



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

ODI RESUME

Investigation: EA07-017
Date Opened: 12/07/2007 Date Closed: 07/16/2008
Principal Investigator: Stephen McHenry
Subject: Rear drivetrain component failure

Manufacturer: General Motors Corp.
Products: 2004 - 2006 Cadillac CTS-V
Population: 7,642

Problem Description: Rear drivetrain components (e.g., rear differential carrier housing, rear axle half shafts) may fracture while driving causing a loss of motive power and vehicle disablement.

FAILURE REPORT SUMMARY

	ODI	Manufacturer	Total
Complaints:	6	17	23
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	0	0

* Description of Other:

Action: This Engineering Analysis is closed.

Engineer: *Stephen McHenry* SM
Div. Chief: *Jeffrey L. Quandt*
Office Dir.: *Kathleen C. DeMeter*

Date: 07/16/2008
Date: 07/16/2008
Date: 07/16/2008

Summary: In July of 2007 the Office of Defects Investigation (ODI) opened PE07-037 to investigate allegations that the rear differential may fail causing a loss of motive power, and in some instances a loss of control, in model year (MY) 2004 through 2006 Cadillac CTS, CTS-V, and STS vehicles. As a result of that investigation GM issued recall 07V-589 to correct a leaking pinion seal problem. EA07-017 was opened to investigate complaints of fractured rear differential housings or rear half shafts in high performance Cadillac CTS-V vehicles. According to GM, these failures resulted from the cumulative damage from multiple power hop events that can occur during very aggressive driving.

In February 2008 Investigators from ODI met with GM representatives to conduct testing of the subject CTS-V vehicles. During the testing the subject vehicles were subjected to considerable torsional forces from standing starts and while driving. Power hop occurred during some of the most aggressive driving maneuvers. The testing did not result in failure of any rear drivetrain components. The engineering design and testing data supplied to ODI by GM and the results of the testing conducted by ODI tend to support GM's position that the differential design is not defective.

Complaints listed in the failure report do not include those indicative of failure of the rear pinion seal in CTS-V vehicles covered by Recall 07V-589.

Further investigation in this matter would not be an efficient allocation of agency resources. Accordingly, this investigation is closed. See attached closing report for further details.

Engineering Analysis Closing Report

EA NUMBER: EA07-017

SUBJECT: Rear drivetrain component failure.

DATE OPENED: December 7, 2007

DATE CLOSED:

||| 1 6 2008

SUBJECT VEHICLES: Model year (MY) 2004 through 2006 Cadillac CTS-V vehicles.

SUBJECT COMPONENT: The focus of Engineering Analysis EA07-017 was the rear drivetrain components of the Cadillac CTS-V including the rear differential carrier housing, the internal gears, and the rear axle half shafts.

ALLEGED DEFECT: The rear drivetrain components may fracture while driving causing a loss of motive power and vehicle disablement.

VEHICLE POPULATION: The total population is 7,642 vehicles (Table 1).

Model Year	U.S. Market Volume
2004	2,432
2005	4,048
2006	1,162

Table 1: CTS-V Population

DESCRIPTION OF SUBJECT VEHICLE: Cadillac introduced the CTS (C-Series Touring Sedan) in MY 2003 as a mid-sized, entry level, luxury car. The CTS was designed with a rear wheel drive powertrain, originally powered by a 3.2 L engine. In MY 2004, the CTS-V was introduced as a sportier, higher performance version. The CTS-V was equipped with a six-speed manual transmission and with an engine that generated significantly more horsepower (400hp vs. 220hp) and torque (395ft-lbs vs. 218ft-lbs) than the Cadillac CTS.

BASIS OF THE INVESTIGATION: On July 17, 2007, the Office of Defects Investigation (ODI) opened Preliminary Evaluation PE07-037 to investigate allegations that the rear differential may fail causing a loss of motive power and in some instances a loss of control in MY 2004 through 2006 Cadillac CTS, CTS-V, and STS vehicles. ODI had 20 Vehicle Owner Questionnaire reports (VOQs) of rear differential failure resulting in a loss of motive power.

On December 19, 2007, GM submitted a Defect Information report to NHTSA concerning defective rear axle pinion seals in approximately 275,936 vehicles, which included MY 2005 through 2007 Cadillac CTS, CTS-V, STS, and SRX vehicles, as well as MY 2006 through 2007 Pontiac Solstice and MY 2007 Saturn Sky Vehicles (Recall 07V-589). GM had discovered that the seal supplier made an unauthorized change to the material used in the manufacture of the seal. This change resulted in premature seal wear and leakage. A loss of differential lubricating fluid via a leaking pinion seal can result in the bearings and gears becoming overheated. One consequence is that the internal components could jam and cause the rear differential to lock-up suddenly, stopping one or both of the rear wheels (axles).

EA07-017 was opened to determine if certain types of failures of the rear differential components attributed to CTS-V vehicles were created by a different cause other than the leaking seal covered by the recall. Some failures reported for the CTS-V indicated that the vehicle would lose motive power during acceleration from a stop, or merging into traffic (such as merging onto a freeway or pulling out into traffic from a turn).

MANUFACTURER'S EVALUATION OF THE ALLEGED DEFECT: In response to PE07-037, regarding the CTS-V vehicles, GM maintained the breakage was the result of "snap clutch" events, where the foot is aggressively removed from a fully depressed clutch at high RPMs when the vehicle is at rest. GM further stated that breakage did not occur after a single or even several "snap clutch" events; instead, it stated that breakage was seen after around 50 events.

ODI ANALYSIS: On February 12, 2008, investigators from ODI met with GM representatives at the GM Desert Proving Grounds in Mesa, Arizona, where testing of Cadillac CTS-V vehicles was conducted. GM demonstrated some of the testing that was performed on the CTS-V drivetrain to certify its durability before model introduction and also demonstrated the snap clutch condition that generates excessive loads on the drivetrain.

During the testing session ODI verified that wheel-hop can occur from a standing start with RPMs at 2,000 or higher with an aggressive clutch release on a dry traction surface (the severity of the wheel-hop increasing with higher RPMs). The sudden, forceful application of power on a high traction dry surface creates twisting forces and a winding up in the rear components. Before the tires can begin to turn and propel the vehicle forward, the tires lose traction and start to spin in place. The bound up, twisting forces cause the rear end to wheel-hop and the rear differential and axles to bang up and down, striking blows to the components that are already under stress. Although this condition can be created due to the great amount of horsepower and torque the high performance engine in the CTS-V is capable of generating, such a driving style is neither typical nor appropriate for normal public roadway usage. The wheel-hop condition can easily be controlled by the driver by simply modulating the throttle application. When done properly, the most efficient take-offs are achieved without "burning rubber" unnecessarily and with no damage or stress to the vehicle's components. The wheel-hop result can be made worse if the driver turns off the traction control, a system designed to prevent a loss of traction when excessive throttle or steering is applied by the driver.

Based on engineering analysis, GM estimated that it would take at least 50 wheel-hop events to induce a failure of the rear differential components on the CTS-V subject vehicles.

During the testing session ODI also investigated a condition reported by some complainants that wheel-hop is more likely to occur on wet or slippery road surfaces. It was determined that this type of wheel-hop differs significantly from dry traction wheel-hop. During a wet surface, reduced traction, condition the rear tires spin more easily because there is reduced grip at the tire contact patch with the road. Because of the reduced grip, there are not the same severe torsional forces being generated in the rear differential as with a "burning rubber," dry surface, occurrence. The rear differential components in a wet surface, reduced traction, event do not suffer the same type or severity of damage as found in a dry surface, reduced traction, event..

No failures of the CTS-V rear differential components were experienced during the testing session in February 2008.

Some of the failures described by CTS-V complainants were indicative of a failure of the rear pinion seal covered by GM-issued recall, 07V-589. However, in some cases the complainants attributed the failures to the high performance nature of the CTS-V. Below is a table summarizing 50 VOQs filed by CTS-V owners that reported a replacement of the rear differential. Importantly, this group is not limited to those who allegedly lost motive power as a result of the failure. Categorization is based on the owner's complaint statement, warranty claim, and field report text relating to those specific vehicles, if available, and interviews with complainants.

Failure Cause	Number of VOQs
Is because of, or is very probably because of, the leaking pinion seal covered by Recall 07V-589	35
Is due to torsional forces generated in the rear differential components, possible normal driving habits	2
Is due to torsional forces created by excessive, or "abusive" (GM's terminology), driving conditions, verified by physical evidence or interview statements	4
Unable to classify	9

Table 1: Categorization of CTS-V VOQ rear differential replacements

Interviews with some wheel-hop complainants revealed that they normally drove with the traction control system off (to achieve a sportier driving feel). These owners understood that the traction control system was designed to help prevent wheel-hop occurrence.

This investigation presents a question of whether the differential in the CTS-V vehicles, other than those recalled for defective seals, is defective. These vehicles are high performance vehicles and considerable hard driving of them, even abuse, is to be expected. These vehicles should stand up to such abuse. Even though they are high performance vehicles, they need not withstand gross abuse. Some of the owner complaints may be viewed as tending to indicate that the differential should not have failed in the circumstances in which it failed. The engineering design and testing data supplied by GM tend to support the position that the differential design was not defective. In the testing at GM proving grounds, which included popping the clutch at considerable engine speeds and other actions that would impose substantial torsion forces on the differential, the vehicles did not fail. In order to develop the facts substantial further investigation would be necessary and such an effort may or may not support a case. There may also be issues whether any defect is safety-related. Further investigation in this matter would not be an efficient allocation of agency resources. 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 continue to monitor complaints and other information relating to the alleged defect in the subject vehicles and take further action in the future if warranted.