP0085	10/2/2001	6/12/2002	11/12/2002	WHEEL OFF	CUSTOMER	6
21KS0194	8/29/2002	5/23/2002	3/17/2003	WHEEL OFF	CUSTOMER	6
21KS0111	5/2/2002	6/24/2002	8/23/2002	2 WHEEL OFF	CUSTOMER	6
21KX0057	3/4/2002	N/A	3/11/2002	WHEEL OFF	TRANSPORT	6
21KX0059	6/19/2002	N/A	9/4/2002	WHEEL OFF	TRANSPORT	6
21KX0068	4/30/2002	7/6/2002	7/18/2002	WHEEL OFF	CUSTOMER	6
21KZ0083	2/12/2002	3/13/2002	7/16/2003	WHEEL OFF	CUSTOMER	6
21KZ0087	5/13/2002	N/A	6/17/2002	STUD/NUT	TRANSPORT	6
31K60052	6/28/2002	N/A	7/18/2002	WHEEL OFF	TRANSPORT	6
31K60062	6/24/2002	N/A	6/30/2002	WHEEL OFF	TRANSPORT	6
31K60067	6/25/2002	N/A	7/9/2002	2 WHEEL OFF	TRANSPORT	6
31K60068	6/25/2002	N/A	7/18/2002	STUD/NUT	TRANSPORT	6
31K60070	6/25/2002	8/27/2002	9/18/2002	WHEEL OFF	CUSTOMER	6
31K60071	6/26/2002	N/A	7/19/2002	WHEEL OFF	TRANSPORT	6
31K60072	6/26/2002	N/A	7/11/2002	WHEEL OFF	TRANSPORT	6
31K60073	6/26/2002	N/A	7/20/2002	WHEEL OFF	TRANSPORT	6
31K60074	6/27/2002	N/A	N/A	WHEEL OFF	TRANSPORT	6
31K60084	6/27/2002	N/A	7/25/2002	WHEEL OFF	TRANSPORT	6
31K60118	6/16/2002	N/A	9/13/2002	WHEEL OFF	TRANSPORT	6
31K60137	6/22/2002	N/A	8/29/2002	WHEEL OFF	TRANSPORT	6
31K60299	3/12/2003	3/21/2003	6/16/2003	WHEEL OFF	CUSTOMER	8
31K60300	5/8/2003	5/21/2003	7/28/2003	WHEEL OFF	CUSTOMER	8
31KL0062	6/15/2002	N/A	9/30/2002	WHEEL OFF	TRANSPORT	6

EA04-019
Appendix A
Sheet 2 of 2

Wheel Separation Incident Information provided by Jayco on December 10, 2003

Serial No.	Production Date	Purchase Date	Report Date	Reported Issue	Comments	Number of "Lugs"
31KS0059	1/28/2003	N/A	7/23/2002	WHEEL OFF	TRANSPORT	6
31KS0060	7/22/2002	6/30/2003	8/13/2003	2 WHEEL OFF	CUSTOMER	6
31KS0064	7/22/2002	7/28/2002	9/4/2002	WHEEL OFF	CUSTOMER	6
31KS0069	7/23/2002	8/19/2002	9/9/2002	WHEEL OFF	CUSTOMER	6
31KS0079	8/22/2002	N/A	9/4/2002	WHEEL OFF	TRANSPORT	6
31KS0089	3/20/2003	N/A	9/4/2002	WHEEL OFF	TRANSPORT	6
31KS0194	2/14/2002	N/A	9/5/2002	WHEEL OFF	TRANSPORT	6
31KS0140	12/18/2002	N/A	1/3/2003	WHEEL OFF	TRANSPORT	8
31KT0123	11/8/2002	7/22/2003	9/30/2003	2 WHEEL OFF	CUSTOMER	8
31KX0076	7/12/2002	7/27/2002	9/5/2002	WHEEL OFF	CUSTOMER	6
31KX0080	8/29/2002	N/A	9/18/2002	WHEEL OFF	TRANSPORT	6
31KX0187	3/18/2003	N/A	5/6/2003	WHEEL OFF	TRANSPORT	8
31KZ0051	7/10/2002	N/A	7/23/2002	WHEEL OFF	TRANSPORT	6
31KZ0052	7/15/2002	N/A	8/21/2002	WHEEL OFF	TRANSPORT	6
31KZ0054	7/16/2002	N/A	7/22/2002	WHEEL OFF	TRANSPORT	6
31KZ0055	1/28/2003	N/A	7/19/2002	WHEEL OFF	TRANSPORT	6
31KZ0195	2/12/2003	3/22/2003	4/21/2003	STUD/NUT	CUSTOMER	8
31SF0073	6/28/2002	7/12/2002	7/30/2002	WHEEL OFF	CUSTOMER	6
31SF0199	8/1/2002	N/A	8/5/2002	WHEEL OFF	TRANSPORT	6
41K40062	7/21/2003	N/A	9/2/2003	WHEEL OFF	TRANSPORT	8
41KA0053	11/5/2003	N/A	9/4/2003	WHEEL OFF	TRANSPORT	8

Total: 55

ODI Summary:

Summary of Wheel Separations by "Vehicle Status" and Number of Wheel "Lugs"

Vehicle Status	Six Lug	Eight Lug	Total
In Transport to Selling Dealer	28	4	32
After Purchase by Customer	18	5	23
Total	46	9	55

ODI interview taken 7/2/04 - Jayco VIN 1UJCJ02R731XXXXXX

Chronology

Date	Event
August 22, 2003	Vehicle Build Date
September 20, 2003	Vehicle Purchased Date
June 26, 2004	Wheel Separation (Driver's Side Rear)
June 28, 2004	ODI – NHTSA Notified
July 1, 2004	Owner Contacted ODI requested vehicle inspection – Scheduled for July 7, 2004

Owner	XXXXXX XXXXXX XXXXXX

The vehicle is currently parked at Campsite # 4, Twin Mountain Outdoor Resorts, Creekstone RV Resorts, 304 Day Springs Road, Pigeon Forge, TN 37863 (1-800-848-9097) Website: www.twinmountainoutdoorresort.com

Background - On July 1, 2004 Tom Bowman of ODI contacted and interviewed the vehicle owner, Mr. XXXXXX. Mr. XXXXXX purchased the Jayco fifth wheel RV Model "Designer" in September 2003. In October 2003, the owner towed the vehicle approximately 400 miles round trip to Tennessee and back to NC. In May 2004 (Memorial Day week-end), the owner towed the vehicle approximately 350 miles round trip to Cherokee, NC and back to Lincolnton, NC. The owner towed the vehicle approximately 20 miles to the dealer for warranty maintenance (unrelated to the wheel ends). The owner towed the vehicle approximately 150 miles on the way to Pigeon Forge, TN when he stopped for a rest stop. The owner observed the tires and felt them for temperature (owner did not suspect any

problems, this was just a routine check). Owner completed the remaining approximately 50 miles to the Twin Mountain resort. Owners noticed the missing wheel when he registered at the campground. The vehicle has been moved only to the campsite since the missing wheel was detected.

In response to ODI inquiry, owner states that he does not remember any instructions about torquing the wheel nuts and has never torqued the wheel nuts since purchasing. Note: Tom Bowman specifically asked the owner whether he had tightened any nuts on any of the wheel ends after the separation and the owner said he had not. Bowman asked that the owner to leave the vehicle as is and not to have the separated end repaired or have any of the wheel nuts tightened.

The owner reports that 4 studs had fractured and 2 studs were intact. The owner had removed the hub from the vehicle with the intention of taking it to the dealer to have new studs installed. ODI has asked Jayco to provide a new hub and stud assembly so that ODI/VRTC can obtain the hub and [fractured] stud assembly for analysis. Jayco has promised to ship the parts to Jim Hague at VRTC who will take them with him to Pigeon Forge for the proposed inspection.

The owner plans to leave his current campsite on July 10. Inspection results may require wheel end maintenance (cleaning or clamp interface) and could require replacement of other wheel end components.

GTB 7/2/04

ODI interview taken 6/22/04 - **Jayco VIN 1UJCJ02R521XXXXXX**

Chronology

Date	Event
Nov 14, 2001	Vehicle Build Date
April 26, 2003	Vehicle Purchased Date
June 11, 2004	Wheel Separation
June 15, 2004	ODI – NHTSA Notified
June 21, 2004	Owner Contacted (owner returned ODI phone message) ODI requested vehicle inspection
June 23, 2004	ODI requested June 30 for inspection

Owner	XXXXXX XXXXXX XXXXXX

Background - On June 21, 2004 ODI contacted and interviewed the vehicle owner, Mr. XXXXXX. Mr. XXXXXX purchased the Jayco fifth wheel RV in April 2003. In May 2003, the owner took the vehicle on an approx 700 miles round trip to the Black Hills of South Dakota and an approx 130 miles round trip to Sioux Falls. In June 2004, the vehicle was again taken to the Heart Ranch (a camper club) in the Black Hills. Driver did not feel a vehicle response when the wheel separated, does not know exactly where the separation occurred, and did not recover the separated wheel. The owner stopped for fuel after traveling approx 200 miles on the return trip (from Black Hills to Artesian, S.D.) and observed that the rear driver's side

(*) note that studs were intact and did not fracture indicating that either all of the nuts completely backed-off or the wheel fragmented. The studs have not been replaced and were re-used to mount the replacement wheel.

ODI estimates the accumulated vehicle mileage of 1200 – 1400 miles at the time of the incident (700 miles + 130 miles + 350 miles + 0 to 200 miles).

wheel was gone when re-fueling. Since the rear driver's position studs were intact (*) owner removed one nut from the three intact wheel ends, mounted the spare tire, and drove 2 miles to a "station" where he procured and installed wheel mounting nuts.

The vehicle is equipped with 6-lug aluminum wheels. The owner had never tightened wheel lug nuts claiming that he did not think it would be necessary on a new vehicle. Owner said that the rear driver's side wheel is located near the camper "hook-ups" and, though not intentionally inspecting the wheels for any problems, had not observed any particular reason for concern when "hooking up."

Owner will make vehicle available for ODI inspection. Owner and vehicle are located approximately 65 west of Sioux Falls, S.D. Owner suggested that vehicle could be taken to Jack's Campers (999-2376), approximately 1 mile from his residence, if ODI needs non-portable tools, lifts, etc for the inspection.

GTB
6-22-04

This appendix summarizes ODI's recommendations based on observations made at various manufacturers in the "towables" industry and was first published on November 24, 2004 as an Appendix to EA04-009.

Other Findings: Opportunities for Industry Improvement

Closing report, EA04-019, summarizes the investigation activity that ODI has conducted at Jayco Enterprises. Based on consumer complaints and/or inquiries of manufacturers who have installed wheel end components similar to those installed by Jayco, ODI has initiated formal investigations of peer Recreational Vehicles manufactured by Jayco (EA04-019) and Thor Industries (PE04-051). ODI has also conducted phone interviews with manufacturers and owners of RVs manufactured by other companies, manufacturers and owners of cargo, livestock, and boat trailers. ODI has also made brief visits to assembly plants of two different RV manufacturers.

Based on the information developed from these sources, ODI has observed several practices that appear to be common in the trailer industry and which potentially hinder identifying, understanding, and eliminating (or significantly reducing) the factors that may cause or contribute to wheel end loosening and separation. ODI has summarized the Agency's observations in this Appendix so that manufacturers (in general) can evaluate whether their companies follow these practices and, if so, to encourage these companies to critically evaluate their current practices so that areas for potential improvement can be identified and the indicated improvements implemented.

Based on the investigations conducted to date, the primary contributor to wheel separations in "towable" RVs appears to be the presence of paint, coatings, grease, and/or other foreign substances in the clamp joint. ODI has also found evidence that certain engineering, manufacturing, and/or quality practices may also be a factors that have contributed to wheel separations themselves and/or obscured the detection of factors that contribute to wheel separation.

The following findings are not intended to be descriptions of defects but rather to provide a summary of practices observed in the "towables" industry that may have contributed to (or at least obscured) the wheel separation issue and are suggested as "areas for review and potential improvement" for the "towables" industry.

I - Inadequate and/or improper torquing of the wheel mounting nuts during the various stages of wheel installation and/or wheel nut torquing.

a) Managing the responsibility for the wheel retention system -

Based on ODI's (limited) investigation in the area of design responsibility, ODI has found that RV manufacturers (in general) rely extensively on the individual suppliers of wheel end components (e.g., wheels, axles/hubs, studs and/or nuts) to provide properly performing parts and supporting technical information. ODI believes that the individual suppliers are likely to provide useful technical information and recommendations, but these suppliers may lack information about other components in the wheel end systems and information about the individual vehicle manufacturer's assembly practices. Therefore, ODI believes that it is more appropriate for the vehicle manufacturer, who integrates the individual components and technical recommendations received from various sources into a wheel retention *system*, to be responsible for the performance of the wheel end system since he is able to combine his knowledge of the performance requirements of the application with an understanding of the compatibility, functional dependence, and inter-relationships of the individual components.

b) Extensive trust in the quality and consistency of supplier components -

Through assembly plant visits and various interviews, ODI has noted that the recreational "towables" vehicle industry places a significant amount of trust in the design, quality, and conformance of supplied components. ODI has noted the absence of engineering drawings for these components at several manufacturers. Without drawings, vehicle manufacturers are less likely to be informed of, and able to evaluate, any product changes made to the wheel ends components. Without engineering drawings to provide a reference, vehicle manufacturers are not able to conduct a meaningful inspection of incoming material to verify the conformance of these components' characteristics to the intended specifications.

ODI believes that vehicle manufacturers have a significant responsibility for the performance of the wheel end components after they have been assembled into the vehicle. However, it appears that many manufacturers have not taken proportionate safeguards to assure conformance (for example, at a minimum, requesting a Certification of Conformance) for these components before installing them into vehicles and selling them for operation into service on the public highways

c) Delegating the "break-in" wheel nut torque responsibility to transporter (delivery) contractors -

In a similar vein, ODI notes that many manufacturers require the transporter who delivers the assembled RV to the selling dealer to perform a series of wheel nut torque checks. (At Jayco, the transporter is asked to torque "at miles 10, 25, and 50 or until proper torque has been established.")

ODI believes that the practice of delegating wheel nut torquing to the vehicle transporter exposes the manufacturer to significant risk. Based on ODI's cursory review, the practice is appealing because the break-in mileage (the wheel-hub embedment period) is performed concurrently with the delivery process.

ODI observes that this practice does not generally appear to be a "closed loop" process in that the manufacturer does not monitor, check, or keep records as to when or whether the retorquing is done and/or the quality or consistency of the retorquing, and/or whether any deficiencies and/or anomalies indicative of a need for corrective action are observed. It appears that frequently the transporter is not provided with the appropriate tool (torque wrench) or training before being assigned the retorquing responsibility.

The delegated responsibility is left more-or-less to the individual integrity of the transporter driver who may be easily distracted for any number of reasons (e.g., adverse weather, tight schedule, forgetfulness, lack of interest, etc.) from performing this assignment assiduously.

Through the field inspections of separated and non-separated wheel ends conducted to date, ODI has observed that a "loosened" wheel can damage the wheel and/or hub mounting faces and/or the wheel stud hole. Damage to these components can potentially compromise the quality of the joint and its ability to achieve its intended clamp though subsequent retorquing. Therefore, inattention to torque during the early "break-in" phase of a vehicle's life may compromise the future capability of the joint to maintain its full clamp after the vehicle has been purchased and placed in service.

d) Delegation of "Break-in" Torque to Owners and "Customer to Blame" Paradigm-

As a part of investigation activity, ODI has discussed many of the individual wheel separation incidents with the respective trailer manufacturer. ODI has found that trailer manufacturers commonly believe and inform the affected vehicle owner that the any wheel separation was caused by the owner's negligence or lack of attention to maintenance in failing to torque the wheel nuts (as outlined in the owner's manual) and that the wheel separation is therefore the owner's fault.

The "blame the owner" paradigm may have evolved due to lack of technical sophistication and/or an intentional strategy of "not wishing to be bothered" with a consumer complaint. "Blaming the owner" has obvious appeal because it provides the manufacturer with "plausible deniability" and may (where additional investigation supports this explanation) actually account for some infrequent and/or unusual wheel separation incidents.

ODI is unlikely to accept "blaming the owner" as a satisfactory explanation for a manufacturer whose customers have experienced a significant number of wheel separations. ODI is also concerned that assigning customer negligence as the sole cause for wheel separations is not consistent with the Agency's investigation findings to date.

Wheel separations pose a risk to highway safety and ODI is concerned that manufacturers who "blame the owner" without conducting any further investigation detract from improving highway safety since these manufacturers are failing to conduct a timely and thorough introspective analysis to determine the true cause of the wheel separation and whether design, manufacturing, or other issues may have been equal or greater contributing factors to wheel separation incidents than the vehicle owner.

ODI is also concerned about the "reasonableness" of assigning responsibility for frequent retorquing during the "break-in" period to vehicle owners (who are generally unsophisticated consumers), with no particular training, skills or experience, who are unlikely to have the required tools (e.g., a torque wrench) since the tool(s) are not provided with the vehicle, and who may lack the necessary skills (understanding of the procedure, physical strength, etc.) and/or motivation to perform the physically demanding task of torquing the wheel nuts multiple times on a newly purchased vehicle.

ODI is concerned that the need for frequent retorquing may be masking marginal design, manufacturing, and component choices made by the manufacturer and has had the effect that manufacturers, perhaps unknowingly, are compensating for wheel retention design or manufacturing short-comings by requiring excessive maintenance requirements.

ODI suspects that many owners are unlikely to fully satisfy the wheel nut torquing recommendations (e.g., the recommended frequency) that have been issued. (The majority of owners that ODI interviewed do not own a torque wrench.) Owners who cannot satisfy or exceed the torquing recommendations increase their risk of experiencing a wheel separation. ODI has interviewed a number of owners who appear to have been reasonably knowledgeable and attentive to the delegated retorquing responsibilities and have nonetheless experienced a wheel separation.

e) Non-graduated Torque at Assembly -

ODI has observed wheel ends being assembled in production. Often, a single wheel nut is fully tightened by fully applying the specified torque before another nut has been tightened at all.

To assure concentricity of the wheel when mounted to the hub, stud piloted wheel systems rely on accurate positioning and assembly of the wheel when clamped. Normally, this alignment is achieved by gradually applying increasing, evenly applied torque (to provide uniform clamp across the clamp surface) to the wheel mounting nuts. Increasing levels of torque are normally achieved by applying the torque in graduated steps (e.g., step one: torque to 50 lb-ft; step two, torque to 70 lb-ft; step three, torque to 100 lb-ft, etc.). Normally, increasing torque is applied in a star or crisscross pattern to assure that the clamp is applied uniformly to the joint. Applying full (non-graduated) torque to a single nut in a stud piloted wheel system may result in misalignment of the wheel to the hub, risks that the wheel is not seated properly on the hub, and could compromise the integrity of the wheel clamp.

II - Appropriateness, adequacy, or compatibility of the joint design (appropriate selection, matching, and understanding of limitations associated with the various wheel end components that need to be evaluated so that the system can reliably satisfy its intended function).

a) <u>The use of wheel nut torque values as a proxy for clamp</u> -

ODI is concerned that the RV "towables" industry frequently uses wheel nut torque as a proxy to indicate clamp strength. Wheel nut torque is a means to achieve the desired clamp but the actual clamp is likely to vary substantially depending on the condition of the wheel mounting nut threads, nut face, and/or wheel mounting stud threads.

The wheel-mounting clamp can be influenced by the surface finish, flatness, and contour of the wheel, the surface finish, flatness, and contour of the hub, the absence or presence of coatings, and the physical properties (e.g., elasticity) of the wheel end components. The wheel nut mounting torque cannot be increased beyond the torque that results in the maximum safe working stress (tension) in the stud. It is unlikely that wheel mounting torque maintenance regimens can compensate for inadequate or marginal designs, compromised manufacturing practices, and/or a wheel clamp joint degradation.

Since vehicle manufacturers frequently do not obtain suppliers' drawings, these manufacturers lack the means to specify or verify these component characteristics.

b) The need to frequently re-torque may be indicative of a clamp that is only marginally capable of withstanding its load conditions-

ODI is concerned that the "towables" trailer industry has not established a clear description of the normal and/or extraordinary road load events that the wheel end clamp joint must be capable of withstanding.

Since ODI is not aware of any data that has measured the forces associated with road bumps, braking cycles, cornering, side loading imposed by tight maneuvering, curbing, etc., ODI is concerned that these events may impose loads of sufficient magnitude to loosen tight and apparently well-assembled joints consisting of compatible components, but with marginal or inadequate clamp capability.

c) Characteristics of Aluminum and Steel Wheels -

ODI has also concluded that many aluminum wheels are more susceptible to loss of clamp than steel wheels because the design and material properties of these aluminum wheels make them relatively "inefficient" at "seating" or "embedding" than steel wheels. Steel wheels are generally fabricated (formed) and the mounting holes and hub pilot bore are "pierced and coined" in the wheel, leaving a raised lip at each hole location. The center sections of steel wheels are generally "contoured" to provide rigidity. The raised lips (coined edges) provide a small contact zone that, when clamped, creates high unit pressures capable of penetrating paints and coatings and enabling the steel wheel to achieve a line contact between the wheel and hub when the wheel is clamped.

By contrast, aluminum wheels are generally made of cast material and the mounting holes are drilled through the center section of the wheel. Since aluminum wheels generally (*) lack the protruding surfaces that provide a line contact, the contact zone of the wheel against the hub is spread over a larger contact area making it much more difficult to cut through or extrude paint, coatings, and foreign materials from the clamp area. Aluminum wheels may also lack the "spring-back" characteristics of steel wheels, be more subject to local yielding (such as extrusion or deformation by the forces of the clamped wheel mounting nut), and more subject to expansion and contraction due to thermal excursions associated with frequent or descent braking applications, and the like.

(*) Certain aluminum wheels have been manufactured with a circumferential "step" machined in the mounting face at the location of the mounting holes. These and other design approaches may provide certain designs of aluminum wheels with a higher density contact than available in aluminum wheels with a smooth flat mounting face.

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Trailer Safety Industry Coalition Publishes Recommended Practices For Wheel-Axle Attachments

The newly formed Trailer Safety Industry Coalition, in consultation with the National Highway Traffic Safety Administration, announces the publication of recommended practices, providing guidelines to vendors supplying wheels, axles, and other wheel-assembly components to the trailer industry and to manufacturers of trailers, principally with gross vehicle weight ratings under 26,000 lbs. These recommended practices, by addressing selection, condition, assembling, and application of wheel and axle components, assist in creating and preserving the integrity of the resulting wheel joint. They represent the current state of knowledge of the Coalition participants as to the recommended practices for wheel fastening systems.

The Coalition is comprised of representatives of the National Association of Trailer Manufacturers (NATM), the Recreation Vehicle Industry Association (RVIA), the National Marine Manufacturers Association (NMMA), the National Truck Equipment Association (NTEA), and a broad range of steel wheel, aluminum wheel, axle, and trailer manufacturers.

The recommended practices document is the byproduct of a unique, on-going government-industry effort to elevate public and industry understanding of important issues surrounding safe wheel assemblies. According to Co-Chair Jack Klepinger, "by promoting observation of these practices, the Coalition is working to achieve and maintain acceptable levels of torque and clamp on wheel fasteners within the trailer industry."

For a free copy of these recommended practices, click on www.natm.com, www.rvia.org, or www.ntea.com. If you would like to participate on the voluntary Trailer Safety Industry Coalition, please contact NATM, RVIA, NMMA, or NTEA.

TRAILER SAFETY INDUSTRY COALITION

December 20, 2004

To: All Manufacturers of Trailers Under 26,000 lbs. GVWR and Suppliers of Wheels, Wheel Assemblies, and Components

Re: Recommended Industry Practices for Wheel Mounting and Application

Dear Industry Colleagues:

The trailer industry has noted an increase in recent years in warranty claims for wheel separation incidents. These incidents involve both aluminum and steel wheels on a variety of trailer types. The Trailer Safety Industry Coalition (TSIC) has determined this is an important issue, potentially affecting customer satisfaction, manufacturer's liability, and the industry's image and reputation. The federal government, specifically, the U.S. DOT's National Highway Traffic Safety Administration (NHTSA), has launched on-going investigations into these incidents.

In a cooperative response, leaders of the trailer industry and its trade groups, the National Association of Trailer Manufacturers (NATM), the Recreation Vehicle Industry Association (RVIA), the National Marine Manufacturers Association (NMMA), the National Truck Equipment Association (NTEA), and major wheel, axle, and trailer manufacturers have come together to form a coalition, the "TSIC." TSIC's purpose is to conduct the industry's own investigation into wheel-attachment technology and wheel-separation issues affecting trailers under 26,000 lbs. GVWR and to interact proactively with NHTSA. TSIC's long-term goal is the development of a series of recommended actions, communicating these throughout the industry, to eliminate or significantly reduce incidents of torque loss and wheel separation.

The enclosed list of "recommended practices" represents the product of TSIC's initial efforts. Aimed at vendors of components for the wheel assembly and at manufacturers of trailers and their transporters and dealers, they are recommended guidelines for the assembly of the fastening systems for aluminum and steel wheels. Developed by TSIC's Technical Committee, approved by TSIC, and tweaked following meetings with NHTSA, they present the state of knowledge when published. Early next year (2005), TSIC plans to initiate a testing program to learn more about the forces of clamping and torque and the effects of paint, lubricants, and varying road conditions on those forces, short term and long term.

Because NHTSA preliminarily has identified such elements as inadequate torque, improper torquing, excessive paint, and poorly engineered wheel assembly systems as potential contributing factors in wheel separations, TSIC has made as its immediate priority the preparation of its consensus-based "recommended practices" to address these suspected problem areas. TSIC strongly recommends that, whether supplier, trailer manufacturer, or dealer, you, as your own immediate priority, should compare your processes and practices with these lists of "do's" and "don'ts" and institute appropriate corrections to conform to these guidelines. If you have questions about this activity, please contact the TSIC (Jack Klepinger (Wells Cargo) and Bruce Hopkins (RVIA), co-chairs) or one of your industry associations, such as NATM, RVIA, NMMA, or NTEA for additional input. If there are technical questions, we will direct you to an appropriate source for assistance.

If you are a trailer manufacturer, these "recommended practices," particularly as they relate to torque and paint, should be communicated directly and clearly to your plant staff and upstream to your transporters and dealers and downstream to your component manufacturers and distributors. NHTSA staff has stated that NHTSA intends to pursue any company about whom it receives even one consumer report of a wheel separation.

Sincerely,

Trailer Safety Industry Coalition

_____
Jack Klepinger, Co-Chair

_____
Bruce Hopkins, Co-Chair

TRAILER SAFETY INDUSTRY COALITION RECOMMENDED PRACTICES:* WHEEL MOUNTING AND APPLICATION FOR TRAILER USE

The following "recommended practices"* have been prepared as guidelines by a technical committee composed of representatives from the National Association of Trailer Manufacturers, (NATM), the Recreation Vehicle Industry Association (RVIA), the National Marine Manufacturers Association (NMMA), the National Truck Equipment Association (NTEA), and a range of steel wheel, aluminum wheel, axle and trailer manufacturers. The Trailer Safety Industry Coalition (TSIC) has tasked this Technical Committee to conduct an investigation into the engineering of the fastening systems for road wheels on trailers and to develop a "recommended practices" document for the assembly of the fastening systems. The Technical Committee provides the guidelines below to communicate these recommended practices for wheel fastening systems. By promoting observation of these practices, the Technical Committee expects to reduce the rate of claims for torque loss on wheel fasteners and the number of wheel separation incidents within the trailer industry.

I. Component Guidelines

1. Surfaces of contact on an aluminum wheel (the nut seat and the mounting surface) must be free of paint, contamination and damage. Smooth, clean surfaces provide the most uniform clamping pressure and best retain torque.
2. Surfaces of contact on a steel wheel (the nut seat and the mounting surface) must be free of excessive paint, contamination and damage. Smooth, clean surfaces provide the most uniform clamping pressure and best retain torque.
3. Surfaces of contact on the axle (the flat hub surface and the threaded studs) must be free of excessive paint, oils, grease, contamination and physical damage.
4. Lug nut geometry must match that of the wheel nut seat. The threads and nut seat must be free of paint, oils, grease and other contamination.
5. Stud length must be sufficient that, after mounting the wheel to the hub, the lug nut is engaged to a depth at least equivalent to the diameter of the stud. For example, a lug nut threaded on a ½ inch diameter stud should thread on for a depth of at least ½ inch.

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* These recommended practices represent the state of knowledge when published and may be amended as additional information becomes available.

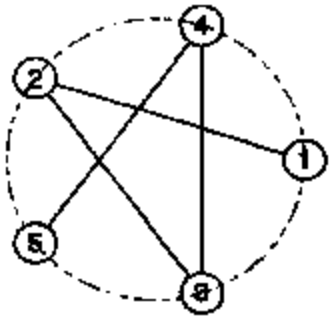
II. Assembly Guidelines

Assembly of the wheel onto the hub is a critical, safety-related process. The proper method of assembly and the consistency of the torque applied to wheel fasteners are important factors in ensuring reliability of the fastening system and retention of the wheel to the trailer. The trailer manufacturer, distributor/dealer, and end user must consistently follow proper torquing technique in order to ensure the hub and wheel are properly seated and use caution to prevent anything from interfering with the flat, full designed mating contact of wheel mounting surface and hub. Excess paint, oil, and grease must be removed from the fastener contact surfaces (the mounting surfaces, studs, and lugs) or not applied at all. Adherence to the recommended "do's" and "don'ts" set out below will minimize the likelihood of fastener torque-loss and wheel-separation.

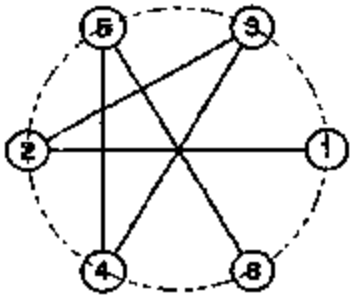
DO'S:

- Obtain confirmation from each component manufacturer that its component/s is/are appropriate for the application, meets the appropriate component guidelines and is/are compatible with the other components in the wheel system
- Develop and distribute a list or manual of proper assembly and torquing procedures consistent with these guidelines and specific technical information provided by component manufacturers
- Train appropriate personnel (factory and field) in proper assembly and torquing procedures
- Insist on consistent, strict adherence to these assembling and torquing procedures
- Conduct and document regular audits or checks to verify compliance with assembly and torquing procedures
- Investigate and correct any obstruction at the center bore of a wheel, resulting from a poor fit between the ornamental cap and the wheel
- Remove all oil and grease from threaded fasteners (studs and lugs)
- Mask or shield (cover) all fastener contact surfaces (mounting surfaces and studs) before painting axles, whether for improved cosmetics or for corrosion protection

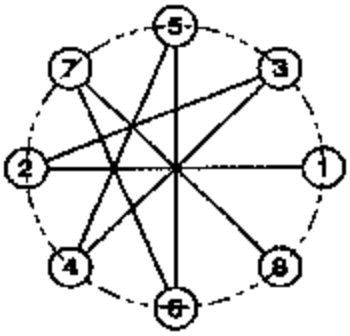
Only use an impact wrench with torque stick as a tool initially to lightly secure the wheel, applying a criss-cross or star pattern (see diagram below)



5 LUG BOLT PATTERN



6 LUG BOLT PATTERN



8 LUG BOLT PATTERN

- Use a calibrated torque wrench to complete the torque fastening process, applying the same criss-cross or star pattern
- Retorque periodically during the trailer's initial towing and thereafter in accordance with the component suppliers' recommendations
- Maintain records of the maintenance and torque checks performed by transporters, noting any loss of torque or any corrective measures taken
- Investigate any customer claim involving wheel loss

DON'TS:

- **DON'T** deviate from the component manufacturers' recommendations regarding compatible components without a competent engineering review
- **DON'T** substitute any component for the components the suppliers have specified without a competent engineering review
- **DON'T** deviate from the component suppliers' fastener torque specifications, where provided, without a competent engineering review
- **DON'T** use adhesive products to maintain fastener tension
- **DON'T** use lubricants or oils on threaded fasteners (studs or lugs) to make applying the torque easier unless assembly specifications require it
- **DON'T** apply any additional paint on fastener contact surfaces (mounting surfaces/hub faces or studs)

III. Important Note and Disclaimer

The design, manufacture, assembly, and maintenance of running gear, wheels, and fastener hardware must be performed under controlled conditions and as part of a system of quality control practices. This system works best when there is constant communication and flow of information between and among component manufacturers, their distributors, trailer manufacturers, transporters, dealers, and end users.

The Trailer Safety Industry Coalition (TSIC) has produced these "recommended practices" as voluntary guidelines to clarify and assist in the proper selection, preparation, assembly, and maintenance of components for steel and aluminum wheel assemblies. These Guidelines do not purport to state that any particular type of component or product should be used in any specific application or that any particular practice, procedure, or methods will not achieve as good or better results, depending upon the particular circumstances involved. The user of these Guidelines, whether manufacturer, distributor, or assembler of these products, has the responsibility to select the proper components for the application intended, perform appropriate process controls, and exercise sound management oversight within its respective operations. The TSIC and its respective members expressly disclaim any responsibility for any specific result relating to the use of these Guidelines, for any errors or omissions contained therein, and for any liability for any loss or damage arising out of their use. Those using the Guidelines agree, as a condition of their use, to release the TSIC and its respective members from any and all liability, claims, losses, or damages of any kind or nature arising out of or relating in any way to their use.

The TSIC expressly reserves the right, in its sole discretion, to update, revise, amend, and otherwise modify these Guidelines from time to time as it sees fit and to do so without furnishing specific notice, or the revised edition itself, to prior recipients of the Guidelines.