

Engineering Analysis Closing Report
Park Brake Ineffectiveness on MY 1999-2003 Silverado/Sierra ½ ton Pickup Trucks
Equipped with Manual Transmissions
EA04-011

Background

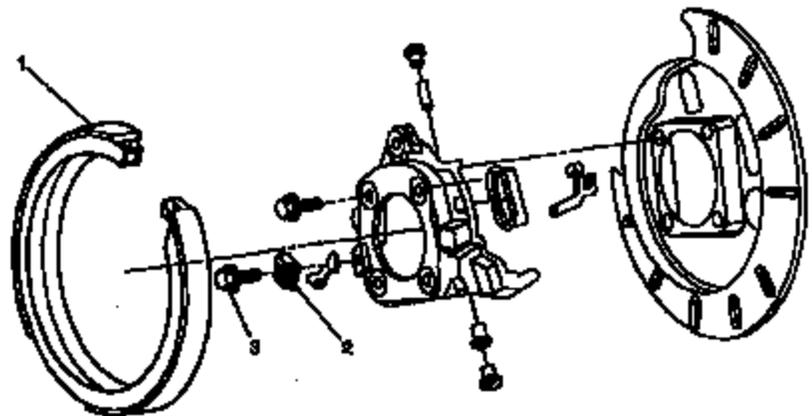
The Office of Defects Investigation (ODI) opened a Preliminary Evaluation (PE03-057) on December 8, 2003, based on a technical service bulletin and eight Vehicle Owners Questionnaires (VOQ) reporting premature parking brake wear-out in Model Year (MY) 1999 – 2003 Sierra and Silverado 1500 (½ ton) “C/K” pickup trucks. PE03-057 was upgraded to an Engineering Analysis (EA04-011) on April 9, 2004. During the investigation, ODI collected data concerning the manual transmission-equipped Silverado/Sierra 1500 pickups (subject vehicles) and millions of peer vehicles that included ½ ton pickup trucks manufactured by Ford and Dodge, as well as all MY 1999 – 2004 automatic transmission-equipped GM C/K pickups and sport-utility vehicles based on the same platform as that used in the subject vehicles. This information covered the 1500 series (½ ton), as well as the heavier 2500 and 3500 series trucks (¾ and 1 ton respectively).

ODI’s chief concern in this investigation has been the possibility that an unattended vehicle containing an ineffective parking brake may inadvertently roll, striking persons or property. While the investigation was opened on MY 1999 – 2003 vehicles, subsequent analysis has shown that the alleged defect is localized in MY 1999 – 2002 vehicles.

GM filed a defect information report on April 22, 2005, indicating that it would perform a safety recall to remedy the alleged defect in 58,633 MY 1999 – 2002 subject vehicles. This recall campaign is designated 05V161.

Subject System

The subject vehicles feature rear disc brakes that utilize a small non-service drum brake contained within the “hat” portion of the brake rotor¹. This particular system is supplied to GM by PBR and is intended solely as a parking-assist device that would supplement the vehicle transmission’s immobilization



features (park pawl in automatics, Reverse or First gear in manuals). This parking brake system is distinguished from other DIH designs in that it contains a single brake shoe bearing two friction linings (Item 1 in Figure 1) and is referred to as a “Banksia”-style brake. The brake shoe is expanded by a cable-actuated piston and is confined against the backing plate by a spring-loaded hold-down clip (Item 2 in Figure 1). The Banksia parking brake system contains fewer

¹ Placement of a small drum-style parking brake within the “hat” portion of a brake rotor is common and is typically referred to as “Drum-in Hat” (DIH).

parts than the traditional two-shoe systems and, in this particular implementation, includes no active self-centering or self adjustment mechanisms.

Alleged Defect

The alleged defect has been identified as premature wear-out of the parking brake linings after one of them remains in contact with the brake drum surface while driving. This condition is characterized by the brake shoe pivoting about the piston assembly within the plane of the brake system backing plate so that the end of one of its linings rests against the drum surface. Relative motion of the drum during driving acts to self-energize the brake so as to maintain the drum/lining contact and may occur even in the absence of a parking brake application². GM analysis found that the original-design hold down clip (Figure 2) contributed to this condition by preventing the shoe from retracting the lining away from the drum surface. Examination of complaint vehicles in the field showed that wear occurred earlier and to a greater extent on the driver's side parking brake unit and was largely localized at the tip of one of the linings. A revised clip (Figure 3) designed to exert less force on the shoe was introduced into MY 2003 vehicle production and was concurrently released into the service part stream. Installation of the newer clip and replacement of worn linings has been shown to remedy the defect.



Figure 2: Original Clip



Figure 3: Revised Low-Force Clip

Problem Experience

Consumer Complaints

To date, ODI is aware of over 600 nonduplicative consumer complaints³ reporting premature parking brake wear-out in all MY 1999-2002 C/K 1500 trucks, regardless of transmission type. The majority of complaints involved vehicles that had accumulated 20,000 – 60,000 miles, or 15 – 41 months in service. Most (over 90%) expressed concern over a worn out or inoperative parking brake system, usually discovered during a service visit or mandatory state safety inspection. Interviews of many automatic transmission complainants showed that they rarely used their parking brakes and were surprised and disappointed to learn that the system had worn

² The subject vehicles will warn their operators with a chime if the vehicle is driven over 3 mph with the parking brake engaged.

³ Consumer complaints submitted either directly to ODI or to GM.

out under relatively modest usage. Very few of the interviewed owners indicated that they had noticed noises or any other sign that the park brake had been engaged. Likewise, the majority had not used their vehicle in adverse conditions or used the brake to execute dynamic stops.

Rollaway Events

A total of 46 rollaway events were reported concerning MY 1999 – 2002 C/K 1500 trucks, 22 of which occurred in the subject vehicles, yielding a rate of 38.5/100k, with the balance (24) occurring in 3.7 million sister vehicles containing automatic transmissions, generating a rate of 0.7/100k. Further comparisons of GM to peer Ford and Dodge ½ ton manual transmission vehicles showed that the subject vehicles experienced 3 – 10 times the rollaway rate of their peers, whereas automatic transmission-equipped GM vehicles containing the subject (PBR) parking brake system have displayed rollaway rates similar to those observed in Ford and Dodge trucks.

Service Bulletins

GM has issued four technical service bulletins concerning the subject system:

- Mar-2001 01-05-26-001 "Park Brake- Low Effort Apply System Description"
Indicates that new parking brake systems require less pedal force and are self-adjusting; Describes a park brake test procedure
- Oct-2002 02-05-26-002 "Brakes- Scraping Noises from Rear of Vehicle"
Announced the availability of the low-force clip in certain ½ ton GMT800s
- Feb-2003 02-05-26-002A "Brakes- Scraping Noises from Rear of Vehicle"
Adds Suburban and Yukon XL to earlier models
- Aug-2004 02-05-26-001B "Brakes- Parking Brake Shoe Retainer Clip Availability"
Announces availability of new retainer clip service kit for DIH-equipped vehicles

Modifications

Effective with the start of MY 2003 production, GM's C/K 1500 trucks were equipped with the newer lower force hold-down clip. Field data corresponding to these vehicles shows a dramatically lower failure rate than in the subject vehicles at comparable exposure levels, suggesting that the newer clip has significantly extended the service life of the PBR system. MY 2005 vehicles containing this system have received two hold-down clips, which further enhance the brake shoe's ability to self-center.

Manufacturer Position

GM has stated that the parking brake system in the subject vehicles is intended strictly for use as a parking assist device, to be used in concert with proper transmission settings, that certain use conditions including suspension/wheel modifications and off-road driving may accelerate parking brake wear, and that vehicle owners should periodically test their parking brakes to verify their holding power.

Peer Investigations/Recalls

Since 1985, the auto industry has conducted seven uninfluenced parking brake ineffectiveness⁴ recalls in light vehicles, usually within the first 1-3 years of exposure of the vehicle fleet and usually on both automatic and manual transmission-equipped vehicles. The recalls themselves are relatively small, averaging approximately 20,000 vehicles.

Over this time period, ODI investigations have led to three influenced safety recalls, all involving manual transmissions only, averaging approximately 600,000 vehicles each, and affecting vehicles ranging from 1 to 6 years of age. In two cases (EA93-020 and CA90-001), the alleged defect was the inability of self-adjusters within the parking brake system to maintain proper lining-drum (or rotor) clearance and, by extension, holding torque over the life expectancy of the system. In the third case (EA01-002), the concern was a combination of actuation cable release and insufficient friction capability by the brake lining.

Additional Vehicles Included in Recall 05V161

During its analysis of parking brake matters in C/K trucks equipped with the PBR system, GM identified an additional and unrelated parking brake ineffectiveness concern in the heavier 2500/3500-series (¾ and 1 ton) trucks covering MY 2001-2005, and equipped with a two-shoe DIH parking brake system supplied by TRW. The passenger-side parking brake assembly was observed to wear out far faster than the driver's side due to unexpected forces exerted by cable routing. GM will remedy an estimated 83,000 vehicles containing manual transmissions for this concern by installing a stronger return spring on the passenger-side cable assembly so as to balance cable forces imposed on the system.

Discussion

The subject brake system is used in over 4 million MY 1999 – 2004 C/K 1500 vehicles. Field data and manufacturing changes indicate that the defect is present only in the MY 1999 – 2002 vehicles. Further analysis of complaint data shows that vehicle rollaways- the primary concern in this investigation are largely limited to the relatively small population (58,633) of vehicles equipped with manual transmissions, whereas the remaining population shows a rollaway rate comparable to that of peer vehicles. GM has initiated a recall to remedy the premature wear condition in these manual transmission vehicles.

⁴ In this case, parking brake ineffectiveness is defined as an inability on the part of the parking brake to develop sufficient holding torque to immobilize a parked vehicle (as opposed to a sudden release of an otherwise operational system).

Reasons for Closing

This Engineering Analysis is closed because GM's recall action will remedy the defect condition in the MY 1999 - 2002 C/K 1500 pickup trucks equipped with manual transmissions.


Safety Defects Engineer 5/10/05
Date

I Concur:


Chief, Vehicle Control Division 5-10-05
Date


Director, Office of Defects Investigation 5-10-05
Date