



U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

ODI RESUME

Investigation: EA 09-004
Prompted by: PE08-062
Date Opened: 03/20/2009
Investigator: Ali Motamedamin
Approver: Richard Boyd
Subject: Turn Signal Lamps

Date Closed: 08/12/2010
Reviewer: Scott Yon

MANUFACTURER & PRODUCT INFORMATION

Manufacturer: GENERAL MOTORS CORP.
Products: 2004-2005 Chevrolet Malibu, Malibu Maxx
Population: 344,722

Problem Description: Exterior bulbs for front park/turn signal/DRL or rear stop/turn signal/tail lamps are not illuminating.

FAILURE REPORT SUMMARY

	ODI	Manufacturer	Total
Complaints:	103	853	956
Crashes/Fires:	0	0	0
Injury Incidents:	0	0	0
Fatality Incidents:	0	0	0
Other*:	0	128,057	128,057

*Description of Other: Warranty claims for bulb and sockets: 114,613 for bulbs and 13,444 for sockets.

ACTION / SUMMARY INFORMATION

Action: This Engineering Analysis (EA) is closed.

Summary:

GM designed the MY 2004 and 2005 Chevrolet Malibu and Malibu Maxx vehicles with a daytime running lamp (DRL) system that uses the same filament (the high power filament of a dual filament bulb) as the front turn signals. The high power filament operates at full battery voltage when functioning as a DRL. The DRL is illuminated whenever the headlamps are off, increasing the duty cycle of the front turn signal bulb. The MY 2003 and earlier Malibu vehicles (Malibu Maxx was not manufactured for sale in the U.S. prior to MY 2004) used a headlamp based design, operated at a reduced voltage, for the DRL function; GM reverted back to this design on the MY 2006 and later Malibu and Malibu Maxx vehicles.

Filament based bulbs have a finite life (hours of illumination) for any given operating voltage. As a result, increasing the duty cycle of a bulb typically decreases the life span of the bulb.

GM identified and addressed two front turn signal/DRL and rear turn signal bulb quality issues early in MY 2004 production, however vehicle warranty claims for failed bulbs continued to occur. To address the high warranty levels of bulb failures (90% of the warranty claims submitted to ODI by GM were bulb failures and 10% were socket failures), GM issued a technical service bulletin in March 2006 advising dealers to use a new specification of bulb when addressing service failures, and to also inspect the electrical sockets for thermal damage and replace if necessary. In June 2006 (after subject vehicle production ended) GM changed the turn signal bulb specification to that of the TSB bulb in vehicle production also.

To date, ODI has not identified any allegations of crash, injury, or fire related to the alleged defect even though the subject vehicles have experienced 5 - 6 years of field exposure. ODI's analysis of consumer complaints, both VOQ and manufacturer, shows a declining trend. The warranty rate for turn signal bulb replacement is high however

statistical analysis of the warranty data suggests that the majority of the original equipment bulbs have already been replaced.

GM conducted a safety recall (06V-263) for MY 2004-2005 Cadillac XLR to replace the front turn signal/DRL bulbs and the electrical sockets. However GM advised that the turn signal/DRL bulbs/sockets on the subject vehicles differ from those on the recalled XLRs in several respects, including using bulb sockets with four electrical terminals as opposed to three, which improves the electrical connection, allows the bulb to operate at a lower temperature, and adds stability to the bulb in the socket; operating at a lower voltage, which increases vehicle bulb life; using vented headlamps, which allows bulbs to run cooler than those installed in a non-vented XLR headlamp; and using a clear bulb, which runs cooler than the amber bulbs installed on the XLR. Additionally, the warranty claim level related to subject vehicle sockets is unremarkable compared to other defect investigations into defective socket assemblies.

A safety-related defect trend has not been identified at this time. 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 attached report for further information.

Engineering Analysis EA09-004 Closing Report

BACKGROUND: On September 21, 2008, ODI opened a Preliminary Evaluation (PE08-062) to investigate an alleged loss of front turn signal/daytime running lamp (DRL) and rear turn signal function on MY 2004 Chevrolet Malibu and Malibu Maxx (wagons) vehicles. After reviewing the information submitted to the Office of Defects Investigation (ODI) by General Motors (GM), ODI upgraded the PE to an Engineering Analysis (EA09-004) on March 20, 2009 and amended the subject vehicle population to include the MY 2005 Malibu and Malibu Maxx vehicles. The investigation focused on premature failure of the front turn signal/ DRL and rear turn signal bulb and socket assemblies.

THE ALLEGED DEFECT: Failing front turn signal/DRL and/or rear turn signal bulbs and/or sockets.

DESCRIPTION OF COMPONENT AND VEHICLE SYSTEM: The subject vehicles use combination front turn signals/DRL, which means that one bulb performs two functions: turn signal and DRL. Both functions are performed by a single filament (the high power filament) within the dual filament bulb. The tail lamp has a combination park/stop/tail/turn signal bulb, which illuminates when the vehicle is braking, when the headlamps are on, and when the turn signal or hazard switch is activated. The bulbs attach to the vehicle harness through a socket assembly and electrical terminals. The socket assembly is connected to the vehicle wiring harness. The bulb is pushed into the socket assembly and retained by an interference fit between the terminals on the socket and those on the bulb. The combined bulb/socket is then rotated into the turn signal headlamp assembly.

VEHICLE POPULATION: A total of 344,722 subject vehicles were sold in the U.S.; 132,367 MY 2004 and 212,405 MY 2005 subject vehicles.

CHANGES/MODIFICATIONS: The MY 2003 and earlier Chevrolet Malibu vehicles used a headlamp based design, operated at a reduced voltage, for the DRL functionality. Beginning with the MY 2004 Chevrolet Malibu and Malibu Maxx, GM revised the design of the DRL system to function using the same filament (the high power filament of a dual filament bulb) actuated by the front turn signals. The DRL operates at full battery voltage. The DRL is designed to illuminate whenever the headlamps are off—an increased duty cycle for the front turn signal bulb compared with the MY 2003 design, which does not illuminate when the DRL is activated. Filament-based bulbs have a finite life, often expressed in hours of illumination, and an increase in duty cycle results in a shorter bulb life and more frequent bulb replacement. GM reverted back to the MY 2003 design for MY 2006 and later vehicles.

The table below (Table 1) shows other component modifications and changes that relate to the bulbs and sockets used on the subject vehicles.

<u>Model Year</u>	<u>Change Date</u>	<u>Description of Change</u>
MY 2004	Feb-04	Redesign base of bulb: to reduce wobbling (improve fit) between bulb and socket.
MY 2004	Jul-04	Change bulb sealing: intended to reduce air leaking into bulb, which can cause premature bulb failure.

Table 1: Design Changes

SERVICE BULLETINS: In March 2006, GM issued a Technical Service Bulletin (TSB) in response to increased warranty claims and consumer complaints that subject vehicle front turn signal/DRL and rear turn signal lamps were failing prematurely. TSB #06-08-42-004 states that if the turn signals are not functioning properly, technicians should inspect the bulbs and replace them with new specification bulbs (redesigned bulbs with improved durability characteristics) if they have failed. The TSB also states that if the sockets appear heat damaged they should be replaced also.

MANUFACTURER’S EVALUATION OF THE ALLEGED DEFECT:

In GM’s view, the most significant contributor to the replacement of these bulbs is bulb quality—bulb wobble and ineffective sealing—which was addressed in the bulb modifications described above. Contributing factors included operation at a higher voltage and an increased duty cycle, both of which decrease overall bulb life.

In its analysis, GM identified two component-related factors that could affect the performance of the bulb and/or socket assemblies: 1) bulb wobble, which increased the chances of “arcing” between bulb and socket; and 2) ineffective sealing between the bulb housing and filament terminals, which allowed air to leak into the evacuated bulb causing the bulb to fail prematurely. Other factors identified by GM that can shorten bulb filament life are operating at a higher battery supply voltage and an increased duty cycle. GM notes the majority of warranty claims are for bulb replacements (about 90% of the claims were for bulbs, as opposed to 10% for socket replacement) and that driver warning is present in the vehicle when a turn signal bulb is out (per FMVSS 108, which requires rapid blinking/audible indicator). GM did not identify any claims alleging crashes or injuries attributable to this issue and noted that if one stop/park/DRL lamp is inoperative others are still available to perform these functions at other locations on the vehicle (i.e., there are redundant bulbs). GM states that the TSB minimizes repeat failures and ensures an effective repair.

GM considers operation at higher voltage and increased duty cycle as contributing to the shorter life of the bulbs. GM states that bulbs used in the subject vehicles are replaceable items that wear-out out with

normal vehicle use including during the warranty period (3 yrs 36,000 miles), and that bulbs on all vehicles eventually fail due to normal use. GM notes that the front turn signal/DRL filament usage (duty cycle) is approximately 20 times higher on systems that combine the turn signal/DRL functions than vehicles with turn signal only systems.¹ GM concludes that the subject vehicles will require more frequent replacement of the front turn signal/DRL and rear turn signal bulbs.

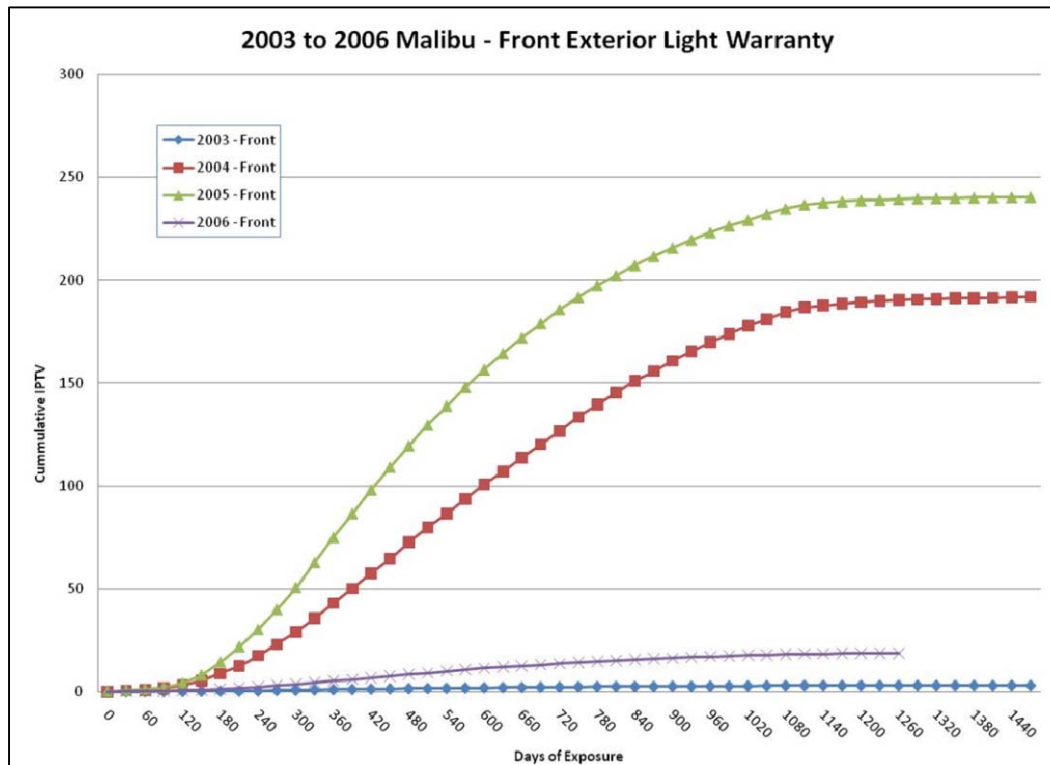


Figure 1: Subject vehicle cumulative front exterior light warranty claims versus days in service (1080 days = 3 years)

ODI'S ANALYSIS: ODI's review of the manufacturer data submitted by GM indicate that GM received significantly more warranty claims for turn signal bulb replacement—primarily the front turn signal/DRL bulb—than claims for socket replacement. Additionally most warranty claims occurred in the earlier stages of the vehicle's life.

Bulbs on subject MY 2004 and 2005 vehicles appear to be failing at a higher rate than those on peer MY 2003 and 2006 vehicles. From Figure 1 above, the warranty chart indicates that the MY 2003 and MY 2006, which use the (reduced voltage) low beam bulb filament for the DRL functionality, have lower levels of front bulb warranty claims compared to the subject vehicles, which have the (full voltage) turn signal based DRL. The graph appears to support that dual turn signal/DRL functionality reduces bulb life.

¹ See response to Request 18 from GM's EA04-035 IR response to ODI dated March 22, 2005.

Figure 2 below provides data comparing the warranty claim rates for front and rear turn signal bulbs between the subject vehicles and peer MY 2006 vehicles. The data indicate the front turn signal/DRL and rear turn bulbs on subject vehicles fail at a higher rate than the MY 2006 peer. One significant difference is that the MY 2006 vehicles do not use the front turn signal for the DRL function (thus the front bulb has a lower duty cycle). Additionally the MY 2006 peers did not contain the bulb quality issues described in Table 1 above, which further explains the differences in front and rear bulb warranty between the subject and peer vehicles.

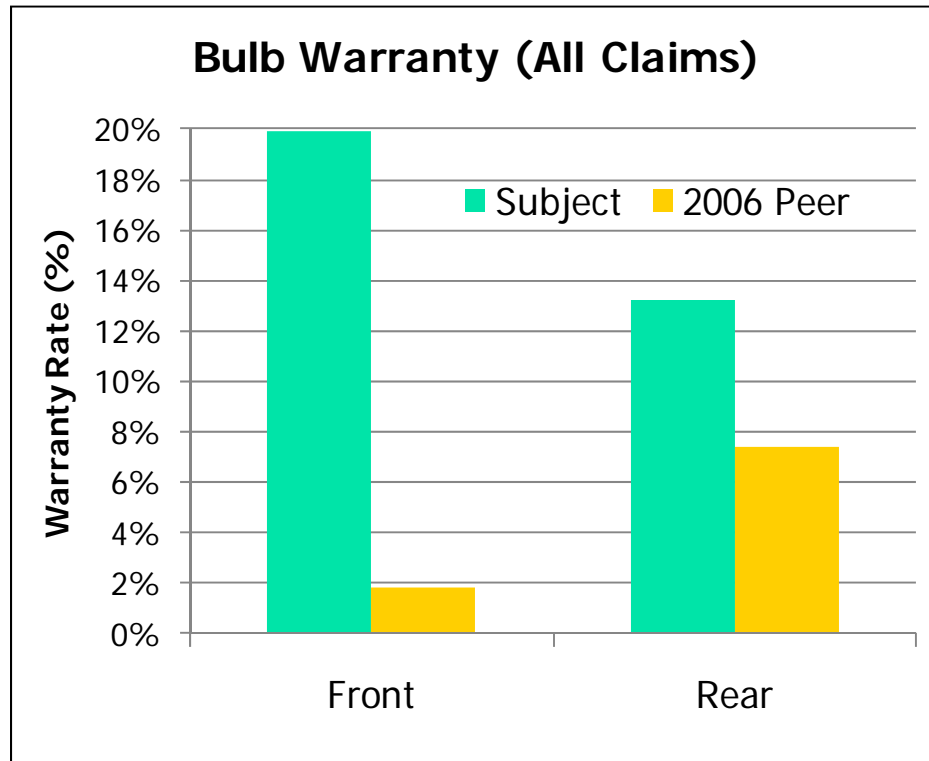


Figure 2: Comparison of Warranty Claims rate between the Subject (turn signal based DRL) and MY 2006 Peer (headlamp based DRL).

Figure 3 below shows a plot of front turn signal/DRL and rear turn signal bulb warranty claims versus the age of the vehicle (in months) the first time the bulb was replaced on a particular vehicle.² (Subsequent bulb replacement(s) on the same vehicle are not represented on Figure 3.) The plot appears to indicate that the warranty claim rate was highest during the first 12 months of the vehicle's service life and decreased thereafter. This data suggests an early life failure mechanism with a declining failure trend.³

² The chart is based on data which includes vehicles (unique VINs) receiving at least one warranty claim involving replacement of a front or rear turn signal bulb. The age at the first warranty repair is shown.

³ An alternative explanation for this declining trend is that vehicle owners are addressing turn signal failures in some manner other than through GM's warranty; for example, vehicle owners may be replacing the failed bulb themselves. The declining complaint trend shown in Figure 5 also suggests a declining bulb failure rate. ODI notes that it is less likely that a consumer would replace a bulb socket themselves since this is a more costly repair that requires a higher level of technical skill; consumers would likely make use of warranty coverage in this case.

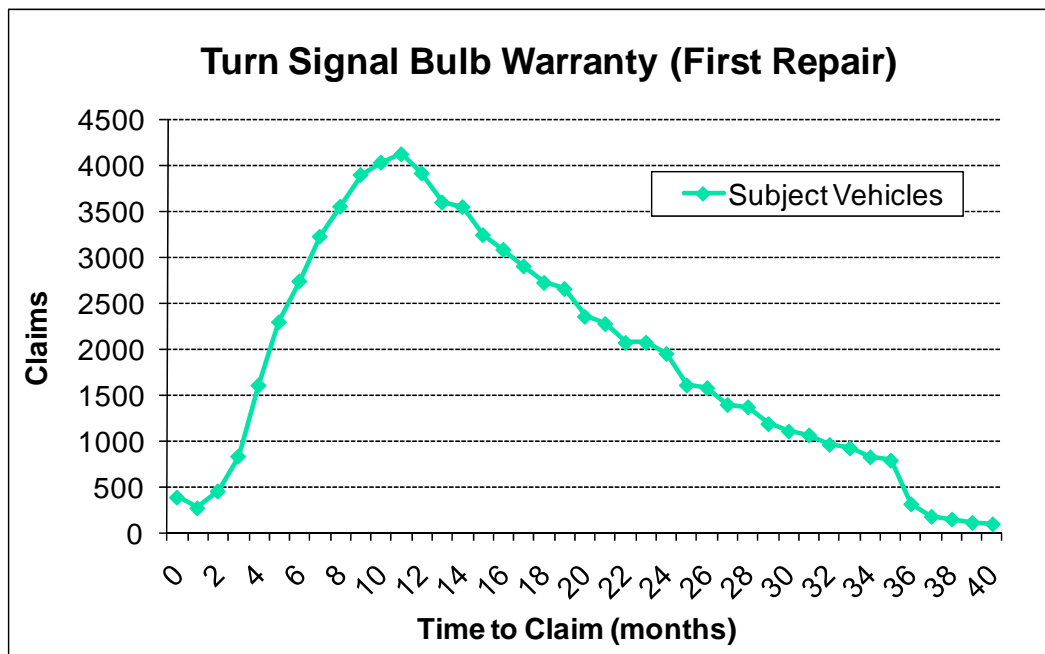


Figure 3: Turn Signal Bulb Warranty versus Age at Time of Claim

ODI conducted a Weibull analysis on the warranty data that appeared to indicate that the majority (about 70 percent for the MY 2004 vehicles) of the original equipment bulbs would have failed at this point in the vehicle's life. In ODI's view, this suggests that most of the original equipment bulbs have been replaced with a higher quality replacement bulb.

Figure 4 below is a plot of the turn signal bulb and socket warranty claims versus the date of warranty repair.⁴ The chart indicates that, starting in calendar year (CY) 2005, GM received significantly more warranty claims for turn signal bulb replacement than claims for socket replacement. The claims for both the bulbs and the sockets fell after GM issued its TSB in March 2006. Warranty coverage expired for most subject vehicles approximately in mid to late CY 2008. The TSB addressing component bulb quality issues apparently lowered the failure rate of the bulbs.

⁴ The chart is based on data which includes vehicles (unique VINs) receiving at least one warranty claim involving replacement of a turn signal bulb or socket.

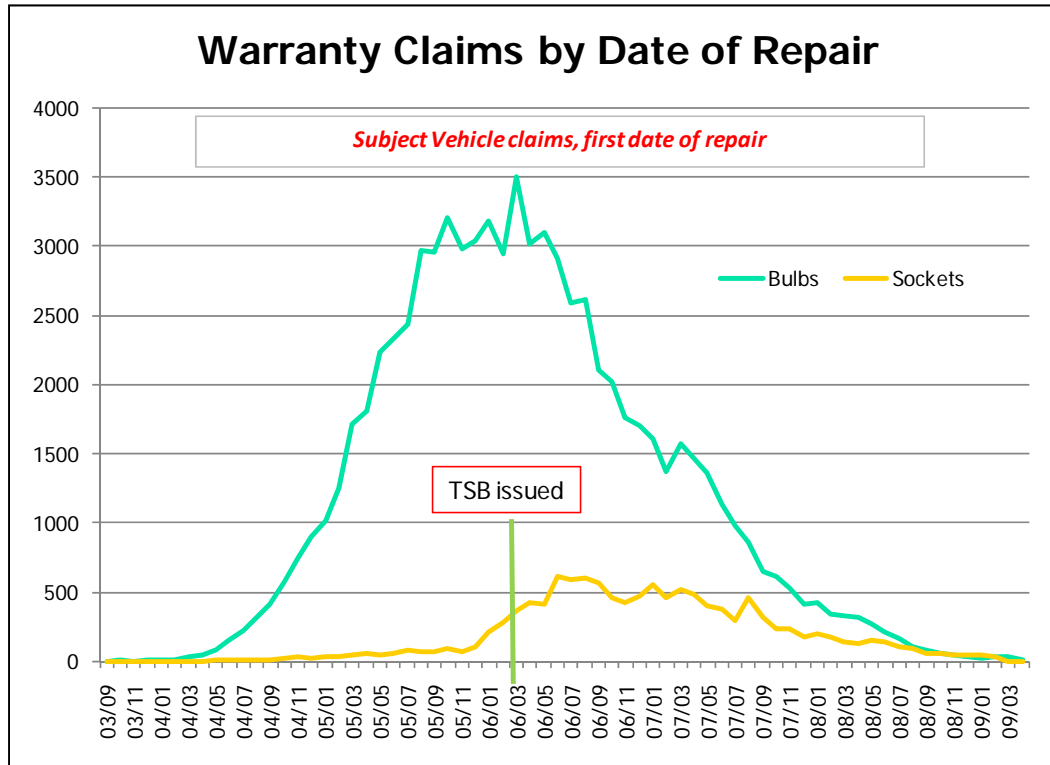


Figure 4: Malibu Bulb/Socket Claims versus Date of Repair.

Figure 5 below shows the numbers of subject vehicle consumer complaints for turn signal related concerns (bulbs and sockets), by date of receipt, as reported to ODI and GM. The complaints increased until around mid 2006, about the time GM issued the TSB, and decreased thereafter. This declining complaint trend is consistent with the likelihood that most of the original bulbs have been replaced and those remaining in use likely will soon be replaced. The warranty rate for subject vehicle bulb sockets is low (3.9% in total) and, like the bulb replacement warranty rate, shows a declining trend. Thus the alleged problem has passed.

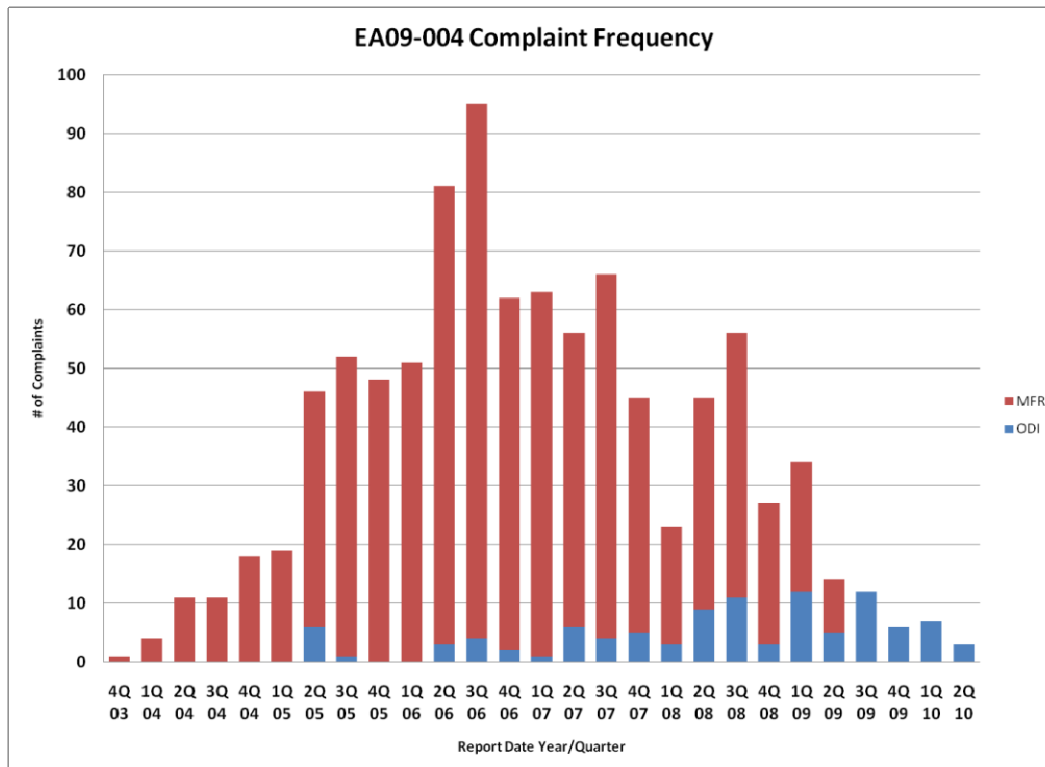


Figure 5: Malibu Complaint Frequency by Quarter.

ODI has not received (either directly or through this investigation) any allegations of crash, injury, or fire likely related to the alleged defect on the subject vehicles, which have been in service for approximately five to six years.

XLR RECALL: GM conducted a safety recall (06V-263) for MY 2004 and 2005 Cadillac XLR vehicles to replace the front turn signal bulbs and sockets. The XLR has a similar dual function front turn signal/DRL bulb system as the subject vehicles. However, the socket related warranty claim levels for the XLR at the time of the recall exceeded that of the subject vehicles. Also, there were several design differences between the subject vehicle bulbs and those installed on the XLR:

1. The sockets installed on the subject vehicles have four terminals, as opposed to three on the sockets installed on the XLR. The additional terminal adds stability to the bulb in the socket, improves the electrical connection thus allowing the bulb to operate at a lower temperature. The XLR was retrofitted with the subject vehicle sockets as a recall remedy.
2. A slightly higher operating voltage in XLR than the subject vehicles results in reduced bulb life.
3. The subject vehicle headlamps are vented, which allows bulbs to run cooler than those installed in the XLR headlamp, which is not vented
4. The subject vehicles have a clear bulb and an amber lens, while the XLR had an amber bulb and a clear lens. Clear bulbs operate at lower temperatures than amber bulbs.

CONCLUSION: This investigation focused on the front turn signal/DLR and rear turn signal bulb and socket assemblies as the possible cause of bulb failures. The subject vehicles contain a dual function filament turn signal/DRL design on the front bulbs. The design results in a higher duty cycle for the front bulbs that likely shortens their life. Bulb quality issues on the original equipment bulbs appear to have caused them to fail prematurely; however, in ODI's view most of the original equipment bulbs on the subject vehicles likely already have failed and been replaced with a higher quality replacement bulb, either through GM's TSB and/or warranty program or by other means.

Bulb socket failure rates for the subject vehicles are low in comparison to those associated with other NHTSA investigations involving sockets. GM conducted a safety recall for a turn signal/DRL related issue on a similar vintage and design product, but the subject vehicles do not contain the defective parts. ODI has not identified any other components suspected of causing loss of turn signals. Neither GM nor ODI identified any allegations of crashes, injuries, or vehicle fires related to this issue, even though the subject vehicles have been in service for approximately five to six years.

A safety-related defect trend has not been identified at this time. 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.