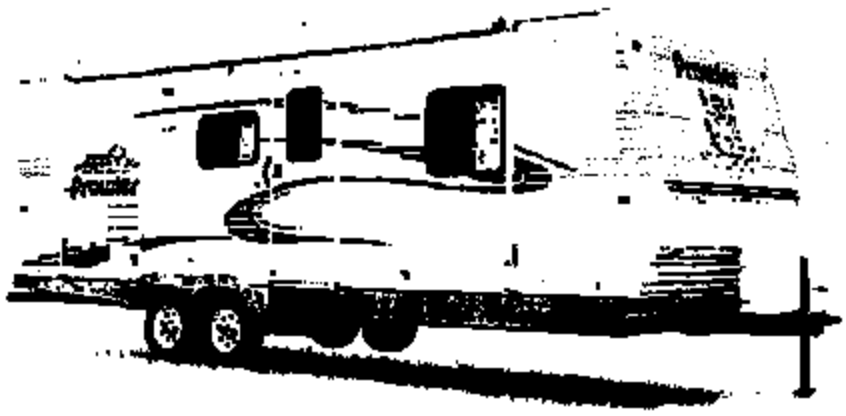
EA04-009 Closing Report

Wheel Separations in Model Year 2002 -2004 Fleetwood 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 Fleetwood Enterprises ("Fleetwood") beginning with model year 2002 through model year 2004. The following photographs depict representative vehicles.



Fleetwood Model "Prowler" Source: Fleetwood Enterprise Website

Fleetwood Model "Pride" Source: Fleetwood Enterprise 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. Fleetwood has advised ODI that vehicle models that end with a "5" indicate a fifth wheel mount.
Travel trailers	Trailers designed to connect to a towing vehicle through a ball stud mounted to a rear mounted trailer hitch. Fleetwood has advised ODI that vehicle models that end with a "0" or a "2" indicate a ball stud hitch mount.
Lug Nuts	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.

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

(2) Background

On September 10, 2003, a consumer filed a Vehicle Owner's Questionnaire (VOQ 10039701) reporting that the right rear wheel had separated from his recently purchased 2004 model year Fleetwood Prowler Fifth Wheel Recreational Vehicle ("RV") Trailer. The owner reported that he had received a notification from Fleetwood and was uncertain about the torque values that he was supposed to use when torquing (*) the wheel mounting nuts.

During the week of October 6, 2003 ODI contacted Fleetwood to discuss the reported incident. In response to ODI's inquiry, Fleetwood representatives reviewed their records and indicated that they were aware of more than 50 wheel separation incidents that had occurred within the last year or two. Fleetwood also informed ODI that Fleetwood had discovered that their wheel supplier had conveyed incorrect values for wheel mounting nut torque to Fleetwood and that Fleetwood had installed wheels using these incorrect values. Fleetwood revised the torque values published in the Fleetwood Owner's Manual instructions and attempted to notify the affected owners of the changes in May 2003.

(*) The Fleetwood Owner's Manual Section titled "On the Road" (page 04-18 and 04-19) states, "It is critical that the wheels be properly torqued during the first 25 to 50 miles of road operation. Although the wheels have been properly torqued before leaving the manufacturing plant, settling and wearing in of components during the first few miles of operation may cause some loosening of the wheel nuts."

Fleetwood's Owner's Manual Supplement (undated) states that, "Before each trip, be sure to check and tighten the wheel lug nuts if necessary to the specified torque. If a wheel has been removed or replaced check the torque again at 10, 25, and 50 miles.

ODI discusses Fleetwood's specified torquing requirements in Appendix C, "Other Findings – Opportunities for Improvement" in this report.

Following the initial discussions with ODI, Fleetwood filed a Defect Notice (03V-437) on October 29, 2003. This notice advised owners that, "certain 2002 and 2003 Pride and Triumph conventional and fifth wheel travel trailers and 2004 model year Pride, Triumph, Prowler, Wilderness, Terry, Mallard, and Pioneer conventional and fifth wheel travel trailers may not have had the proper wheel lug torque applied for the optional 'Aluminum Wheel' before leaving the manufacturing plant. Additionally, the owner's manual may not contain the correct torque requirements for the 'Aluminum Wheels'..." The notice also reminded owners of aluminum wheel-equipped vehicles of the importance checking the wheel mounting nut torque.

On November 21, 2003, ODI initiated Recall Query (RQ03-009) to evaluate the timeliness, appropriateness, and technical issues associated with Campaign 03V-047.

On November 25, 2003, ODI requested information from Fleetwood. Fleetwood provided the requested information to ODI on February 23, 2004. In the response, Fleetwood stated that, "we [Fleetwood] have...concluded that the initial torque applied at the manufacturing facilities...was not a primary cause of the wheel separations...rather... the nature and characteristics of aluminum versus steel, what is typically referred to as gasket creep, embedment relaxation, vibrations loosening, and numerous other variables...[are the significant contributing factors]."

In April 2004, ODI inspected the wheel end equipment installed in three Fleetwood vehicles that had recently experienced wheel separations. These inspections consisted of removing each of the four wheels installed on the vehicle and inspecting the condition of wheel, hub, wheel mounting studs and wheel mounting nuts with particular focus on determining the condition of the wheel and hub mounting surfaces.

ODI notified Fleetwood of the first inspection that ODI conducted on April 7, 2004, but Fleetwood did not sent representatives to this inspection. Fleetwood representatives participated in the inspections conducted on April 13 and April 29, 2004. The inspection findings are summarized in Section 6, "ODI Investigation," of this report.

On June 30, 2004, Fleetwood issued Recall Notice 04V-310 advising ODI that Fleetwood would contact 3,426 owners of 2002-2004 "towable" Fleetwood RVs and offer to have the Fleetwood dealer remove the wheels, inspect the condition of the wheel end components, clean the hub, wheel, wheel mounting studs and wheel mounting nut mounting surfaces, re-install wheels and inform (train) the owners regarding the proper procedures for checking (torquing) the wheel end nuts and the importance of following these procedures.

Following is a summary of the significant investigation activities:

Date	Activity
04-05/03	Fleetwood issues a Bulletin to Owners advising them that the Owner's Manual does not contain correct wheel lug nut torque information.
09/10/03	Complaint VOQ 10039701 is received at NHTSA.
10/03	ODI makes an inquiry at Fleetwood regarding VOQ 10039701 and the associated Owner Notices that Fleetwood issued in April-May, 2003.
10/29/03	Fleetwood files Defect Report 03V-437.
11/21/03	ODI initiates Recall Query (RQ03-009).
11/25/03	ODI sends an Information Request to Fleetwood.
2/23/04	Fleetwood provides the requested information to ODI.
4/7/04	ODI and VRTC inspect VIN 4CB1G322042XXXXXX (Columbia, Ga.).
4/13/04	ODI and VRTC inspect VIN 1EC5F362244XXXXXX (Crawfordsville, Ind.).
4/29/04	ODI and VRTC inspect VIN 4CA5L362842XXXXXX (Pine Mountain, Ga.).
5/5/04	Fleetwood visits ODI (VRTC connected by video conference).
5/20/04	Fleetwood conducts video conference with ODI and VTRC.
6/30/04	Fleetwood files Defect Notice 04V-310.

(3) Population

On February 23, 2004, Fleetwood provided production information to ODI indicating that Fleetwood had manufactured approximately 140,000 "towable" Recreational Vehicles during calendar years 2000-2003.

Of these vehicles, 3,426 vehicles (approximately 2 - 3%) were equipped with aluminum wheels and the remaining (approximately 97 - 98%) vehicles were equipped with steel wheels.

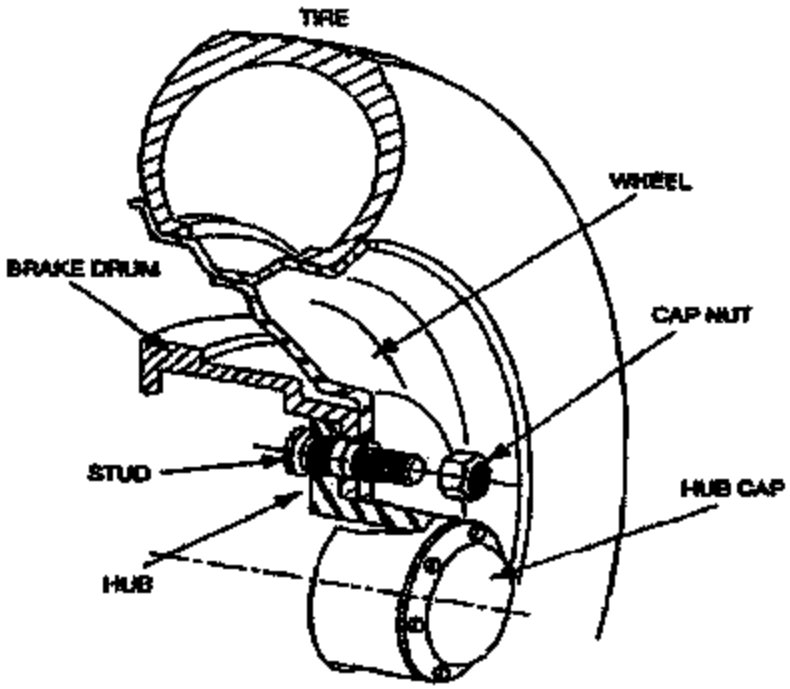
ODI focused the investigation on the vehicles equipped with aluminum wheels because Fleetwood reported 64 incidents affecting the 3426 vehicles equipped with aluminum wheels. By contrast, Fleetwood informed ODI that wheel separation incidents occurred in vehicles equipped with steel wheels "only once or twice a year."

(4) Description - Wheel Mounting and Retention System

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

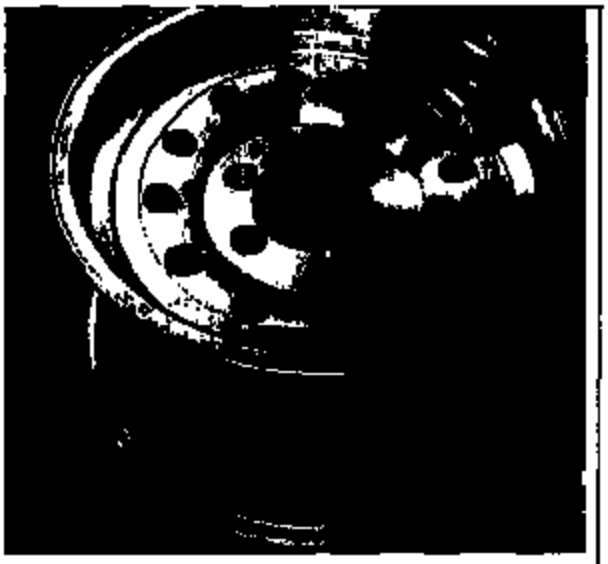
Fleetwood installs wheels equipped with 5, 6, or 8 wheel mounting nuts. The significant majority (if not all) of the wheels are equipped with tapered wheel mounting nuts that thread on to the wheel mounting studs and seat in a hole machined into the aluminum wheel. The holes that are machined in the wheel have a tapered bore intended to center the wheel on the stud circle. (See photos below.)

TYPICAL SINGLE WHEEL CONFIGURATION
(STUD PILOTED)



Representative Wheel Mounting System

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



Representative Aluminum Wheel

Representative Wheel Mounting Nut

Source: Samples that Fleetwood provided to ODI.

(5) Product Changes

Wheel End Components -

Steel Wheel Assemblies-

> In response to ODI's request for information (Request # 16) for an engineering drawing depicting a representative wheel end assembly that incorporates a steel wheel, Fleetwood advised ODI that "Fleetwood does not create nor maintain wheel end assembly drawings for these supplier equipped components."

Aluminum Wheel Assemblies-

> In response to ODI's request for information (Request # 20) for an engineering drawing depicting a representative wheel end assembly that incorporates an aluminum wheel, Fleetwood advised ODI that, "Fleetwood does not create or maintain supplier wheel end assembly drawings incorporating aluminum wheels."

Based on the above responses, it appears that Fleetwood is not likely to be aware of design, material, dimensional, or other changes made to individual wheel end components unless the changes are visually evident or the

respective supplier specifically informs Fleetwood when such changes have been made to the product.

Torque Specifications and Methods-

Steel Wheels –

In response to ODI's inquiry regarding wheel mounting and wheel nut torque procedures for steel wheels (Request No. 18), Fleetwood advised ODI that, "the steel wheel mounting and wheel nut torque procedures are updated as needed. No significant change has occurred with steel wheels."

ODI has summarized the wheel installation and torquing procedures in Appendix C.

(6) ODI Investigation

ODI conducted the following investigation activities:

(1) ODI reviewed Fleetwood's response to ODI's November 25, 2003, Information Request and conducted numerous discussions with Fleetwood representatives during the course of this investigation.

In response to ODI's request in January 2004, Fleetwood provided a list of 64 incidents of wheel separations. Of the 64 wheel separation incidents, two of the reported separations allegedly caused property damage. There are no known fatalities or personal injuries associated with any of the reported wheel separation incidents. See Appendix A for a summary of the reported incidents.

After providing the incident information to ODI in January 2004, Fleetwood conducted some additional search activity to identify any previously reported incidents that had been overlooked in preparing the January 2004 summary. Fleetwood has advised ODI that they had found some additional reports of wheel separations through this effort, but ODI did not request Fleetwood to update the summary with these additional reports since the already developed information was sufficient to justify the need for corrective action.

(2) ODI conducted phone interviews through the course of this investigation (from October 2003 through July 2004) with:

(A) Fleetwood Enterprises;
(B) Dexter Axle, a principle axle supplier to Fleetwood;
(C) Tredit Wheel, a principle tire and aluminum wheel supplier to Fleetwood;
(D) Carlisle Wheel, a supplier of steel wheels;
(E) Enkei Wheel, the principle supplier of aluminum wheels to Tredit;
(F) Various peer manufacturers of "towable" recreational vehicles including Jayco RV, Sunnybrook RV, Forest River Industries, Thor Industries, Holiday Rambler, etc. and
(G) Owners of Fleetwood vehicles who had experienced wheel separation events.

In general, these interviews indicated that wheel separations had occurred elsewhere in the industry and appeared to be predominately associated with vehicles that had been equipped with aluminum wheels. The incidents frequently occurred relatively early in the vehicle life, typically within the first 1000 miles of use.

(3) ODI conducted inspections of three Fleetwood vehicles that had recently experienced a wheel separation.

In order to better understand the failure mode and contributing factors, ODI had requested Fleetwood to notify ODI promptly after learning of any new wheel separation incidents. In response to these notifications, ODI interviewed owners and made arrangements to inspect three Fleetwood vehicles that had recently experienced a wheel separation.

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 the principle factors that compromised the clamping capability of the wheel assembly system. (ODI has identified other potentially contributing factors that are summarized in Appendix C.)

Inspected Vehicle # 1

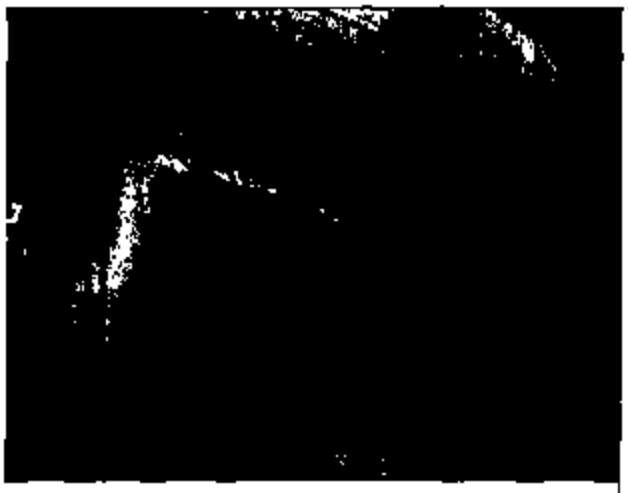
Representative wheel hub indicating black paint found on the hub face where the wheel is clamped. The paint that had been applied in the area around each stud was transferred to the wheel when the wheel was removed.

Mounting face of a representative aluminum wheel indicating that the black paint originally applied to the wheel hub had transferred to the mounting face of the wheel when the wheel was removed.

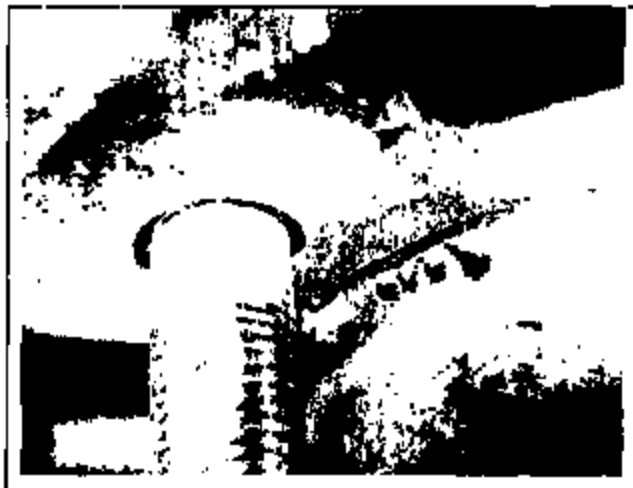
Debris found in the cavity of the hub mounting face. This material appears to be paint that has extruded from the clamp faces between the wheel and hub during clamp and/or when the joint was subjected to service loads.

Unidentified material found in the tapered mounting hole of the aluminum wheel. The material is most likely a coating material intended to coat the front face of the wheel but inadvertently applied to the mounting bore of the wheel.

Inspected Vehicle # 2

	
Representative wheel exhibiting paint that has transferred from the painted hub to the wheel's clamp surface.	Grease found on the center bore area of the wheel on, or proximate to, the clamp face of the wheel.

Inspected Vehicle # 3

	
The paint applied to the hub mounting face of the separated wheel appears to have been extruded by the wheel clamp forces and/or the forces encountered during road use (e.g., imposed by braking, cornering, road loads, curbing, etc.).	One of the wheel ends inspected indicated that grease had been in, or proximate to, the wheel to hub clamp joint. The most likely source of the grease was migration of wheel grease from the hub cap pressed onto the end of the wheel hub.

ODI has maintained a complete set of inspection photographs and notes in the ODI investigation file.

(7) ODI Assessment

ODI's investigation has indicated that the wheel end clamp in Fleetwood vehicles has experienced a significant reduction in clamp strength due to the presence of paints, coatings, grease, and/or other foreign substances etc. in the clamp joint that caused or contributed to loosening of the joint.

The diminished clamp allowed the affected wheel to displace circumferentially (loosen) relative to the hub and subjected the wheel mounting studs to bending and shear loads rather than the "pure" tensile loads intended in the 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.

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.

Many Fleetwood owners that ODI interviewed had experienced a wheel separation at highway speeds. Fleetwood provided information to ODI that alleged that two wheel separation incidents resulted in property damage to other vehicles. These incidents provide supporting evidence that separated wheels are uncontrollable and can potentially pose a hazard to other users of the roadway.

(2) The affected vehicle may lose stability.

Frequently owners have reported that they were unaware of any change in vehicle handling after a wheel had separated from their vehicle. The loss of a single wheel in a tandem axle vehicle may not immediately cause a loss of vehicle stability. However, after a wheel separation, the remaining attached wheel must support all of the weight of the affected side of the vehicle. Under this overloaded condition, loosening of the clamp, stud breakage, and separation of the sole supporting wheel end is likely and vehicle control could be seriously threatened. The post-separation overload condition also overloads the supporting tire and risks a tire "failure" which can also threaten vehicle control.

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.

Characteristics of Separations

1 - A significant majority of wheel separations that have occurred in Fleetwood vehicles occurred in vehicles equipped with aluminum wheels. Fleetwood procured these aluminum wheels from two separate suppliers: "Tredit" and "Continental Imports."

Based on the summary provided by Fleetwood in January 2004, 45 wheel separations had occurred on vehicles equipped with aluminum wheels supplied by Continental Import and 19 separations had occurred on vehicles equipped with aluminum wheels supplied by Tredit.

2- Wheel separations have occurred very early in the vehicle life, usually within the first (approximately) 1000 miles of service. Many separations occurred while the vehicle was being delivered from the Fleetwood assembly plant to the selling dealer prior to purchase by the original owner.

3- Paint, coatings, and/or foreign material were found in the wheel-hub clamp joint all three of the inspected vehicles.

4 - Wheels that have separated are seldom available for inspection. Separated wheels are frequently lost and never recovered. When recovered, the separated wheels are frequently reinstalled in the vehicle and the broken studs and nuts are frequently discarded during the repair servicing.

To investigate a wheel separation, it is has proven necessary to take prompt action to quarantine the relevant parts. The opportunity and/or quality of inspection activity is likely to be compromised by delays.

(8) Fleetwood's Actions

On June 30, 2004, Fleetwood issued Recall Notice 04V-310 advising ODI of Fleetwood's intention to conduct a Product Safety Campaign notifying 3,426 owners of 2002-2004 "towable" Fleetwood RVs to have the Fleetwood dealer remove the wheels, inspect the condition of the wheel end components, clean the hub and wheel mounting faces, wheel mounting studs and wheel mounting nut mounting surfaces, re-install the wheels, and advise the owners of the proper procedures for checking (torquing) the wheel end nuts and the importance of following these torquing procedures.

ODI expressed concern to Fleetwood that the Campaign instructions require the owner to perform the re-torquing of wheel nuts during the break-in period (at intervals of 10, 25 and 50 miles) subsequent to the wheel end inspection (and repairs, if any, performed to correct any deficiencies found through the inspection). In response, Fleetwood promised to notify ODI of any occurrences of wheel separations that occur in a vehicle repaired under Campaign 04V-310 so that the Agency can assess whether asking the vehicle owner to perform the torquing procedures is effective and/or appropriate.

On November 16, 2004, Fleetwood notified ODI that a vehicle (2004 Prowler Regal AX6, VIN 1EC1F302041XXXXXX) that had been serviced at a Fleetwood dealer in accordance with Campaign 04V-310 had experienced a wheel separation during the 50-mile trip from the servicing dealer to the owner's home. Fleetwood advised ODI that their investigation had determined that the Campaign actions (cleaning and inspecting the wheel end components, installing the wheel and torquing the wheel mounting nuts, and providing instructions to the vehicle owner about the importance of re-torquing) had not been performed as outlined in the Campaign. Allegedly, the owner traveled along a freeway route and had little opportunity to perform the wheel mounting nut re-torquing at the recommended 10, 25, and 50- mile intervals.

ODI maintains that vehicle manufacturer's recommendations that request/require owners to inspect the wheel ends of their vehicles, and to retorque the wheel nuts, is consistent with prudent maintenance practices. However, ODI continues to be concerned that vehicle manufacturers have come to rely on these maintenance requests/ requirements to compensate for shortfalls in component compatibility and/or the appropriate assembly quality of the wheel end components.

ODI remains concerned about the efficacy of the repair and will be vigilant regarding any future "remedy failures." ODI has cautioned Fleetwood to closely monitor and manage future Campaign repairs so that no additional wheel separations occur in campaigned vehicles.

(9) Conclusion

This investigation is closed.

Fleetwood has taken a responsive action to address a significant factor (paint, coatings, etc.) that has caused or contributed to wheel loosening and separations.

On September 15, 2004, ODI outlined the Agency's concerns regarding wheel separations to representatives of the Recreational Vehicle Industry Association (RVIA), the National Association of Trailer Manufacturers (NATM), and the National Marine Manufacturers Association (NMMA). ODI disseminated information that was intended to create a general awareness of the wheel separation issue among all trailer manufacturers and to prompt an industry assessment and response to address any factors that may contribute to wheel separations.

G. T. Bowman, Safety Defects Engineer — Date: 11/22/04

I Concur:

Chief, Medium & Heavy Duty Truck Division — Date: 11/23/04

R Boyd for Kathy Dellefer

Director, Office of Defects Investigation — Date: 11/24/04

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List of Aluminum Wheel Separation Incidents
Reported by Fleetwood on January 23, 2004

Vehicle Model	Model Year	Mfg Date	Date Reported	Model	Wheel Make
Pride	03	6/12/2002	7/17/2002	36 5L	Import
Pride	03	6/18/2002	9/3/2002	31 5G	Import
Triumph	03	6/14/2002	9/16/2002	31 5G	Import
Triumph	03	05/29/02	9/24/2002	36 5L	Import
Pride	02	04/24/02	10/15/2002	36 5L	Import
Triumph	03	04/28/02	11/15/2002	36 5L	Import
Advantage AX6	04	11/15/03	11/17/2003	365FL	Import
Triumph	04	11/19/02	11/21/2002	33 5Z	Import
Pride	04	11/14/02	12/2/2002	36 5L	Import
Triumph	04	11/19/02	12/3/2002	33 5Z	Import
Pride	04	11/07/02	12/5/2002	31 5G	Import
Triumph	02	04/24/02	12/18/2002	36 5L	Import
Pride	03	09/05/02	12/30/2002	36 5L	Import
Quantum AX6	04	01/29/03	2/17/2003	36 5F	Import
Pride	04	2/25/03	3/6/2003	335Z	Import
Pride	04	10/28/02	3/11/2003	365L	Import
Pride	04	11/20/2002	3/21/2003	32 G	Import
Pride	04	1/9/2003	3/24/2003	31 5G	Import
Triumph	03	9/20/2002	3/27/2003	30 5J	Import
Triumph	04	10/16/2003	3/27/2003	36 5L	Import
Advantage	04	12/0/02	4/1/2003	300FQ	Tredit
Quantum	04	4/4/2003	4/8/2003	2952B	Tredit
Triumph	04	4/4/2003	4/9/2003	365FL	Import
Advantage AX6	04	6/12/2003	4/9/2003	365FL	Import

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List of Aluminum Wheel Separation Incidents
Reported by Fleetwood on January 23, 2004

Vehicle Model	Model Year	Mfg Date	Date Reported	Model	Wheel Make
Advantage	04	3/8/2003	4/13/2003	365FL	Tredit
Regal	04	3/6/2003	4/14/2003	365FL	Import
Regal AX6	04	4/4/2003	4/16/2003	365FL	Import
Regal	04	3/27/2003	4/21/2003	365FL	Tredit
Pride	03	9/5/2002	4/23/2003	36 5L	Import
Advantage AX6	04	4/16/2003	5/1/2003	365FL	Import
Regal AX6	04	12/12/2002	5/2/2003	300FQ	Import
Pride	04	11/14/2002	5/8/2003	365L	Import
Regal AX6	04	3/18/2003	5/9/2003	365FL	Import
Regal AX6	04	1/21/2003	5/9/2003	365FL	Import
Triumph	04	3/14/2003	5/13/2003	36 5L	Import
Quantum AX6	04	4/9/2003	5/16/2003	36 5L	Import
Advantage AX6	04	4/11/2003	5/19/2003	305RL	Import
Pride	04	1/10/2003	6/3/2003	31 5G	Import
Advantage	04	4/1/2003	6/11/2003	320DB	Tredit
Quantum	04	4/4/2003	6/6/2003	2952B	Tredit
Regal AX6	04	1/14/2003	6/19/2003	300FQ	Import
Pride	03	6/13/2002	6/23/2003	36 5L	Import
Quantum	04	3/21/2003	6/24/2003	365FL	Tredit
Triumph	04	2/27/2003	6/25/2003	33 5Z	Import
Quantum	04	4/7/2003	7/2/2003	2952B	Tredit
Regal	04	1/6/2003	7/2/2003	255BH	Tredit
Quantum	04	4/7/2003	7/1/2003	2952B	Tredit
Quantum	04	4/7/2003	7/7/2003	2952B	Tredit
Quantum AX6	04	7/11/2003	7/17/2003	365FL	Import

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List of Aluminum Wheel Separation Incidents Reported by Fleetwood on January 23, 2004

Vehicle Model	Model Year	Mfg Date	Date Reported	Model	Wheel Make
Advantage	04	4/1/2003	8/6/2003	2952B	Tredit
Regal	04	3/20/2003	8/11/2003	365FL	Tredit
Regal	04	5/23/2003	8/11/2003	365FL	Tredit
Regal AX6	04	2/11/2003	8/19/2003	365FL	Import
Regal	04	7/9/2003	9/12/2003	330RL	Tredit
Advantage AX6	04	12/11/2002	9/8/2003	300FQ	Tredit
Triumph	04	10/30/2002	9/26/2003	32 G	Import
Advantage	04	4/15/2003	11/13/2003	2952B	Tredit
Triumph	04	2/6/2003	11/20/2003	365L	Import
Wilderness	04	4/15/2003	12/10/2003	300BH	Tredit
Advantage	04	3/18/2003	12/10/2003	300BH	Tredit
Quantum	04	5/6/2003	12/10/2003	2952B	Import
Triumph	04	11/13/2003	12/10/2003	365L	Import
Regal AX6	04	4/1/2003	12/15/2003	365FL	Import
Triumph	04	11/19/2002	1/22/2004	32G	Import

List of Wheel Separation Incidents Resulting in Property Damage

VIN	Date of Incident (D/I)	Source of Incident Information
1EA5B292341XXXXXX	6/16/03	Fleetwood Response to ODI Request No. 7a
4CA1G322042XXXXXX	Unknown; Report date 3-23-03	Fleetwood Response to ODI Request No. 9a

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Summary of Fleetwood's Wheel End Installation and Wheel Nut Torquing Procedures

Steel Wheels -

In response to ODI's inquiry (Request No. 17) for a description of the wheel mounting and wheel mounting nut torque procedure for steel wheels, Fleetwood stated, "the steel wheel mounting and wheel mounting torque procedure for steel wheels installed in the vehicles ... is found in the Fleetwood Travel Trailer Assembly Manual. This procedure is found in two sections of the Assembly manual – first, in the Chassis Section, AMR-01-A39 and second, in the Final Finish Section AMR-28-A75."

Aluminum Wheels -

In response to ODI's inquiry (Request No 21) for the wheel mounting and wheel mounting nut torque procedure for aluminum wheels, Fleetwood advised ODI to, "Refer to response and attachments to question 17 [i.e. the procedures for steel wheels]."

Based on the information supplied by Fleetwood, ODI has summarized the wheel installation and wheel mounting nut torque procedures chronologically below.

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A) Assembly Procedure Manuals -

Document	Verbatim Procedure	Other Comments
AMR-01-039 06/10/99	1. In the chassis department, an impact wrench may only be used with an "accu-torq" stick (see new tool bulletin # 49). With accu-torq the lug nuts will be tightened to approximately 100 ft/lbs. 2. Final tightening to 120 ft/lbs is to be done in the final, finish, or re-work area.	The statement, "DO NOT EXCEED 120 FT/LBS" accompanies a diagram labeled "Lug tightening Sequence" that depicts a star-pattern tightening sequence.
AMR-01-039 02/04/03 and AMR-28-A75 1/29/03	1. A torque wrench must be used to tighten the lug nuts to 120 foot pounds on all travel trailers and 5th wheels. Do not tighten by hand or use an impact wrench at final finish. 2. Follow the appropriate sequence (five or six lug wheel) for tightening the lug nuts.	The statement, "TORQUE TO 110-120 FT/LBS" accompanies a diagram labeled "Lug tightening Sequence" that depicts a star-pattern tightening sequence.
AMR-01-A39 03/17/03 and AMR-28-A75 3/17/03	1. A torque wrench must be used to tighten the lug nuts on all travel trailers and 5th wheels. Do not tighten by hand or use an impact wrench at final finish. 2. Follow the appropriate sequence (five or six lug wheel) for tightening the lug nuts.	A chart lists steel and aluminum wheels by size and part number. Depending on wheel size, the recommended torques are 80-90 ft/lbs or 90-110 ft/lbs for steel wheels and 110-120 ft/lbs for aluminum wheels. A diagram labeled "Lug tightening Sequence" depicts a star-pattern tightening sequence.

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AMR-01-A39 04/14/03 and AMR-28-A75 4/14/03	1. Place the wheel on the wheel mounting surface. Place the wheel lug nuts with rounded end of the nut toward the wheel. Tighten each nut by hand or use an impact wrench until the wheel is held against the wheel mounting surface. Lower the tire to the ground and tighten the wheel lug nuts to the specified torque with a torque wrench. 2. Follow the appropriate sequence (five or six lug wheel) for tightening the lug nuts. 3. Once wheels are installed check the torque again at 10, 25, and 50 miles.	(same information / instructions as stated above)

AMR-01-A39 06/23/03 and AMR-28-A75 6/23/03	(same information / instructions as stated above)	A chart lists steel and aluminum wheels by size and part number. Three aluminum wheel part numbers were removed and three "Chr" (chrome) wheels were added. The torque values for the "Chr" wheels is 85-95 ft/lbs. A diagram labeled "Lug tightening Sequence" depicts a star-pattern tightening sequence.

ODI notes that Fleetwood's procedures do not specify a "graduated" increase in torque. Applying the torque in graduated steps is more likely to correctly align and seat the wheel. Fully tightening each nut before proceeding to the next nut may result in wheel misalignment and affect the integrity of the clamp.

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(B) Internal Memos

Fleetwood also provided two internal memos that summarize wheel nut torque information.

(1) An October 31, 2002 letter titled, "Aluminum Wheel Torque" states,

"Please be aware of the following wheel torque requirements.

Steel wheel torque requirements (if equipped):

13 inch wheel nut torque is 80 - 90 ft. lbs.
14 inch wheel nut torque in 80 - 90 ft. lbs.
15 inch wheel nut torque is 80 - 100 ft. lbs.
16 inch wheel nut torque is 80 - 100 ft. lbs.

Aluminum wheel from imports:

15 inch wheel nut torque is 80-85 ft.lbs.
16 inch wheel nut torque is 80-85 ft.lbs.

Aluminum wheel from Tredit:

15 inch wheel nut torque is 120-125 ft. lbs.
16 inch wheel nut torque is 120-125 ft. lbs.

[ODI Note: It appears that this information was distributed as an internal letter. Since these "requirements" were not incorporated in the manufacturing procedures manual [excerpts above], it is not clear whether or not the stated torque values have ever been incorporated as a production procedure at Fleetwood.]

(2) An internal letter dated April 15, 2003 titled, "Steel and Aluminum wheel lug nut torque and nut tightening intervals – Transporter Responsibility/Compliance" states, "

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The procedure for attaching all steel and aluminum wheels is as follows:

1. Start all nuts by hand to prevent cross threading.
2. Tighten bolts or nuts in a specific sequence. (See bulletin.)
3. The tightening of the fasteners should be done in stages (See bulletin.)
4. Follow the recommended sequence, tighten fasteners per wheel torque requirements diagram (see bulletin.). This may change based on wheel manufacturer's recommendation.
5. Wheel nuts should be torqued before the first road use and after each wheel removal. Check and re-torque after the first 10, 25, and 50 miles or until torque has been established. Check periodically thereafter.

The "Recommend (sic) Torque" values are listed in a table on the attached bulletin. The table is summarized below:

Wheels	Type	Size	Recommend (sic) Torque" (Verbatim)
Steel Wheel 13 x 4.5 x 545 AW	Spoke	13	80 - 90 Ft/Lbs.
Steel Wheel 14 x 5.5 x 545 AW	Spoke	14	80 - 90 Ft/Lbs.
Steel Wheel 15 x 5 x 545 AW	Spoke	15	80 - 90 Ft/Lbs.
Steel Wheel 15 x 6 x 655 AW	Spoke	15	90 - 100 Ft/Lbs.
Steel Wheel 16 x 6 x 655 AW	Spoke	16	90 - 100 Ft/Lbs.
Aluminum Wheel 15 x 7 x 655	Spoke	15	110 - 120 Ft.Lbs.
Aluminum Wheel 16 x 7 x 655	Spoke	16	110 - 120 Ft./Lbs
Aluminum Wheel 15 x 6 x 545	Spoke	15	110 -120 Ft./Lbs.
Aluminum Wheel 15 x 6 x 655	Spoke	15	110 - 120 Ft/Lbs.
Aluminum Wheel 16 x 6 x 655	Spoke	16	110 - 120 Ft/Lbs.

Since these are internal letters and not plant process specifications, ODI is not certain that the information outlined in internal letters were intended, or were, implemented in the assembly process.

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Other Findings: Opportunities for Industry Improvement

This closing report, EA04-009, summarizes the investigation activity that ODI has conducted at Fleetwood Enterprises. Based on consumer complaints and/or inquiries of manufacturers who have installed wheel end components similar to those installed by Fleetwood, 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.

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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 Fleetwood, 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 retorqing, 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.