



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

ODI RESUME

Investigation: EA 07-005
 Prompted By: PE06-050
 Date Opened: 04/03/2007
 Principal Investigator: Andrea Noel
 Subject: Wheel Failure
 Date Closed: 08/04/2008

Manufacturer: Nissan North America, Inc.
 Products: 2005-2007 Nissan 350Z with 5-Spoke wheels
 Population: 47,700

Problem Description: Spoke fracture near the wheel hub resulting in wheel separation.

FAILURE REPORT SUMMARY

	ODI	Manufacturer	Total
Complaints:	5	4	5
Crashes/Fires:	1	1	1
Injury Incidents:	1	1	1
# Injuries:	1	1	1
Fatality Incidents:	0	0	0
# Fatalities:	0	0	0
Other*:	2	8	10

*Description of Other: Complaints alleging cracks of subject wheels.

Action: This Engineering Analysis is closed.

Engineer: Andrea Noel *AN*
 Div. Chief: Jeffrey L. Quandt
 Office Dir.: Kathleen C. DeMeter

Date: 08/04/2008
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Summary: All of the wheel separation incidents identified in EA07-005 have involved wheels subjected to aftermarket chroming in California. Metallurgical analysis of aftermarket chromed wheels obtained from incident vehicles showed significant changes in material properties that can increase the chance of structural failure. Nissan has issued several communications to dealers, both before and after ODI's investigation began with PE06-050, warning against the practice of chroming wheels. Nissan has advised ODI that it will be sending another communication this year that repeats the warnings against aftermarket chroming.

No defect has been identified in the original equipment Nissan wheels. There have been no wheel separation incidents involving those wheels and they passed the SAE radial fatigue, cornering and side impact tests conducted by VRTC. While there have been a few complaints, warranty claims and survey responses indicating cracks in original equipment wheels, they are few in number, often exhibit evidence of impact damage and may sometimes involve cracks in different locations of the wheel. At this time, in view of the limited incidence of the cracks and the fact that the cracks do not appear to have progressed, further use of agency resources on this investigation does not appear to be warranted. The agency will continue to monitor complaints and other information pertaining to the wheels on the subject vehicles and will take further action if warranted.

AN
8/12/08

ENGINEERING ANALYSIS CLOSING REPORT

SUBJECT: Wheel separation due to spoke fracture.

EA No: EA07-005 **DATE OPENED:** 09-April-2007 **DATE CLOSED:**

SUBJECT VEHICLES: The subject vehicles are model year (MY) 2005 through 2007 Nissan 350Z vehicles equipped with 5-spoke wheels (subject wheel).

BASIS: On November 9, 2006, the Office of Defects Investigation (ODI) opened a Preliminary Evaluation (PE06-050) to investigate two complaints alleging that original equipment 5-spoke wheels had separated without warning due to spoke fracture near the wheel hub. One of the incidents resulted in a crash and injury when the separated wheel struck a motorcycle officer of the California Highway Patrol.

During PE06-050, ODI determined that both of the wheels involved in the separation incidents had been subjected to aftermarket chroming prior to sale by the dealer. PE06-050 was upgraded to an Engineering Analysis on April 9, 2007 to further assess factors contributing to spoke fracture and separation of the subject wheels. The scope of the investigation was expanded to all model years that were equipped with the 5-spoke wheels.

ALLEGED DEFECT: Spoke fracture near the wheel hub resulting in wheel separation. Figures 1 through 3 show a subject wheel that was involved in a separation incident.

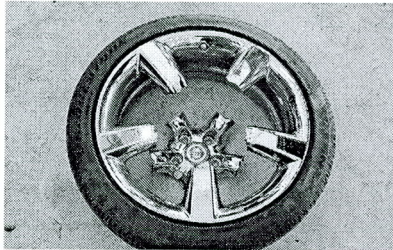


Figure 1



Figure 2

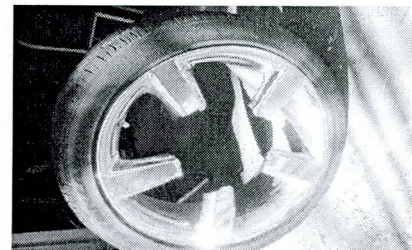


Figure 3

SUBJECT COMPONENT: The subject components are the 5-spoke wheels used on the subject vehicles (Figure 4). Some MY 2005 350Z vehicles were sold with 5-spoke wheels as optional equipment, but 6- and 7-spoke wheels were standard equipment for that model year (Figures 5 and 6).

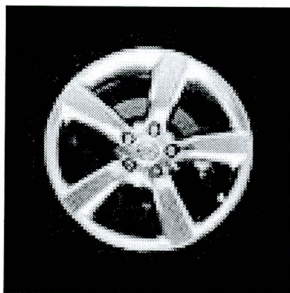


Figure 4
5-Spoke Wheel



Figure 5
6-Spoke Wheel



Figure 6
7-Spoke Wheel

VEHICLE POPULATION: Nissan sold approximately 47,700 subject vehicles in the United States. Approximately seven percent of MY 2005 vehicles and all of the MY 2006 and 2007 vehicles were shipped with 5-spoke wheels (Table 1). It is unknown how many subject wheels have been subjected to aftermarket chroming, by dealers or by consumers¹.

MY	5-Spoke Wheels	6-Spoke Wheels	7-Spoke Wheels	Total
2005	1,991	5,736	18,893	26,620
2006	30,066			30,066
2007	15,651			15,651
Total	47,708	5,736	18,893	72,337

Table 1. Vehicle Population By Model Year And Wheel Type².

PROBLEM EXPERIENCE: ODI has identified four wheel separation incidents involving the subject wheels. All four occurred in California and involved wheels that had been subjected to aftermarket chroming. As noted previously, one of the incidents resulted in a crash and injury when the separated wheel struck a motorcycle patrolman of the California Highway Patrol. Only one incident has been reported since December 2006.

Date	MY	Wheel Design	Aftermarket Chromed	Mileage	State	Speed	Crash	Inj
31-Jul-06	2006	5-spoke	Yes	3,877	CA	65		
11-Oct-06	2006	5-spoke	Yes	10,855	CA	65	Yes	1
19-Dec-06	2005	5-spoke	Yes	14,000	CA	15		
28-Aug-07	2006	5-spoke	Yes	9,900	CA	65		

Table 2. Subject Wheel Separation Incidents.

ODI also identified a wheel separation incident involving a 7-spoke wheel on a MY 2004 350Z vehicle with 55,551 miles of service. That incident also occurred in California and involved an aftermarket chromed wheel. ODI did not identify any wheel separation incidents outside California for aftermarket chromed wheels. However, ODI did receive a complaint from a consumer in Texas alleging cracks in a single spoke of three wheels of a MY 2006 350Z with approximately 24,000 miles of service. The wheels were all aftermarket chromed wheels. Nissan provided information about two other complaints of cracked spokes involving aftermarket chromed wheels on MY 2006 350Z vehicles at 10,800 and 12,500 miles of service (Table 3).

ODI has not identified any wheel separation incidents involving any original equipment Nissan wheels of any spoke design or wheel finish. However, ODI did review complaints and warranty claims alleging cracks in Nissan original equipment wheels (Figure 7). There were seven complaints alleging cracks in Nissan original equipment wheels that had not been subject to aftermarket chroming, 5 involving 5-spoke wheels and 2 involving 7-spoke wheels (Table 3). For four of the 5-spoke and both 7-spoke crack complaints, dealers denied warranty coverage because

¹ Information furnished by two Southern California dealers involved in the two initial separation incidents indicate that, through December 2006, one had replaced original equipment wheels with aftermarket chromed wheels in about 14 percent (13/94) of the subject vehicles and the other in about 3 percent (3/100).

² Vehicle sales by wheel type estimated from Nissan data on vehicle wheel options as shipped.

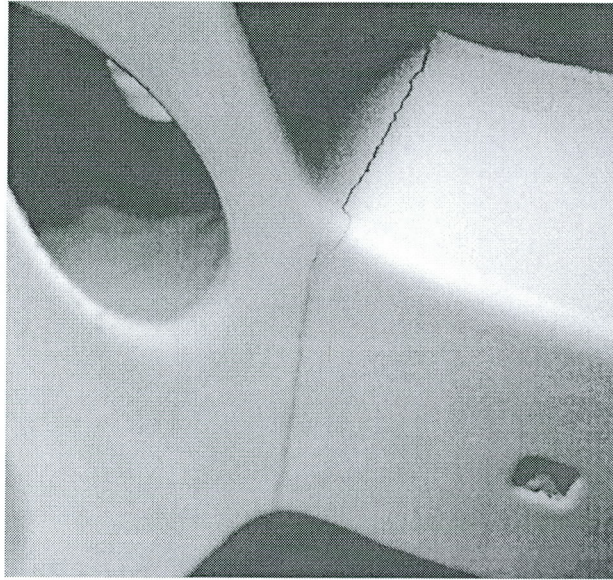


Figure 7. Cracked spoke (near hub) in original equipment subject wheel.

inspections identified signs of impact³. Impact with curbs, potholes or other road hazards can significantly overload wheels and other vehicle components. There were four additional complaints where ODI was not able to contact the consumer to establish whether the wheel had been subjected to aftermarket chroming. These complaints were all from California and involved 2 of the subject 5-spoke wheels, a 6-spoke wheel and a 7-spoke wheel.

Aftermarket Chromed	Wheel Design	Date	MY	Wheels cracked	Spokes cracked	Mileage	State	Impact Cited	Location
Yes	5-spoke	13-Apr-07	2006	1	Unk	12,500		Unk	Unk
		9-May-07	2006	1	Unk	10,800		Unk	Unk
		25-Oct-07	2006	3	1x3	24,000	TX	No	Spokes
No	5-spoke	25-Oct-06	2006	2	1	12,000	FL	Yes	Spokes
		15-Dec-06	2006	1	1	10,600	AL	Yes	Spoke
		23-Mar-07	2006	1	1	20,000		Yes	Spoke
		10-Apr-07	2006	1	1	21,000		Unk	Spoke
		12-Jun-07	2006	1	1	16,000		Yes	Spoke
	7-spoke	10-May-06	2005	1	1	17,000	FL	Yes	Spoke
		12-Jun-07	2005	1	2	18,829	MI	Yes	Spokes
Unk	5-spoke	30-May-06	2006	1	Unk	11,000	CA	Unk	Unk
		26-Oct-06	2006	1	Unk	3,000	CA	Unk	Unk
	6-spoke	3-Oct-06	2005	1	Unk	28,000	CA	Unk	Unk
	7-spoke	3-Jan-07	2005	1	Unk	44,000	CA	Unk	Unk

Table 3. Summary Of Complaints Alleging Cracking (Without Separation).

³ Impact includes, but is not limited to, striking a curb, pothole, or road debris.

Warranty claims for wheel cracking are not paid if the wheel has been subjected to aftermarket chroming (see Nissan service bulletins) and are generally not paid if there is evidence of impact damage. However, when there has been no obvious evidence of such abuse, Nissan has paid some claims for cracked wheels. ODI's analysis of 25 claims in MY 2005 through 2006 Nissan 350Z vehicles found that the claim rate for the subject wheels was similar to those of the 6- and 7-spoke wheels, which all had low rates of less than one claim per thousand vehicles. These are summarized in Table 4.

Wheel Design	Front	Rear	Both	Total	Rate (IPTV)
5-spoke	7	8	2	17	0.53
6-spoke	1	3	0	4	0.70
7-spoke	2	2	0	4	0.21

Table 4. Warranty Claims By Wheel And Axle.

ODI also reviewed the subject wheel claims for evidence of common failure modes or patterns. ODI's analysis found one of the claims for 5-spoke wheels specifically indicated cracks in spokes. Another claim, paid for goodwill, attributed the crack to impact damage. Six claims for the 5-spoke wheels and 2 for the 6-spoke wheels described cracks on an unspecified interior section of the wheel, with several also indicating air loss as a symptom – both of which appear to be inconsistent with spoke cracking. A summary of the claims is provided in the Appendix (Table 7).

TESTING: The Vehicle Research and Test Center (VRTC) in East Liberty, Ohio, conducted testing and vehicle owner surveys as part of EA07-005. This included performance testing of Nissan original equipment subject wheels, metallurgical analyses of original equipment wheels and aftermarket chromed wheels that had experienced failures while in service and owner surveys in California and Ohio.

VRTC tested the original equipment 5-spoke cast aluminum alloy wheels' performance in dynamic radial fatigue (SAE J328), dynamic cornering fatigue (SAE J328) and axial (lateral) curb impact collision (SAE J175) tests. The wheels met all the requirements of these tests. Metallurgical analysis of original equipment wheels and aftermarket chromed wheels collected from incident vehicles showed significant reductions in yield strength, tensile strength and hardness for the aftermarket chromed wheels.

Because of the pattern of failures of aftermarket chromed wheels in that region, VRTC conducted a survey of MY 2003 through 2006 Nissan 350Z owners in 10 counties in southern California⁴. For comparison, VRTC conducted a similar survey in Ohio. The results of these surveys for MY 2005 through 2007 350Z vehicles, including the subject vehicles with the subject 5-spoke wheels, are shown in Table 5. The results for MY 2003 through 2004 vehicles are shown in Table 6.

The percentage of vehicles with chromed wheels in the MY 2005 through 2007 vehicles was slightly higher in California, with 36 percent (34 of 94) compared with 31 percent (24 of 78) in Ohio. In both states the vehicles with 5-spoke wheels had the highest percentage of chrome, with

⁴ Imperial, Kern, Los Angeles, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara and Ventura counties.

Wheel		California					Ohio				
		Vehicles	Wheels with crack(s)		Wheel separations		Vehicles	Wheels with crack(s)		Wheel separations	
Finish	Design		No.	%	No.	%		No.	%	No.	%
Alloy	5-spoke	36	0	0.0%	0	0.0%	27	1	3.7%	0	0.0%
	6-spoke	8	0	0.0%	0	0.0%	10	0	0.0%	0	0.0%
	7-spoke	5	1	20.0%	0	0.0%	13	0	0.0%	0	0.0%
	Unk	11	0	0.0%	0	0.0%	4	0	0.0%	0	0.0%
	Total	60	1	1.7%	0	0.0%	54	1	1.9%	0	0.0%
Chrome ⁵	5-spoke	26	3	11.5%	0	0.0%	17	0	0.0%	0	0.0%
	6-spoke	3	0	0.0%	0	0.0%	2	0	0.0%	0	0.0%
	7-spoke	1	0	0.0%	0	0.0%	3	0	0.0%	0	0.0%
	Unk	4	0	0.0%	0	0.0%	2	1	50.0%	0	0.0%
	Total	34	3	8.8%	0	0.0%	24	1	4.2%	0	0.0%

Table 5. VRTC Survey Results, MY 2005-07 350Z Vehicles.

42 percent in California and 39 percent in Ohio. The rates of cracking were similar in the two states for alloy wheels, 1.7 percent for California and 1.9 percent for Ohio. The rates of cracking for chrome wheels were higher in both states, 8.8 percent in California and 4.2 percent in Ohio. All three cracked chrome wheels in California were 5-spoke wheels.

Wheel		California					Ohio				
		Vehicles	Wheels with crack(s)		Wheel separations		Vehicles	Wheels with crack(s)		Wheel separations	
Finish	Design		No.	%	No.	%		No.	%	No.	%
Alloy	5-spoke	11	0	0.0%	0	0.0%	10	0	0.0%	0	0.0%
	6-spoke	11	1	9.1%	0	0.0%	38	1	2.6%	0	0.0%
	7-spoke	22	0	0.0%	0	0.0%	32	1	3.1%	0	0.0%
	Unk	9	1	11.1%	0	0.0%	7	0	0.0%	0	0.0%
	Total	53	2	3.8%	0	0.0%	87	2	2.3%	0	0.0%
Chrome	5-spoke	6	0	0.0%	0	0.0%	7	0	0.0%	0	0.0%
	6-spoke	6	0	0.0%	0	0.0%	4	0	0.0%	0	0.0%
	7-spoke	9	2	22.2%	1	11.1%	6	0	0.0%	0	0.0%
	Unk	5	0	0.0%	0	0.0%	1	1	100.0%	0	0.0%
	Total	26	2	7.7%	1	3.8%	18	1	5.6%	0	0.0%

Table 6. VRTC Survey Results, MY 2003-04 350Z Vehicles.

⁵ These figures include both Nissan OE chrome wheels and Nissan wheels subject to aftermarket chroming. These groups are grouped together because owners often could not discern the difference (i.e., owner with "chromed" wheels often believed they were Nissan OE parts).

As expected, the responses for MY 2003 through 2004 survey vehicles contained higher percentages of 6- and 7-spoke wheels. These vehicles have greater time in service than the MY 2005 through 2007 vehicles, and the results show slightly higher rates of cracked wheels for all but the California chrome wheels which were slightly lower than the MY 2005 through 2007 results. One survey respondent experienced a wheel separation incident in a MY 2004 350Z vehicle with 7-spoke wheels that had been subjected to aftermarket chroming in California.

As in the warranty data, the location of the crack is unknown in most of the survey responses indicating cracked wheels. Also, while only a few of the owners with chrome wheels indicated that they were aftermarket chromed wheels, ODI does not believe that information is reliable since most of the consumers who have experienced problems with wheels that had been subjected to aftermarket chroming by dealers prior to sale were not aware that the wheels had been modified until after the failures occurred.

SERVICE BULLETINS: Nissan has issued technical service bulletins warning its dealers not to engage in aftermarket chroming. Nissan issued four service bulletins on the following dates: December 22, 1992, August 30, 2006, September 24, 2007, and February 12, 2008. Each service bulletin advised that:

If Nissan Original Equipment or Genuine Accessory Alloy wheels are subjected to aftermarket chroming, problems may occur as a result of the chroming process, including:

- 1. The chroming process generally removes original finish by "burning" or "chemical" methods, both of which may cause the heat treatment of the alloy to be changed.*
- 2. Aftermarket chroming may degrade the durability, long term appearance, and **may affect safety and performance of the wheels.***

*Accordingly, Nissan **most** strongly recommends that Original Equipment or Genuine Accessory Alloy wheels **NEVER** be modified by processes such as aftermarket chrome plating.*

NISSAN'S POSITION: Nissan maintains that it knows of no defect in design, manufacture, or performance of the original equipment road wheels in the subject vehicles that has caused or contributed to structural failures of the wheels. Nissan attributes the reported incidents of wheel separation to unauthorized wheel modification (application by an aftermarket chroming process). With regard to wheel cracking, based on an inspection of wheels that have been made available to Nissan, damage to those wheels resulted from impact damage.

Concerning unauthorized chroming after an OE wheel has left the control of Nissan, Nissan explains that the process of chroming a wheel, which has already been manufactured with a final finish, can affect the metallurgical structure of the wheel. The chroming process requires a high level of engineering and metallurgical expertise, as well as strict production quality controls. If the heating to remove the original factory finish is a hand process, is done too quickly, or is not well controlled, non-uniform heating can be expected. Non-uniform heating will introduce large local strains and leave high residual stresses in the wheel surface. High residual stresses can be

generated by the stripping process and may lead to the introduction of incipient cracks. Such cracking, even if not visible to the naked eye, can eventually lead to structural failure.

Nissan states that concerns about unauthorized modifications to any Nissan OE wheel has been the subject of communications with dealers for years due to the potential negative affect of the modifications to a wheel. Nissan has issued several service bulletins to Nissan dealerships indicating that it does not approve of and cautions against aftermarket chroming of Nissan OE alloy wheels. Nissan does not now, nor has it ever, authorized such a modification to original equipment wheels.

REASONS FOR CLOSING: All of the wheel separation incidents have involved wheels subjected to aftermarket chroming in California. Metallurgical analysis of aftermarket chromed wheels obtained from incident vehicles showed significant changes in material properties that can increase the chance of structural failure. Nissan has issued several communications to dealers, both before and after ODI's investigation began with PE06-050, warning against the practice of chroming wheels. Nissan has advised ODI that it will be sending another communication this year that repeats the warnings against aftermarket chroming.

No defect has been identified in the original equipment Nissan wheels. There have been no wheel separation incidents involving those wheels and they passed the SAE radial fatigue, cornering and side impact tests conducted by VRTC. While there have been a few complaints, warranty claims and survey responses indicating cracks in original equipment wheels, they are few in number, often exhibit evidence of impact damage and may sometimes involve cracks in different locations of the wheel. At this time, in view of the limited incidence of the cracks and the fact that the cracks do not appear to have progressed, further use of agency resources on this investigation does not appear to be warranted. The agency will continue to monitor complaints and other information pertaining to the wheels on the subject vehicles and will take further action if warranted.

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APPENDIX:

Wheel Design	Date	MY	Wheel position	Spokes cracked	Location	Air Loss
5-spoke	10-Jul-06	2006	RR		Interior	
	5-Oct-06	2006	RF			
	02-Feb-07	2006	RF/LR			Yes
	28-Feb-07	2006	RF		Inside	Yes
	10-Apr-07	2005	RR		Inner side	
	13-Apr-07	2006	LF			
	19-Apr-07	2006	LR			
	05-Jun-07	2005	RF			
	09-Jun-07	2006	RF		Inside	Yes
	30-Jun-07	2006	RR			
	12-Jul-07	2006	RF		Rear side	
	24-Jul-07	2006	RF/RR	1/1	Spokes	
	08-Aug-07	2006	RF		Inside	
	22-Aug-07	2006	RR			
	23-Aug-07	2006	LR		Struck object, goodwill	Yes
	Unk	2006	LR		Near emblem	
Unk	2006	RR		Goodwill	Yes	
6-spoke	14-Feb-06	2005	LR		Inside, near spoke	
	28-Jun-06	2005	RF	2	Spokes	
	23-Aug-06	2005	LR		Internally	
	07-Aug-07	2005	RR	1	Spoke	
7-spoke	30-Mar-06	2005	LF			
	12-May-07	2005	LR			
	31-Jul-07	2005	UF			
	Unk	2005	RR			

Table 7. Warranty Claims, Wheels - Cracked.