



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

ODI RESUME

Investigation: EA08-009
 Prompted By: PE08-002
 Date Opened: 04/28/2008 Date Closed: 12/16/2009
 Principal Investigator: Chris Lash
 Subject: Brake line chafe

Manufacturer: Mercedes-Benz USA, LLC.
 Products: 1999 – 2002 Mercedes Benz ML 430/500/55 with V-8 engine
 Population: 49,291

Problem Description: The brake line from the master cylinder to the ABS pump may leak due to chafing with the fuel supply line.

FAILURE REPORT SUMMARY

	ODI	Manufacturer	Total
Complaints:	3	16	18
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	125	125

* Description of Other: Warranty Claims.

Action: This Engineering Analysis has been closed.

Engineer: Chris Lash *CL*
 Div. Chief: Jeffrey L. Quandt
 Office Dir.: Kathleen C. DeMeter

Date: 12/16/2009
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Summary:

Analysis of complaints to ODI and Mercedes and warranty claim data submitted by Mercedes indicates that the alleged defect has occurred at a low rate (36.5 complaints per 100,000 vehicles and 0.29 percent warranty claim rate), with no discernable defect trend indicating that the rate of chafing related brake line failures is increasing. There have been no new complaints since January 2009. When the analysis is limited to incidents of brake line leakage that resulted in allegations of reduced brake effectiveness, the rate drops even further (22.3 complaints per 100,000 vehicles and 0.04 percent warranty claim rate).

Mercedes provided data showing that in the rare instances when chafing did progress to brake line leakage the driver would be immediately alerted to a problem by illumination of the bright yellow "ESP/BAS" warning lamp and changes in brake pedal feel. Continued operation with a leaking brake line would result in illumination of the bright red "brake" warning lamp and an audible chime due to low master cylinder reservoir level. Continued operation with the brake warning lamp illuminated would ultimately drain the reservoir for the affected circuit, resulting in loss of the circuit and an approximately 80% increase in stopping distances.

Surveys conducted by ODI and VRTC indicate that routing anomalies may be more common than the complaint and warranty data suggest for the subject line bundle, with line contact or other routing anomaly noted in 13 of 51 vehicles surveyed by ODI and VRTC (25.5%). While evidence of contact between the fuel line and subject brake in a particular vehicle is not necessarily predictive of eventual line failure/leakage, significant chafing wear was noted in two survey vehicles (3.9%). To address concerns with line routing and ensure that lines with evident chafing do not progress to a leak condition, Mercedes will conduct an Owner Notification Program instructing owners to bring the vehicles to a dealer for a free inspection and repair. Lines that do not have a spacer (rubber Grommet or Omega-clip) between the subject fuel and brake lines will have an Omega-clip spacer installed to ensure adequate clearance between the lines. Brake lines with chafe marks will be replaced.

Accordingly, this investigation has been 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.

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ENGINEERING ANALYSIS CLOSING REPORT

SUBJECT: Brake Line Chafe

EA No.: EA08-009

OPENED DATE: 28-Apr-2008

CLOSED DATE:

SUBJECT VEHICLES: Model year (MY) 1999 through 2002 Mercedes Benz M-Class sport utility vehicles equipped with V-8 engines. This includes the ML430, ML500 and ML55 models.



Figure 1. MY 2000 M-Class.

BASIS: The Office of Defects Investigation (ODI) opened Preliminary Evaluation PE08-002 on January 10, 2008, to investigate early warning data indicating that the brake line from the master cylinder to the ABS pump may be damaged by contact with the main fuel supply line near the master cylinder in MY 2002 Mercedes Benz ML500 and ML55 AMG vehicles equipped with V-8 engines. ODI verified the concern by inspecting a subject vehicle and noting contact between the fuel and subject brake line. ODI had not received any consumer complaint related to the alleged defect when PE08-002 was opened.

In response to the information request letter for PE08-002, Mercedes indicated that the subject fuel and brake lines are manufactured as part of a pre-packaged bundle (“line bundle”). The line bundle (Part No. A1634201526) was used without significant change from MY 1999 through 2002 on all M-Class vehicles (both V-6 and V-8 engines). The investigation was upgraded to an Engineering Analysis on April 28, 2008, and the scope broadened to all MY 1999 through 2002 M-Class vehicles equipped with V-8 engines.

ALLEGED DEFECT: The brake line from the master cylinder to the ABS pump may leak due to chafing with the fuel supply line (Figure 2).

DESCRIPTION OF THE SUBJECT COMPONENT: The line bundle is attached to the vehicle frame by plastic clips at eight different attachment points. The area of potential contact with the fuel line is above the frame, in the upper portion of the left-rear corner of the engine compartment, just below the brake master cylinder (see Figure 2). The relative position of the two lines is not controlled by frame clips in the area of concern. The design specification for the line bundle includes a requirement for no contact in this area and the subject vehicles have a 100

percent quality inspection procedure before release, which includes a verification of line separation in this area.

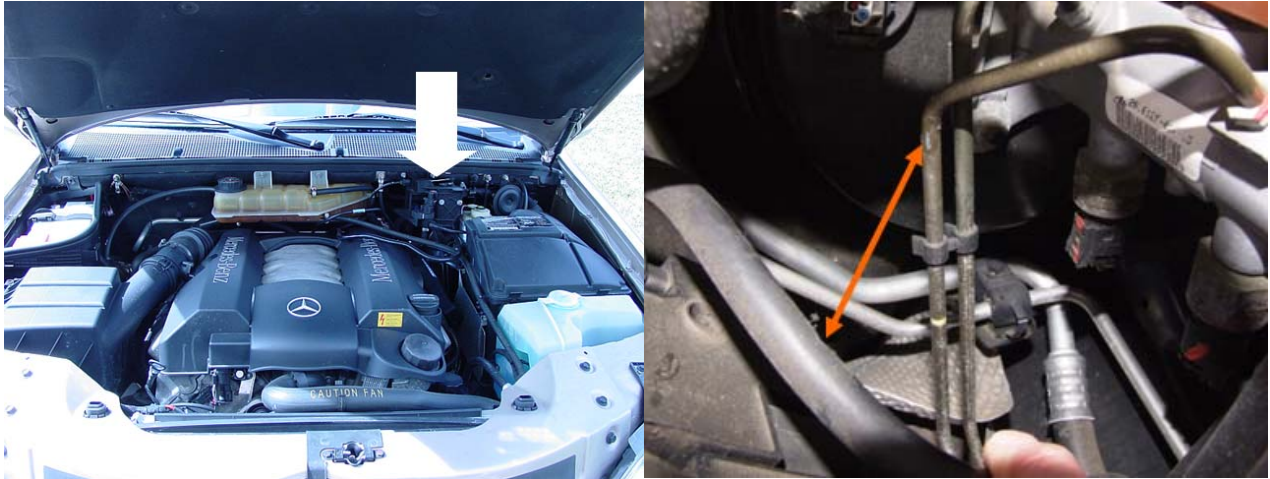


Figure 2. Location of the area of potential contact between the subject brake line and fuel supply line.

As described in the April 16, 2008 Mercedes response to PE08-002, there are a number of design factors that control the relative position of the two lines, including: (1) the location of the fuel rail connection (the termination point for the fuel line in the line bundle); (2) the location of the connection to the brake master cylinder (the termination point for the subject brake line); (3) the length of the flexible portion of the fuel line; (4) the precise location and angle of each of the fourteen (14) bend in the pre-bent steel brake line. The design clearance between the fuel line and subject brake line in the area of concern is about 1.3 inches (32.3 mm), which accounts for relative motion between the two lines during changes in engine torque which cause the engine to rotate slightly on its longitudinal axis (engine “rock”). Because the fuel line is connected to the engine, it will move relative to the fixed brake line as a result of engine rock. The separation decreases during engine braking and increases during acceleration. According to Mercedes this movement is approximately +/- 5mm.

In its April 2008 letter, Mercedes identified a number of factors that could contribute to the potential for contact between the fuel line and brake line, including: (1) the size of the engine (the larger V-8 engines provide less free space in the engine compartment and change the relative position of the fuel rail and master cylinder connections); (2) small supplier variations in the precise length of the flexible portion of the fuel line; (3) the orientation of the fuel line connection to the fuel rail; (4) small supplier variations in the angle of positioning bends in the brake line; and (5) the location of the frame holes used to fasten the eight line bundle frame clips. Mercedes indicated that contact would require the simultaneous occurrence of a number of these factors and, thus, would be “extremely rare.” If contact occurs during the assembly process, Mercedes stated that it would be detected during the inspection process and addressed using an “off-line repair protocol,” which involved using plastic spacer clips to ensure adequate separation between the lines.

DESIGN CHANGES: Mercedes first identified “the potential for this type of brake line and fuel line contact” as an assembly line issue after a larger V-8 engine was introduced in production in 2002. Mercedes responded by implementing changes in the installation process in May 2002 to ensure proper spacing of the fuel and brake lines. If necessary, a plastic spacer clip was added to ensure separation of approximately 0.8 in. between the fuel line and brake line. Mercedes indicated that “a similar remedy” would have been employed through the “off-line repair protocol” that was used previously for routing contact/anomalies.

FAILURE MODE: Contact between the fuel line and brake line first results in abrasive wear of the outer rubber sheath of the fuel line, exposing the braided stainless steel cover of the fuel line. Mercedes conducted wear simulation tests to study the rate at which the brake line would wear from contact with the fuel line. The tests indicated that the braided steel cover of the fuel line would result in failure of the softer metal brake line within 12,000 – 13,000 simulated miles.

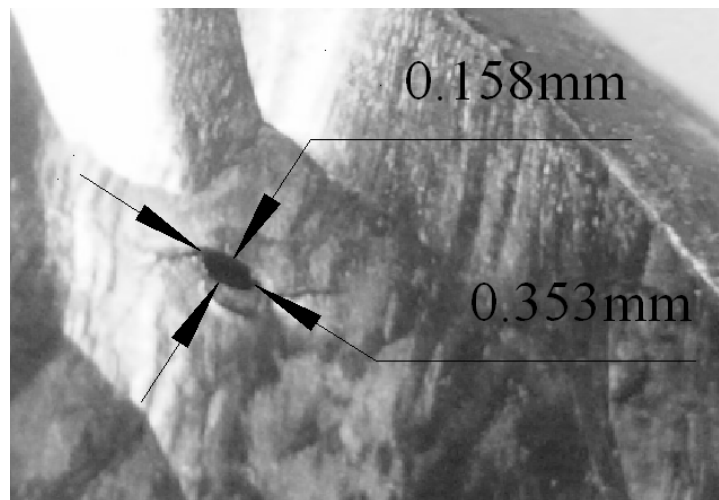


Figure 3. Field return brake with pin-hole leak.

The contact wear produces a small, pin-hole, leak that provides the drivers with some symptoms without initially resulting in reduction of brake effectiveness. Figure 3 provides a magnified view of a field return part with a pin-hole leak. The driver complained of a low pedal and diminished brake performance. When tested by NHTSA’s Vehicle Research and Test Center (VRTC) in East Liberty, Ohio, this part did not result in any notable change in brake effectiveness. The testing did note changes in brake pedal feel (e.g., low, “soft” pedal). Symptoms of line leakage may include illumination of the yellow ESP/BAS warning lamp, should the leak result in sufficient difference in brake line pressure between the affected and unaffected circuits. Statements from some incident drivers (including the driver who provided the field return part depicted in Figure 3) and testing by VRTC, indicate that the ESP/BAS lamp does not always illuminate during braking with a pin-hole leak. Drivers should notice a change in brake pedal feel with a leaking brake line, such as a low or sinking brake pedal during sustained brake application.

Continued operation and braking with a leaking brake line will eventually cause the red BRAKE warning lamp to illuminate and an audible chime warning to sound due to low fluid level in the

affected half of the master cylinder brake fluid reservoir. Further loss of fluid would ultimately drain the reservoir and cause a loss of the affected brake circuit (the left-front and right-rear wheels are in the affected circuit). Table 1 shows the effects of a loss of the affect hydraulic circuit on vehicle stopping distances when tested in accordance with the requirements of Federal Motor Vehicle Safety Standard FMVSS 135, Light Vehicle Brake Systems, S7.10, Hydraulic circuit failure. The data show that stopping distances increased by about 80 percent on average, ranging from a 70 percent increase for the ML430 to an 87 percent increase for the ML55; and the mean deceleration decreased by about 45 percent on average, ranging from a 41 percent decrease for the ML430 to a 47 percent decrease for the ML55. The FMVSS 135 standard requires that vehicles with a hydraulic circuit failure¹ stop in ≤ 168 m (551 ft) from a test speed of 100 km/h (62.1 mph). Each of the subject vehicles tested by Mercedes comply with the requirements of FMVSS 135 S7.10.

Setup	Vehicle	Speed		Pedal Force		Stopping distance		Mean deceleration	
		[mph]	[km/h]	[lbf]	[N]	[ft]	[m]	[m/s ²]	g
Fully functional	1999 ML430	60.0	96.9	101.4	451.1	151	46.1	7.8	0.80
	2002 ML500	62.4	100.4	107.9	480.0	165	50.3	7.7	0.79
	2002 ML55	62.5	100.6	103.4	460.0	168	51.2	7.6	0.77
Hydraulic circuit failure (FL/RR)	1999 ML430	60.0	96.9	108.0	480.5	258	78.6	4.6	0.47
	2002 ML500	62.1	99.9	110.2	490.0	301	91.8	4.2	0.43
	2002 ML55	62.1	99.9	112.4	500.0	314	95.7	4.0	0.41

Table 1. Mercedes brake performance compliance testing data.

VEHICLE POPULATION: Mercedes produced approximately 49,000 subject vehicles with V-8 engines. A breakdown of production volumes by model and model year is provided in Table 2.

Model	Model Year				Total
	1999	2000	2001	2002	
ML430	16,491	12,148	7,092	-	35,731
ML500	-	-	-	9,635	9,635
ML55	-	1,621	1,602	-	3,223
Total	16,491	13,769	8,694	9,635	49,291

Table 2. MY 1999 through 2000 M-Class production with V-8 engines.

¹ For vehicles manufactured with a split service brake system.

FAILURE REPORT SUMMARY: There were 3 complaints to ODI and 16 complaints to Mercedes related to the alleged defect, including one duplicate for a total of 18 complaints. .

Problem Experience	EA Opened			EA Closed		
	ODI	MFR ²	Total ¹	ODI	MFR	Total
Owner Reports / Field Reports	3	16	18	3	16	18
Claims/Lawsuits	-	0	0	-	0	0
Injury Incidents	0	0	0	0	0	0
Fatal Incidents	0	0	0	0	0	0
Warranty Claims	-	66	66	-	125	125

Table 3. Problem experience.

WARRANTY: Mercedes provided information regarding 144 warranty claims related to the subject line bundle in the subject vehicles. Sixty-eight claims did not contain to categorize the condition of the brake line or the warning lamp status and 55 of these also did not provide any information regarding the alleged effects on brake performance. Thirteen of the 68 did indicate that the claim involved a customer concern of increased stopping distance.

Of the 76 claims that did include details regarding line leakage and warning lamp illumination, 19 indicated chafing with no leakage and, hence, no effect on brake performance. For the 57 claims indicating brake line leakage, 9 included indications of reduced brake effectiveness (15.8%).

Leakage	Warning Lamp	Increased Stopping Distance				% known indicating increased stopping distance
		Yes	No	Unknown	Total	
No	No	0	19	0	19	0.0%
Yes	No	8	34	0	42	19.0%
	Yes	1	14	0	15	6.7%
	Subtotal	9	48	0	57	15.8%
Unknown	Unknown	13	-	55	68	-
Grand Total		22	67	55	144	24.7%

Table 4. Warranty claims by symptom and brake effect.

REASON FOR CLOSING: Analysis of complaints to ODI and Mercedes and warranty claim data submitted by Mercedes indicates that the alleged defect has occurred at a low rate (36.5 complaints per 100,000 vehicles and 0.29 percent warranty claim rate), with no discernable defect trend indicating that the rate of chafing related brake line failures is increasing. There have been no new complaints since January 2009. When the analysis is limited to incidents of brake line leakage that resulted in allegations of reduced brake effectiveness, the rate drops even further (22.3 complaints per 100,000 vehicles and 0.04 percent warranty claim rate).

² When EA08-009 was opened the manufacturer warranty claim data were for MY 2002 vehicles only.

Mercedes provided data showing that in the rare instances when chafing did progress to brake line leakage the driver would be immediately alerted to a problem by illumination of the bright yellow “ESP/BAS” warning lamp and changes in brake pedal feel. Continued operation with a leaking brake line would result in illumination of the bright red “BRAKE” warning lamp and an audible chime due to low master cylinder reservoir level. Continued operation with the BRAKE warning lamp illuminated would ultimately drain the reservoir for the affected circuit, resulting in loss of the circuit and an approximately 80% increase in stopping distances.

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