



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

# ODI RESUME

Investigation: PE03-058  
 Prompted By: IE03-065, Consumer Complaints  
 Date Opened: 12/17/2003 Date Closed: 04/22/2004  
 Principal Investigator: Kyle Bowker  
 Subject: Engine Crankshaft Pulley Failure

Manufacturer: Mercedes-Benz USA, LLC  
 Products: 1998-2000 Mercedes-Benz Equipped With M112/M113 Engines  
 Population: 421,204

Problem Description: The complainants allege that the engine crankshaft pulley harmonic balancer failed.

## FAILURE REPORT SUMMARY

	ODI	Manufacturer	Total
Complaints:	55	508	546
Crashes/Fires:	0	0	0
Injury Incidents:	0	0	0
# Injuries:	0	0	0
Fatality Incidents:	0	0	0
# Fatalities:	0	0	0
Other*:	0	59,211	59,211

\*Description of Other: Warranty claims for replacement of the engine crankshaft pulley harmonic balancer.

Action: This Preliminary Evaluation has been closed.

Engineer: Kyle M. Bowker KMB  
 Div. Chief: Jeffrey L. Quandt  
 Office Dir.: Kathleen C. DeMeter

Date: 04/23/2004  
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Summary: The Office Of Defects Investigation (ODI) opened this Preliminary Evaluation to investigate allegations of engine crankshaft pulley harmonic balancer failure that could result in loss of power-steering assist. ODI has received a total of 546 non-duplicative reports that allege engine crankshaft pulley harmonic balancer failure on all Mercedes-Benz vehicles using the subject component.

The subject component failures are progressive in nature and only a small percentage of the complaints and warranty claims involved a failure that had progressed far enough to effect power steering performance (6 of 55 ODI complaints reference increased steering effort). There have been no crashes or injuries related to the alleged defect.

A safety-related defect has not been identified at this time and further use of agency resources does not appear to be warranted. Accordingly, this investigation is closed. The closing of this investigation does not constitute a finding by NHTSA that a safety-related defect does not exist. The agency will take further action if warranted by the circumstances.

See summary report attached for further detail.

KMB  
4/23/04

**PE03-058 SUMMARY REPORT**

**SUBJECT:** The engine crankshaft pulley harmonic balancer may fail on certain model year (MY) 1998 through 2000 Mercedes-Benz vehicles with M112 or M113 family engines that were originally equipped with subject components identified by part number (p/n) 112 035 00 00 or p/n 112 035 06 00.

**BASIS:** Initial Enquiry IE03-065, which formed the basis for PE03-058, was prompted by consumer complaints. Daimler Chrysler Japan, Inc. conducted a product improvement campaign in January 2002 to address the subject issue on Japanese market subject vehicles. Additionally, Mercedes-Benz USA, LLC (Mercedes-Benz) voluntarily conducted a previous recall (96V-058) to remedy a similar issue on vehicles not subject to this investigation.

**ALLEGED DEFECT:** The rubber damper ring located between the inner hub and the outer belt pulley of the harmonic balancer may develop cracks and fail, which could allow the outer belt pulley to separate from the inner hub. Should the outer belt pulley separate from the inner hub, the serpentine V-belt will no longer transmit power to drive various accessory components including the alternator, the air-conditioner compressor, the water pump, the power-steering assist pump, and in vehicles equipped with Active Body Control, the ABC pump (a radial piston pump situated in tandem with the power-steering pump).

**DESCRIPTION OF VEHICLE SYSTEM:** The engine crankshaft pulley is located on the end of the crankshaft, external to the engine. The pulley provides power to accessory components by driving a serpentine V-belt. Integrated into the design of the pulley is the harmonic balancer. The harmonic balancer is made of three components: 1) a cast iron inner hub that mounts directly to the engine crankshaft; 2) a cast iron outer belt pulley that carries the load of the serpentine belt; and 3) a rubber ring sandwiched between the inner hub and outer belt pulley. The rubber ring dampens torsional vibrations in the crankshaft and ensures transfer of energy from the inner hub to the outer belt pulley, and subsequently to the serpentine belt and the accessory components. The rubber ring is fixed in place by compression forces between the inner hub and the outer belt pulley. It is located axially with a "positioning ridge" that mates to corresponding grooves in the inner hub and outer belt pulley and ensures proper pulley/belt alignment.

**CORRESPONDENCE:** ODI received information from an Information Request (IR) letter submitted to the manufacturer on January 14, 2004. Mercedes-Benz provided responses to the IR letter dated March 12, 2004, March 26, 2004, March 29, 2004, and April 13, 2004.

**VEHICLE POPULATION:** The manufacturer provided Vehicle Identification Number (VIN) level detail for each of the subject vehicles, as defined by ODI, including the model class, model year, date of production, date the warranty coverage commenced, and the U.S. State where the vehicle was sold. It is noteworthy to report that Mercedes-Benz identified an additional 57,679 MY 1999-2000 CL-, S-, and SL-class vehicles not originally investigated by ODI that use engine crankshaft pulley harmonic balancers that are the same or substantially similar to those originally equipped on the subject vehicles of this investigation. The following table summarizes the vehicle populations identified by the manufacturer as subject vehicles.

Table 1: Subject Vehicle Populations

CLASS	MODEL	MY			Grand Total
		1998	1999	2000	
C (W202)	C280W	9,443	14,618	6,240	30,301
	C43 AMG	596	828	25	1,449
CL (W215)	CL500	---	---	1,451	1,451
CLK (W208)	CLK320	5,264	12,936	9,458	27,658
	CLK430	---	5,143	6,914	14,057
E (W210)	E320S	4,827	5,880	5,720	16,427
	E320W	30,810	35,831	33,063	99,804
	E430W	4,794	8,555	8,837	22,186
	E55 AMG	---	785	989	1,774
M (W163)	ML320	41,651	35,953	41,575	119,179
	ML430	---	16,656	12,277	28,933
	ML55 AMG	---	---	1,657	1,657
S (W220)	S430V	---	---	20,209	20,209
	S500V	---	---	21,633	21,633
SL (R129)	SL600R	---	8,203	5,183	14,386
<b>Grand Total</b>		<b>97,485</b>	<b>146,488</b>	<b>177,231</b>	<b>421,204</b>

**PROBLEM EXPERIENCE:** Fifty-five complainants reported directly to ODI regarding the alleged defect. Mercedes-Benz received 503 complaints related to the alleged defect on the subject vehicles. Additionally, Mercedes-Benz is aware of 5 lawsuits related to the alleged defect on the subject vehicles. Some complainants reported to both ODI and the manufacturer. In total, ODI is aware of 546 unique, non-duplicative complaints (not including field reports) that allege engine crankshaft pulley harmonic balancer failure on the subject vehicles (as defined above in Table 1). There have been no crashes and no injuries related to the alleged defect. The manufacturer has paid 59,211 warranty claims for replacement of the engine crankshaft pulley harmonic balancer for any reason on the subject vehicles.

**PART NUMBER CHANGES:** According to Mercedes-Benz, the failed harmonic balancers on the subject vehicles were overwhelmingly produced by Freudenberg & Co. (now known as Vibraoustic GmbH & Co. KG). Approximately 255,930 of the 421,204 subject vehicles identified above (100% of MY 1998, 90% of MY 1999, and 15% of MY 2000 subject vehicles) were equipped with harmonic balancers supplied by Freudenberg. Beginning in July 1999, Daimler Chrysler AG (DCAG) began purchasing harmonic balancers for subject vehicles from Trelleborg AB. In January 2000, DCAG also began purchasing harmonic balancers for subject vehicles from a third supplier, EaglePicher, Inc. Vibraoustic acquired EaglePicher in 2003. The following table summarizes the p/n changes for the harmonic balancer as originally equipped on the subject vehicles.

Table 2: Part Number Changes

P/N	Supplier	From	To	Replaced By
112 035 00 00	Freudenberg & Co	April-97	September-99	112 035 06 00
112 035 06 00	Freudenberg & Co	July-99	May-00	112 035 09 00
112 035 09 00	Trelleborg AB	July-99	January-04	112 035 08 00
112 035 08 00	EaglePicher, Inc.	January-00	June-03	112 035 13 00
112 035 13 00	Vibracoustic GmbH & Co. KG	June-03	Current	--
112 035 14 00	Vibracoustic GmbH & Co. KG	Future	--	--

**TECHNICAL SERVICE BULLETINS (TSBs):** There have been no TSBs issued by the manufacturer regarding the subject issue. However, the manufacturer did provide its dealers with supplemental service procedure information on how to inspect the harmonic balancer for axial and radial runout, and how to remove and install the harmonic balancer. Mercedes-Benz also requested assistance from its dealers to collect field sample subject components. In addition, a Mercedes-Benz regional field service representative did create a document titled "Tech Tips", for the sole use of factory-authorized service personnel in his assigned region only, as a reference for some known service concerns. A December 1, 2000 publication of "Tech Tips" references new harmonic balancer part numbers that should be used for service repairs.

**FAILURE MODE:** Mercedes-Benz reports that the component failures are progressive in nature. Mercedes-Benz, in conjunction with DaimlerChrysler AG, collected field samples and conducted vehicle performance testing. Through their analysis they have identified 5 distinct stages of subject component failure, described by the manufacturer as follows:

- Stage 1: Includes the majority of field sample parts and represents a normal functioning engine crankshaft pulley harmonic balancer with no evidence of rubber ring cracking or failure.
- Stage 2: Rubber ring cracks have sufficiently advanced (approximately 90° around its circumference) to allow a section of the rubber ring to protrude from the face of the harmonic balancer and would be visible to service personnel. In the later part of this stage the balancer will begin to come into contact with the engine in the area of the front engine cover and the oil pan. At no time during this phase are any vehicle functions associated with the serpentine belt adversely affected.
- Stage 3: Rubber ring cracks have advanced further (approximately 270° around its circumference) to allow an even greater section of the rubber ring to protrude from the face of the harmonic balancer. At no time during this phase are any vehicle functions associated with the serpentine belt adversely affected.
- Stage 4: The rubber ring has separated into two pieces around the entire circumference and the front portion of the ring has completely fallen out of the harmonic balancer. Power-steering assist may be reduced during high power-steering pump loads, such as when the steering wheel is turned sharply during low speed parking maneuvers.

- Stage 5: The outer belt pulley has become disengaged from the remaining rubber ring, no longer rotates with the inner hub, and no longer drives the serpentine belt.

**DRIVER WARNING:** According to Mercedes-Benz, there exist sufficient warnings that manifest before vehicle performance or drivability are affected. During failure Stage 2, the belt pulley begins to make contact with the engine, resulting in a metal grinding noise whose sound pressure level is 10-15 decibels (dB) greater than normal. At this point, the noise is like a clanking sound resulting from the outer belt pulley becoming slightly off-center on the hub and rotating out of axial alignment with the hub. This off-axial alignment causes one section of the outer belt pulley to strike the front of the engine with each revolution of the harmonic balancer. If the failure advances to Stage 4, the metal grinding noise becomes more constant as a greater portion of the outer belt pulley comes into contact with the engine and its loudness increases another 5-10 dB over that of Stage 2. This grinding also results in vibrations that can be felt by the driver.

If the driver ignores the noise and vibration and continues to operate the vehicle to the point where the harmonic balancer reaches failure Stage 4, the outer belt pulley will begin to slip intermittently during high power-steering pump loads, causing the alternator/battery malfunction indicator light to intermittently illuminate and sound a warning chime. Mercedes-Benz reports this slippage also causes feedback that can be felt by the driver in the steering wheel as a quiver or intermittent tugging on the wheel as the level of power steering assist fluctuates with the degree of slippage. Depending on the degree of slippage, this could result in a momentary increase in the amount of steering effort required. The power-steering will continue to function normally at higher vehicle speeds until Stage 5 failure, at which point there will be no power-steering assist.

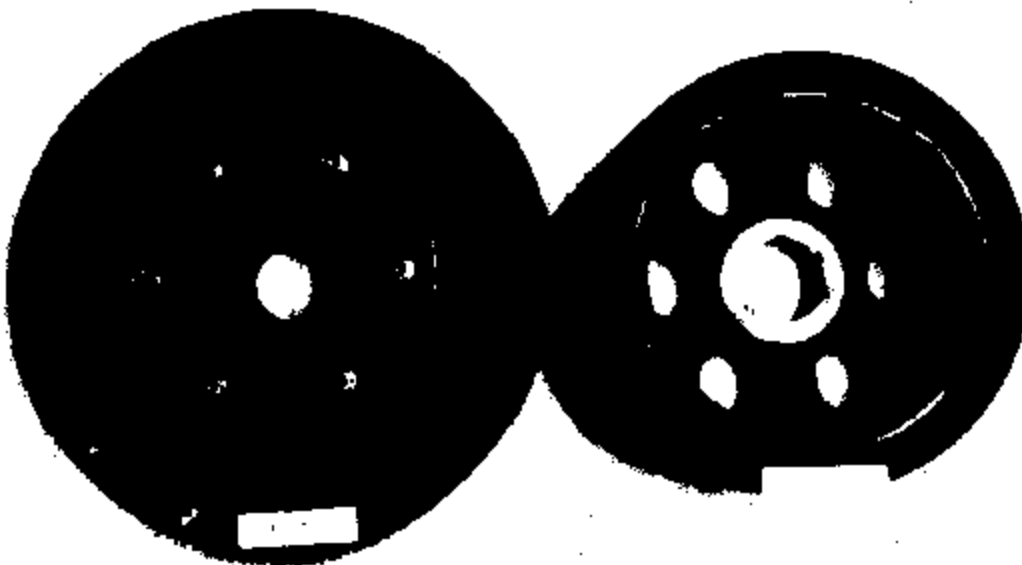
**IMPACT ON VEHICLE PERFORMANCE:** Mercedes-Benz reports that should the harmonic balancer fail completely (Stage 5), the outer belt pulley would become disengaged from the inner hub, affecting all accessory components that receive drive power from the engine crankshaft. Most often times the serpentine belt becomes slack and hangs on the accessory pulleys in the engine compartment. Steering effort is increased due to loss of power-steering assist. The alternator/battery malfunction indicator illuminates and chimes continually which alerts the operator to have the vehicle serviced immediately. The engine will continue to run without immediate consequences. However, because the serpentine belt drives the water pump for the cooling system, the engine will eventually overheat. There is no adverse affect on the vehicle's braking system or on braking performance. The power-brake assist pump on the subject vehicles is powered by vacuum pressure from the intake manifold.

According to the manufacturer, few complaints or warranty claims reference steering difficulty or any degree of power-steering loss. Mercedes-Benz reports that less than 3.5% of all warranty claims (representing approximately 2100 vehicles, or 0.5% of all subject vehicles) indicate that the subject component was repaired because it had experienced a complete Stage 5 failure. Furthermore, Mercedes-Benz's field studies showed that, in many cases, the subject component was replaced under warranty as a precautionary measure without any performance related symptoms (Stage 1).

**FOREIGN CAMPAIGN:** In January 2002, Daimler Chrysler Japan, Inc., working in consultation with Japan's Ministry of Land, Infrastructure, and Transport, voluntarily chose to conduct a product improvement campaign to remedy harmonic balancers in certain MY 1998-2000 Japanese market Mercedes-Benz vehicles. Mercedes-Benz reports that the harmonic balancers covered under this foreign campaign are the same Freudenberg harmonic balancers subject to this investigation. This foreign action was not a safety-recall, and therefore was not reported to NHTSA under the TREAD Act's Early Warning requirements (49USC30166(l) codified in 49CFR579.11). This action was undertaken to address customer satisfaction concerns.

**PREVIOUS RECALL EXPERIENCE:** In April 1996, Mercedes-Benz notified NHTSA that it would voluntarily conduct a safety recall (96V-058) to remedy defective engine crankshaft pulley harmonic balancers in certain MY 1996 C-, E-, S-, and SL- class vehicles. The engine crankshaft pulleys subject to this recall were significantly different in design compared to the Freudenberg components subject to PE03-058. Mercedes-Benz also reports that the failure mechanism of the harmonic balancers in 96V-058 was different than that exhibited by those subject to the current investigation.

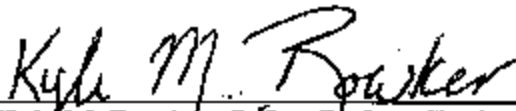
Figure 1: 96V-058 pulley (left) as compared to PE03-058 pulley (right)



Recall number 96V-058 affected 152 vehicles equipped with engine damper pulley p/n 104 030 17 03. This component was manufactured from pressed sheet metal, as opposed to the subject Freudenberg harmonic balancers, which were made from cast iron. The pressed sheet metal pulleys were defective because they lacked a proper fillet radius at the transition area between the inner and outer rings of the pulley. There were no field failures at the time of the recall, but quality assurance testing indicated that some pulleys did not meet company quality standards. The manufacturing defect could allow the pulleys to develop fatigue fractures and fail catastrophically and without warning, resulting in a sudden loss of the V-belt and the potential for flying debris.

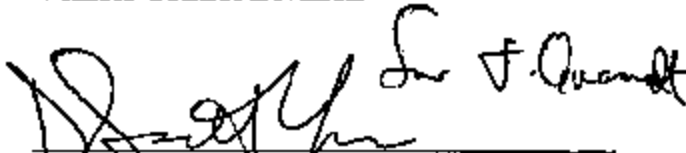
**CONCLUSIONS AND REASON FOR CLOSING:** The subject component failures are progressive in nature and there is audible and visual warning prior to the outer pulley separating from the inner hub of the harmonic balancer. Only a small percentage of the complaints and warranty claims involved failures that had progressed far enough to effect power steering performance (6 of the 55 ODI complaints reference increased steering effort). There have been no crashes or injuries related to the alleged defect.

A safety-related defect has not been identified at this time and further use of agency resources does not appear to be warranted. Accordingly, this investigation is closed. The closing of this investigation does not constitute a finding by NHTSA that a safety-related defect does not exist. The agency will take further action if warranted by the circumstances.



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