WHICH VEHICLES HAVE A HIGHER PROBABILITY OF FAILING A CALIFORNIA SMOG CHECK INSPECTION PRIMARILY CONSISTING OF A DIAGNOSTIC SCAN OF THE VEHICLE'S ON-BOARD COMPUTER SYSTEM?

A Thesis

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William Dean Thomas

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Robert Wassmer, Ph.D.   Date

Department of Public Policy and Administration

Abstract

of

WHICH VEHICLES HAVE A HIGHER PROBABILITY OF FAILING A CALIFORNIA SMOG CHECK INSPECTION PRIMARILY CONSISTING OF A DIAGNOSTIC SCAN OF THE VEHICLE'S ON-BOARD COMPUTER SYSTEM?

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An important component of California's smog check program is the policy of directing the highest polluting vehicles to specialized smog check stations for testing. The State Bureau of Automotive Repair identifies these 'directed vehicles' through the use of a regression model that identifies the potentially highest polluting vehicles based upon past tailpipe emissions readings of the same type of vehicles. However, beginning in 2014, the testing procedure for a large portion of the vehicles in California will no longer include a tailpipe emissions measurement.

The revised testing procedure will rely upon a scan of the on-board computer diagnostic and control system that controls and constantly evaluates the function of the engine and emissions control systems present on most vehicles manufactured since 1996. The revised procedure will also include a visual inspection of the emissions control devices present on the vehicle. Consequently, there is a need for a regression model capable of identifying the vehicles with the highest likelihood of failure based upon the results of the scan of the diagnostic system and the visual inspection.

In this thesis, I developed a binomial logistic regression model that predicts which vehicles are highly likely to fail the vehicle computer diagnostic scan or visual inspection procedure comprising the new inspection procedure. The regression analyses described herein accurately

identified a group of approximately 40% of the vehicles subject to smog check inspections that have a higher likelihood of failure than the remaining vehicles subject to testing. Implementation of the regression models described in this thesis, or similar models, will enable the Bureau to continue to identify approximately 30% of the fleet of vehicles as directed vehicles.

_______________________, Committee Chair
Su Jin Jez, Ph.D.

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Date

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Finally, I must acknowledge the ever-present love and support of my wife, Suzanne. She too has taken a back seat to this thesis for several months, an action I will happily spend the next several months making up for.

Thank You All!

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Chapter 1

INTRODUCTION

Nearly thirty years ago, the State of California began a program of biennial smog check inspections on most motor vehicles registered and operated in the state. Since that time, we have become accustomed to having to get a smog check every other year when we renew our registration or when we transfer ownership of our vehicle to another Californian in a private party transaction. What many people may not be aware of are the various statutes governing the implementation of the program, including designating the Bureau of Automotive Repair (hereinafter referred to as the Bureau) as the oversight and regulatory enforcement entity for the program, appropriately referred to as the “Smog Check Inspection Program”.

An on-going component of the Smog Check Inspection Program is the requirement to identify vehicles highly likely to fail the inspection. Advances in automotive technology and program changes often require adjustments to the model used to identify these vehicles. This thesis proposes new methodologies for identifying these vehicles and details the analyses conducted to validate these methodologies.

The following sections of this chapter include a description of the smog check inspection program, the origin of the program, general and specific requirements of the program, and past and future changes to the program. There is also a discussion of the methodologies used for identifying vehicles highly likely to fail a smog check inspection, the policies behind those methodologies, and the need for revisions to the methodologies. Chapter 1concludes with a summary of the remaining chapters in this thesis.

Origins of the Smog Check Inspection Program

California led the way in the automotive pollution control realm by implementing a program to identify high polluting vehicles in the mid 1960’s (Eisinger, 2010). This initial smog check program consisted of nothing more than a basic visual inspection of the basic emission control components common to vehicles produced at that time. Throughout the 1970's, while California continued to rely upon a basic visual inspection, other states began implementing what were referred to as "inspection and maintenance programs", commonly referred to as I/M programs, which actually measured vehicle emissions rather than simply conducting a visual inspection.

Eisinger (2010) describes California's attempt at an I/M program conducted in the Los Angeles area between 1979 and 1984 as "unpopular and inconvenient" (p. 29), due to the amount of time required to conduct an actual emissions measurement compared to the mere minutes required for the visual inspection, which is what California motorists were accustomed to. Although the United States Environmental Protection Agency (EPA) pushed for expansion of the I/M program throughout the state as part of 1977 amendments to the Clean Air Act of 1970, California resisted. Elected officials and environmental policy makers were in a difficult situation; maintaining leadership in environmental policy would require inconveniencing millions of motorists. The federal government forced the issue when in December of 1980 they delayed the transfer of federal highway funds to California as a sanction for failing to comply with EPA mandates (Eisinger, 2010). In 1981 and in response to the withholding of highway funds, California State Senator Robert Presley proposed a new approach to emissions inspection programs in Senate Bill 33.

Senate Bill 33 (Presley, Chapter 892, Statutes of 1982) mandated the implementation of a smog check inspection program in the State of California. This program of testing vehicles for compliance with emission control regulations by privately owned smog check stations began in March of 1984, and although changes to the program have occurred over the years, the program is still in place today. The purpose of the program is to identify high-polluting vehicles and require the repair or retirement from operation in California of those vehicles. The program became necessary because of the failure of various regions within the state to meet United States Environmental Protection Agency (EPA) air quality standards (Eisinger, 2010). The program never achieved the expected results and after a 1987 study highlighted the extent of the failure of the program, the State implemented changes aimed at improving the smog check inspection program (Eisinger, 2010).

However, the enhancements still failed to achieve the desired results and the Federal Clean Air Act amendments of 1990 enacted even more stringent air quality requirements, resulting in an even greater number of California regions placed in a ‘non-attainment’ status; indicating these regions fail to meet minimum air quality standards. California’s model of independently owned automotive repair facilities performing all but a very small portion of the smog check inspections in the state was inconsistent with the EPA’s desired model of governmentally contracted centralized inspection facilities (United States Environmental Protection Agency, 1992). USEPA (1992) policies demonstrated a preference for government controlled inspection facilities that are completely separate of repair functions, presumably with the intent to exert more regulatory oversight over the program and to dissuade fraud in the program. However, based upon the number of vehicles in the state and after the failure of the 1970’s centralized inspection program in the Los Angeles Area, California officials were certain the centralized inspection model would result in failure (Eisinger, 2010). Consequently, the Bureau, the Air Resources Board of the California Environmental Protection Agency (ARB), and the state legislature vigorously opposed the centralized testing model and pushed for alternative solutions. One of those solutions, eventually drafted into legislation and becoming law, expanded the existing inspection program by creating a network of privately owned ‘test-only’ stations[1] (California State Assembly, 1994).

The Creation of Test Only Stations

The test-only stations met the EPA’s goal of separation of testing and repair functions, as statute prohibits test-only stations from performing any type of repairs. As a solution to the aforementioned disagreement between the EPA and California over the model for smog check inspections, California proposed and the EPA approved the test-only station model (California State Assembly, 1994). Statute prohibits test-only stations from performing any type of automotive repairs other than testing services (Health and Safety Code, § 44014.5.(b)).

In addition to limiting the types of services provided at test-only stations, statute also directs a certain portion of the vehicles required to receive a smog inspection to test-only stations. These vehicles, referred to as directed vehicles, account for approximately 30% of the vehicles tested each year and are statistically more likely to fail a smog check inspection (BAR, 2012). I discuss the method for identifying directed vehicles later in this chapter. Finally, regulations permit test-only stations to certify ‘gross polluting’ vehicles, which are vehicles exhibiting exceedingly high emissions levels. Regulations prohibit regular, non-test-only stations, referred to as “Test and Repair” stations, from certifying directed and/or gross polluting vehicles. The theory behind test-only stations was that by separating the repair and inspection functions of the smog check program, there would be no incentive for the test-only station to fraudulently certify a vehicle; thereby, ensuring the integrity of the smog check inspection program. The incentive for being a test-only station was the privilege of having a certain portion of the fleet directed to these stations (California State Assembly, 1994).

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[1] Health and Safety Code section 44010 establishes the mechanism for privately owned ‘stations’ which shall be referred to as smog check stations and are authorized to certify vehicles pursuant to the Motor Vehicle Inspection Program established by the Code. Throughout this thesis, the terms station or stations are referring to smog check stations.

These test-only stations met California's goal of continuing to allow privately owned facilities to perform practically all (a small portion, 0.45%, of inspections are performed at Bureau contracted referee stations) smog check inspections while meeting the EPA's goal of separating inspection and repair functions (California State Assembly, 1994). The statutes authorizing privately owned test-only stations were contained in SB 521 (Presley, Chapter 29, Statutes of 1993) and became effective in March of 1994. Test-only stations first began operation in 1997 and eventually grew to comprise the significant portion of smog check stations, 34%, but performing a majority, nearly 65% of the approximate 12 million initial inspections annually (Bureau of Automotive Repair, 2012b).

Directed Vehicles

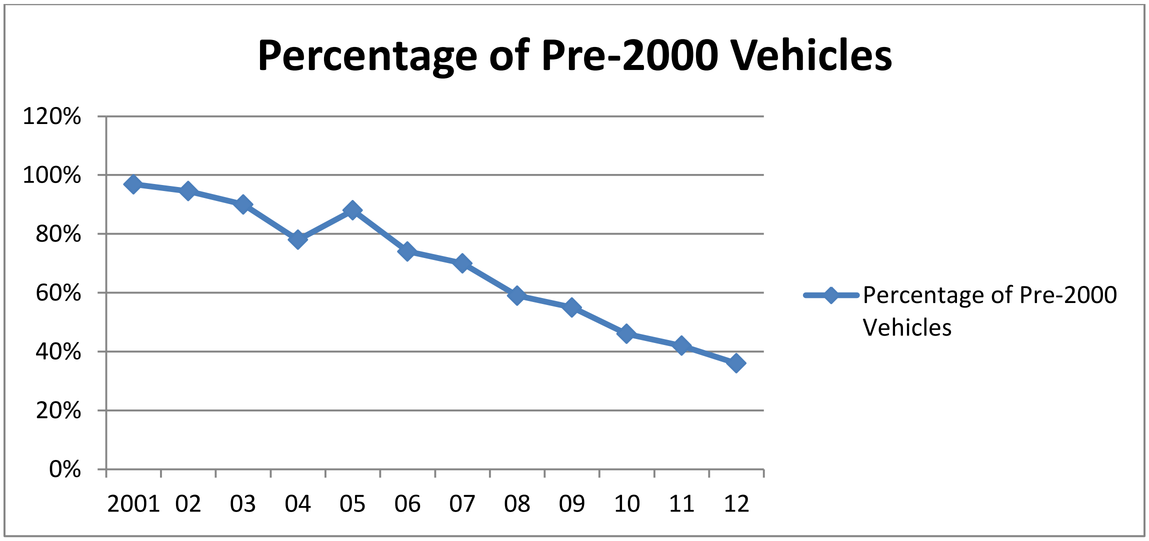
The practice of identifying and directing vehicles for testing at specific stations was also created by the smog check program amendments implemented on March 30, 1994, pursuant to Senate Bill 521 (Presley, Chapter 29, Statutes of 1993). As stated above, test-only stations receive the privilege of testing directed vehicles. Beginning in 1996 and continuing until 2012, the Bureau utilized a model referred to as the high-emitter profile (HEP) model (Bureau of Automotive Repair, 2012a and Choo, Shafizadeh, and Niemeier, 2007) to identify directed vehicles. Although the exact specification for the HEP model remains protected as intellectual property, it reportedly is a logistic regression model that predicts whether a vehicle is likely to generate high emissions based upon certain vehicle design variables (Choo, Shafizadeh, and Niemeier, 2007).

In 2012, the Bureau reported that beginning in 2013, the primary factor for identifying directed vehicles would be the model-year of the vehicle (Bureau of Automotive Repair, 2012a). Specifically, all model-year 1976 through 1999 vehicles will receive directed vehicle status. However, these model-years are diminishing as a percentage of the total volume of tests performed each year and the Bureau has indicated the volume of directed vehicles will remain consistent at the current level of approximately 30 percent of the total volume of tests each year (Bureau of Automotive Repair, 2012a).

A concern with identifying directed vehicles by model-year is simple attrition. As vehicles age and owners replace them with newer vehicles, the number of older vehicles tested each year decreases. As an example, in 2011, model-year 1976 to 1999 vehicles accounted for just over 4.5 million, or 41.80% of the initial inspections performed; while in 2012, these same vehicles accounted for just over 4.0 million, or 35.54% of the initial inspections (Bureau of Automotive Repair, 2012b and 2013). Table 1 below highlights the attrition rate of older vehicles. Appendix A, “Test Volume for Pre-Model-Year 2000 Vehicles”, details the information presented in this graph. As the graph shows, it will only be a few years before the number of vehicles meeting these criteria is too small to provide a sufficient set of directed vehicles. Additionally, California Health and Safety Code section 44010.5 requires the Bureau to direct the vehicles with the highest probability of generating the highest emission levels. Although it is reasonable to assume that the oldest vehicles will generate the highest emissions, this is not a statistically valid approach as required by the code. Finally, beginning in 2014 and as a result of revisions to the smog check inspection procedure, the measurement of emission levels is longer a component of the smog check inspection.

Table 1

Attrition rate of older vehicles



Smog Check Inspection Procedure

The current smog check inspection procedure consists of three components. First is a visual inspection wherein the technician visually inspects all emissions related to components to verify they are present on the vehicle, properly installed, and are free from any visual defects. The second portion of the inspection is the functional test. Depending on the model-year of the vehicle, one or more of the following functional tests will be conducted on the vehicle: Low-Pressure Fuel Evaporate Test (LPFET), which tests the fuel-evaporative control system (primarily the fuel-tank) for leaks; ignition timing test, which measures the ignition timing of the engine; fuel cap test, which is separate from the LPFET and tests the sealing integrity of the fuel cap; On-Board Diagnostic System, Generation II (OBD II) test, which tests the vehicle's engine and emissions control computer; and a visible smoke test, which as the name implies requires the technician to inspect for smoke emanating from the engine or exhaust of the vehicle. The final portion of the inspection is the emissions measurement portion of the test. (Bureau of Automotive Repair, 2009)

Two distinct methods are used for measuring vehicle emissions. The first is the two-speed idle (TSI) test which measures the emissions with the vehicle stopped and the engine running at 2500 revolutions-per-minute (rpm) and at idle speed, generally 600 to 800 rpm. The second came about as a response to the Federal Clean Air Act Amendments of 1990, and is an acceleration simulation mode test of vehicle emissions (Singer & Wenzel, 2003). The acceleration simulation mode (ASM) test places the vehicle on a treadmill-like device allowing the smog check technician to operate the vehicle under a load, simulating driving conditions; specifically vehicle acceleration at 15 miles per hour (mph) and 25 mph (Choo et al., 2007). Both tests are still utilized today, along with the visual inspection and a functional test of certain emissions control components (Bureau of Automotive Repair, 2009). The ASM test is utilized in the more populous areas of the state, referred to as “enhanced” areas (Bureau of Automotive Repair, 2009) and accounted for 76% of the tests performed in 2012 (Bureau of Automotive Repair, 2013)

Further Program Analysis

SB 521 also mandated that BAR perform random, roadside inspections of vehicles throughout the state to confirm compliance with vehicle emissions control laws and to obtain empirical data for smog check program analysis (Health and Safety Code §44024.5). An analysis of the roadside inspection data gathered between 2000 and 2002 revealed that in the category of 1974 to 1995 model year vehicles that had failed an initial smog check inspection, were repaired and subsequently certified as passing, 40% of those failed a roadside inspection within one year after certification (Austin, McClement, & Roeschen, 2009).

To confirm the accuracy of this analysis, Sierra Research conducted a study of 2003 to 2006 roadside inspection data and found that 1976 to 1995 model year vehicles were highly likely to fail a roadside inspection within one year after having failed an official smog check inspection, receiving repairs, and certified as passing; at a level of 49% (Austin, McClement, & Roeschen, 2009). The researchers hypothesized several possible reasons for these results and concluded that improper and poor smog check inspection procedures on the part of technicians is the primary cause of the high roadside inspection failure rates. Further research led to the conclusion that the test-only stations are the predominate source of improper testing procedures. Although it is unclear as to why this is the case, one hypothesis is that the expertise needed to only perform smog check inspections is far less than what is required to diagnose and repair vehicles, leading to poor performance among test-only technicians.

Recommendations for Program Improvement

The Sierra Research analysis concluded with several recommendations for improvements to the smog check inspection program. The primary recommendations are as follows:

- The establishment of performance standards designed to evaluate the inspection practices of technicians and stations
- Elevated monetary penalties, the ability to issue orders of abatement, and other penalty enhancements for those found to be improperly or fraudulently inspecting vehicles
- Modernized testing procedures for vehicles with advanced emissions control technologies
- A complete revision of the model for directing specific vehicles to test-only stations for inspection, so that only those stations demonstrating the highest performance in smog check inspections receive the privilege of testing directed vehicles.

The recommendations and other improvements to California’s smog check inspection program were drafted into new legislation and enacted into law as California Assembly Bill 2289

(Eng, Chapter 258, Statutes of 2010). AB2289 directs the Bureau to implement a program for certifying smog check inspection stations based upon inspection performance and subsequently directing vehicles most likely to be high emitters and gross polluting vehicles only to those stations meeting the aforementioned performance standards. In addition, AB2289 directed the Bureau to implement a new testing model wherein most 2000 model-year and newer vehicles would receive an inspection that consisted only of a computer scan of the vehicles' diagnostic system and a visual inspection of the other applicable emission components. This eliminates the emissions testing portion of the smog check inspection for these vehicles. This testing model is consistent with the USEPA's current preferred inspection model and is already utilized in 31 states and jurisdictions throughout the United States (Environmental Protection Agency, 2013). Inspection procedures for 1999 model-year and older vehicles remain unchanged. (AB2289)

In developing the performance standards as required by AB2289, the Bureau developed a regression model that determines the inspection effectiveness of technicians and stations based upon certain testing behaviors and the probability of a vehicle certified by a particular technician passing a subsequent smog check inspection. These performance measures encompass the Bureau's 'STAR" program, which became effective on January 1, 2013. The STAR program identifies smog check stations that meet the applicable performance criteria as 'STAR Certified', and affords these stations the opportunity to inspect and certify directed and gross polluting vehicles. The performance criteria encompass two sets of measures: short-term and long-term measures. The short-term measures evaluate behaviors such as bypassing a portion of the test or a high number of aborted tests, among other factors. The long-term measure looks at a vehicle certified by a station in the previous test-cycle, 18 to 30 months prior to the current test, and determines the probability of that vehicle passing. A high confidence level in the vehicle passing as it should results in a higher score, on a scale of 0.00 to 1.00 and results in a higher performance rating for the station. Consequently, test-only stations are no longer able to ‘self-certify’ as able to inspect these vehicles and are only able to avail themselves of the increased revenue opportunity in testing directed and gross polluting vehicles by demonstrating acceptable inspection performance levels and becoming STAR certified. (BAR, 2012c)

Modern Vehicle Technology

The above statutorily required modernized testing procedures for the Smog Check program include the elimination of the acceleration simulation mode test for model-year 2000 and newer vehicles equipped with the on-board diagnostics, generation II (OBD II), system (Lyons and McCarthy, 2009). The OBD II system is a microprocessor based electronic control system that monitors and controls the engine operation and the emissions control systems in most light-duty vehicles manufactured since 1996 (Supnithadnaporn, Noonan, Samoylov, and Rodgers, 2011). Light –duty vehicles are passenger cars and light trucks under 14,000 pounds gross vehicle weight rating. This testing method is scheduled for implementation in late 2013 (Bureau of Automotive Repair, 2012d).

Using various sensors, the OBD II system monitors the emissions control and engine management systems to determine if the potential exists for a malfunction that may result in elevated emissions (Lyons & McCarthy, 2009). If a malfunction is identified, the system may illuminate the vehicle’s ‘malfunction indicator lamp’ (commonly referred to as the ‘check engine light’) on the dash and store pertinent information related to the malfunction (Lyons & McCarthy, 2009). Lyons and McCarthy (2009) conducted research and determined that this system is quite accurate and an inspection system that scans and reports this information, and causes the vehicle to fail an emissions inspection as a result of a detected malfunction, is equally as effective as the acceleration simulation mode test. However, a major concern with the Lyons and McCarthy study is that their sample set consisted of only 74 vehicles, which when compared to the greater than 20 million light duty vehicles on California's roadways is not statistically valid. Conversely, the EPA also considers the OBD II system to be quite reliable (Environmental Protection Agency, 2013).

Research Question

The program analysis recommending the use of the OBD II diagnostic system for smog check inspections and redesigning of the model for identifying directed vehicles create a critical need for a regression model capable of predicting which vehicles have a higher probability of failing the revised smog check inspection based solely upon the OBD II functional test results. This leads to the research question for this thesis: *Which vehicles have a higher probability of failing a California smog check inspection primarily consisting of a diagnostic scan of the vehicle's on-board computer system?* To answer this question, I conducted a regression analysis to determine which vehicles are most likely to fail the OBD II functional test of the current smog check inspection. The OBD II functional test is equivalent to the new test procedure that begins in late 2013.

Although the primary component of the new inspection procedure is a scan of the on-board diagnostic system of the vehicle, a visual inspection is also part of the procedure. To insure an accurate model for identifying all vehicles likely to fail the procedure, I developed and evaluated a second set of regression models aimed at predicting which vehicles would fail this portion of the new smog check inspection procedure.

Organization of Remainder of Paper

In Chapter 2, I review the available literature regarding on-board diagnostic systems and their use in smog check inspection programs. Other states are already using this methodology, and the results generated from their experiences provide useful background for the current research. Chapter 3 outlines the methodology employed in the conduct of this research, describes the data collection process, and defines the dataset used in the regression analyses. I also describe the functional form of the regression model selected and discuss the statistical tests performed on the data to confirm the accuracy and significance of the results. Chapter 4 contains an in-depth discussion of the results of the regression analysis and proposes an improved model for identifying directed vehicles. In Chapter 5, I draw conclusions derived from the analysis, discuss the significance of the findings, and make recommendations for future studies and or policy initiatives, as appropriate.

Chapter 2

LITERATURE REVIEW

Chapter 1 of this thesis provides an introduction to the smog check program in California, the policies associated with the program, and future direction of the program. These details served as the impetus for this thesis. In preparation for developing the regression models employed in the current research, I reviewed numerous articles related to the smog check program and automotive on-board diagnostic systems. Chapter 2 provides a summary of the articles and a progression of facts that provide the basis for the statistical analyses described later in this thesis. The first section of this chapter outlines a summary of the smog check program as described by the available literature. The next section discusses the various research projects previously completed that present approaches to statistical models aimed at predicting emission failures. Following is a section a literature that provides an overview of automotive and light truck on-board diagnostic systems or OBD II systems in industry vernacular. Finally, I discuss the literature reporting the results of various empirical studies of OBD II systems, their functionality, and their effectiveness at identifying emissions test failures.

Smog Check Overview

In response to EPA mandates for the State of California to comply with the Clean Air Act Amendments of 1990, the State updated its Smog Check program in 1997 and implemented the acceleration simulation mode (ASM) test described in the introduction to this paper (Eisinger, 2010). The ASM continues as the mandated smog check inspection procedure used in California. As with the original Smog Check inspection procedure, this updated test consists of the same three parts: an emissions measurement conducted at the tailpipe of the vehicle while under load, a visual inspection of the emissions components, and a functional test of certain emissions related devices or functions such as engine timing (Choo, Shafizadeh, and Niemeier, 2007).

The ASM test is a variation of the federal I/M 240 test, which is a 240 second driving sequence that simulates Los Angeles area rush hour traffic, that was in use in other jurisdictions (Eisinger, 2010). It is important to note that the development of the ASM test was a compromise between the EPA, which was pressuring for a centralized testing structure consisting of I/M 240 testing and California officials who felt a centralized testing structure would be ineffective in the State and I/M 240 testing leads to vehicle failures (Eisinger, 2010). This pattern of conflict and compromise between State regulators and the EPA has exemplified the Smog Check program since its inception.

In the mid-1980's, California implemented the Smog Check program, which mandated a biennial emissions test for most vehicles registered in the State (Singer & Wenzel, 2003). This original Smog Check inspection consisted of three parts: a visual inspection of the emissions control devices, a functional test of a small portion of the devices, and an emissions measurement of the vehicle's exhaust (Choo, Shafizadeh, and Niemeier, 2007). The emissions measurement portion of the inspection measured the level of pollutants in the vehicle's exhaust with the vehicle stationary and the engine running at or below 1000 revolutions per minute (rpm) and at 2500 rpm (Singer & Wenzel, 2003). This emissions measurement test is the "two-speed idle" test and has expanded to the current ASM test to meet changes in EPA requirements.

Another of the compromises between the EPA and the State of California in creating the current smog check program was the implementation of test only stations and the direction of a portion of the total fleet of vehicles registered in the State to these stations. The test only stations model served to address the EPA's demands for centralized testing, which would be impractical in California because of the number of vehicles tested each year (Eisinger, 2012). The prevalent theory at the time of creation of this category of directed vehicles and the test-only stations was that there would be no incentive for these stations to game the system by improperly failing vehicles to generate repair revenue or by improperly certifying the vehicles after collecting payment for repairing a vehicle when those repairs were ineffective (Eisinger, 2010).

Modeling to Predict Emissions Test Failures

The on-going dilemma, however, has been in determining which vehicles are appropriate for testing at test only stations. The Bureau eventually selected the high emitter profile (HEP) model developed in 1996 by Radian International corporation discussed earlier (Choo, Shafizadeh, and Niemeier, 2007). However, a later study demonstrated that this model is only slightly more accurate than random chance at identifying vehicles likely to fail a smog check inspection in California (Choo, Shafizadeh, and Niemeier, 2007). Although various research projects produced other models for predicting failures, the Bureau continued to use the HEP model until mid-2012 (Bureau of Automotive Repair, 2012a and Choo, Shafizadeh, and Niemeier, 2007).

Moghadam and Livernois (2010), Bin (2003), and Washburn et al. (2001) all conducted studies designed to develop a regression model capable of accurately predicting which vehicles are most likely to fail an emissions inspection with the goal of allowing the majority of vehicle owners whose vehicles consistently pass an emissions inspection to forego the inconvenience of obtaining a required emissions inspection. The problem with the models developed in these studies is that all of these models focus on predicting which vehicles are more likely to fail an emissions test based upon emissions readings. California's smog check program is changing, reportedly in late 2013, to a testing program consisting only of a visual inspection and a scan of the vehicle's on-board diagnostic system, referred to as the OBD II system. This change renders invalid any failure prediction model based upon emissions readings and necessitates the development of a model for predicting which vehicles may fail a smog inspection that does not utilize emissions measurements.

Moghadam & Livernois (2010) determined the current emissions inspection model utilized in Toronto, Canada achieves the greatest levels of emissions reductions; however, the program is not efficient from a cost standpoint. The researchers conducted a multi-leveled analysis in order to arrive at this determination. First, they conducted a probability analysis to determine at what point in a vehicle's lifespan it would fall out of compliance with emissions standards. The researchers adjusted this value depending upon whether the vehicle had undergone emissions related repairs. Next, the researchers applied cost estimation functions to the level of emissions reduction achieved per dollar spent. Finally, utilizing the above data, the researchers performed a calculation to determine the lifetime (vehicle life span) costs of maintaining emissions compliance. Based upon their findings, they argue that a 2% reduction in the goal for attainment of emissions reductions would result in a 10 – 13% reduction in costs of the program. However, there probably exists little political support for a program that reduces the goals for pollution reduction. This research is important to the current study because the researchers determined that the prevailing theory of focusing inspections on the oldest vehicles in the fleet is not always the most effective approach because these vehicles often do not experience as much use in their remaining years of usage. In fact, the researchers found that by focusing on median aged vehicles, society achieves far greater emissions reductions per dollar spent.

Bin (2003) also conducted a study aimed at determining which vehicles are most likely to fail an emissions inspection. The cost savings to society achieved by only directing those vehicles most likely to fail an inspection for testing and excluding all other vehicles from testing requirements served as Bin's motivating factor in his research. Bin determined there is a positive correlation between the emissions levels of a vehicle and the vehicle's age, number of miles on the vehicle, smaller engine sizes, and certain vehicle manufacturers. The study found that age was the most significant of the variables with a one-year increase in the vehicle's age increasing the likelihood of an emissions failure by 1 to 2%. This study is relevant to this research because it confirms that vehicle age affects emissions levels, supporting the need to use year of manufacture as an explanatory variable in the analysis.

Washburn, Seet, and Mannering (2001) also conducted a study to identify vehicles likely to fail an emissions inspection; however, their study found, at a statistically significant level, that increased age and mileage will cause a decrease in a vehicle's emissions levels. This is inconsistent with most other studies that generally conclude increased vehicle age and odometer reading cause an increase in emissions levels (Bin, 2003; Wenzel and Ross, 2003; Moghadam and Livernois, 2010). Simply stated, prevailing theory dictates that as a vehicle ages in terms of both years and miles accumulated, the emissions levels will increase; yet, Washburn, Seet, and Mannering produced results stating the opposite.

Additionally, Wenzel and Ross (2003) published a comment on the Washburn et al. study and suggested that in the development of their model, Washburn may have focused on the wrong vehicle parameters by utilizing emissions values at an idle and misrepresented certain principles of emissions testing by utilizing certain measured exhaust gasses as explanatory variables for other exhaust gasses. Wenzel and Ross (2003) were correct in their observation that Washburn, Seet, and Mannering's use of emissions values at an idle was incorrect because of the fact that vehicle emissions are nearly always lower at an idle because of the relatively small load (amount of work the engine must perform) placed upon the engine. In addition, Washburn, Seet, and Mannering (2001) utilize certain emissions values as explanatory variables for other emissions values labeled as dependent variables. As an example, Washburn, Seet, and Mattering list carbon dioxide as an explanatory variable for carbon monoxide. Both gasses are products of the combustion process and not causal of one-another. This specification error is problematic in that although the five emissions values measured during an emissions inspection are interrelated and will increase or decrease in expected patterns, they are all the result of vehicle combustion and not causal of one-another. The two errors discussed above likely resulted in the inconsistent results obtained from the study.

The published studies present effective models at predicting which vehicles are likely to fail emissions tests consisting of measurements of vehicle emissions; however, the fact that California will no longer be utilizing tailpipe emissions to certify vehicles as emissions compliant necessitates a different model for predicting failures. The studies above are useful in demonstrating that regression analysis is the appropriate tool for identifying these vehicles, provided the researchers select the appropriate variables. This supports the research conducted in this analysis.

On-Board Diagnostics, Generation Two (OBD II) Systems

The current smog check inspection program consists of three parts: a visual inspection of the emissions components on the vehicle, an emissions measurement of the exhaust gasses of the vehicle, and a functional test of certain vehicle components (Bureau of Automotive Repair, 2009). One of the functional tests performed during a smog check inspection on model-year 1996 and newer vehicles is a scan of the on-board diagnostics, generation two (OBD II) system (Bureau of Automotive Repair, 2009). The OBD II system is a computer based electronic control system that controls engine, transmission, and emissions control system functions to maintain proper engine efficiency and achieve required emissions reductions (Sosnowski and Gardetto, 2001). Currently, 33 states or municipalities utilize an emissions inspection program consisting wholly or partly of an OBD II inspection (Environmental Protection Agency, 2013).

By the 1990's, state and federal regulators had begun enacting regulations requiring automobile manufacturers to utilize on-board diagnostic systems to control the function of the vehicle's engine. California implemented such a requirement by mandating that beginning with model-year 1991 vehicles, all new cars sold in the State would have on-board diagnostics, first generation, (OBD I) systems (Air Resources Board, 2009). At the federal level, the Clean Air Act Amendments of 1990 mandated improvements to on-board diagnostic systems, including standardization between manufacturers, and that these improvements be incorporated into all passenger cars and light trucks beginning with model-year 1996 (Sosnowski and Gardetto, 2001). Eventually, experts attached the label of "OBD II" systems to these improved, standardized on-board diagnostic systems (Air Resources Board, 2009 and Sosnowski and Gardetto, 2001). California followed the federal lead and also implemented a requirement for OBD II systems beginning with model-year 1996 (Air Resources Board, 2009). OBD II systems are still in use today and have undergone numerous improvements in functionality (Lyons and McCarthy, 2009). This supports the use of the system in evaluating the performance of vehicle emissions control systems.

OBD II systems control the operation of the vehicle’s engine, transmission, and emissions control systems to obtain the greatest efficiency while producing the lowest possible emissions levels. The system utilizes a series of sensors to monitor numerous engine parameters. The readings from these sensors are transmitted to the electronic control unit which processes the information and determines how much fuel to supply to the engine and at what point during the engine rotation to ignite the fuel by creating a spark in the ignition system which travels through a spark plug in the engine cylinder, thereby igniting the fuel in the cylinder which generates heat and expansion, creating power. Additionally, the OBD II system determines when to activate various emissions components present on a given vehicle. (Sosnowski and Gardetto, 2001)

Another function of the OBD II system is to perform self-tests of the system and related components. These self-tests are referred to as monitors and are performed automatically during vehicle operation when certain conditions are met. If a failure is detected during the completion of these monitors, the OBD II system may generate a diagnostic trouble code (DTC) and may turn on the malfunction indicator lamp, commonly referred to as the ‘check engine’ light, on the vehicle dash display. By regulation, the OBD II system is required to generate a DTC and illuminate the malfunction indicator lamp if a fault is detected that may cause the vehicle to produce 150% of the specified emissions level for that vehicle.(Sosnowski and Gardetto, 2001)

The OBD II functional test portion of the California smog check inspection consists of scanning the OBD II computer to determine if all of the monitors are complete. If the monitors are complete, the assumption is that the values generated during the functional test are an accurate representation of the engine and emissions system’s current state of health. In addition to determining monitor status, the functional test also requires the smog check technician to determine if the malfunction indicator lamp illuminates when the key is turned on and turns off when the engine is started. This is another indicator of the proper performance of the system. Finally, the functional test scans the OBD II computer to determine if any DTCs are stored in the system. If DTCs are stored in the computer, this is an indicator of a recent or pending malfunction. Failure of any of these three steps will result in the vehicle failing the smog check inspection. (Bureau of Automotive Repair, 2009)

Empirical Studies of OBD II Systems

Researchers have conducted empirical analysis of the functionality of OBD II systems. Some of these studies sought to identify a qualitative method for determining the appropriate design and components for the OBD II system. Others have sought to determine the long-term accuracy of the system at identifying emissions failures. These studies demonstrate the validity of applying statistical models to these systems.

The first study carried the goal of developing a set of models for use by engineers to formulate the decision algorithms for OBD II systems to identify failures (Cascio, Console, Guagliumi, Osella, Panati, Sottano, and Dupre, 1999). At the time of the research, engineers manually created the algorithms for each application, which countered the EPA’s stated goal of standardization. The researchers concluded they were able to develop specific algorithms for OBD II failure determinations. The principles proposed by the researchers are valid because although each vehicle manufacturer may use different structural components within their emissions and engine control systems, the principles of operation are the same. As an example, an ignition system failure in one cylinder of an engine will result in elevated emissions, regardless of the type of ignition system employed. The specific algorithms developed by the researchers will be useful in developing standardized models for the design of the diagnostic and control structures of the systems in place on automobiles such as the fuel control system or the emissions control systems, and identifying specific areas of fault within those systems (Cascio et al, 1999). Because of the need to use the available computing power for the operation of the system, OBD II systems in use in 1999 were only capable of identifying a specific portion of system operating outside of expected parameters or a generalized fault. Research such as Cascio et al has led to OBD II systems that are much more precise in identifying faults than earlier systems and are improved in overall functionality (Lyons and McCarthy, 2009). This is important because variations in technological advancements between automotive manufacturers will likely lead to variation between manufacturers in failure rates of the OBD II functional portion of the smog check inspection.

Barone conducted additional research at streamlining the design process of OBD II systems in 2006. Barone’s stated goal was to develop a statistical method for determining which subsystems to include in the OBD II system. His purpose for the research was to assist automobile manufacturers in achieving the balance between government regulation and consumer satisfaction (2006). Barone pointed out that an OBD II system that was overly sensitive at identifying potential faults would frequently illuminate the malfunction indicator lamp, creating customer satisfaction issues; while a system that was not sensitive enough would fail to meet the requirements of government regulations (2006). Barone's research provides a fundamental statistical basis for the development of OBD II monitors, which are evaluated as a portion of the OBD II functional portion of the smog check inspection. This is related to the current research because of the fact that monitors are evaluated as part of the inspection and variations in the function of the monitors may lead to certain vehicles exhibiting a higher likelihood of failure of the inspection.

In 2011, Supnithadnaporn, Noonan, Samoylov, and Rodgers published a study that detailed the results of an analysis they had conducted to determine the reliability of the emissions inspection program in Atlanta, which utilizes only the on-board diagnostic scan for 1996 and newer light duty vehicles. Their analysis compared the results of on-road emissions measurements gathered for analytical purposes to the results of official inspections to predict the probability of a vehicle passing the official inspection while in actuality the vehicle was emitting excessive emissions. Supnithadnaporn et al. utilized data from an on-going Georgia Tech Research Institute study of actual in-use vehicle emissions and compared that data to the results from the on-board diagnostic scan inspection method. The in-use vehicle emissions data are gathered through the use of remote sensing devices, which measure the emissions of vehicles while the vehicles are in operation (Supnithadnaporn, Noonan, Samoylov, and Rodgers, 2011). The study found that as vehicles age, they are 3.3% per year more likely to generate elevated vehicle emissions while in use in spite of having achieved passing results during an on-board diagnostic scan inspection (Supnithadnaporn, Noonan, Samoylov, and Rodgers, 2011). This means vehicles that successfully pass an inspection consisting of only a scan of the OBD II system may in fact still be generating excessive emissions; especially as those vehicles age. These findings certainly raise concerns about the effectiveness of this methodology at identifying excessively polluting vehicles.

The findings of Supnithadnaporn et al. are statistically significant at the $p<0.001$ level (2011), which indicates a 99.9% probability that actual test results will match the results of their findings. In spite of this statistical significance, there are concerns with the methodology of the study. The major concern is the fact that the regression model compared the on-board diagnostic scan results to the remote sensing data utilizing inspection results obtained after the collection of the remote sensing data. This creates a specification error in the model in that dependent upon the period between the events; it is possible for the vehicle to have been repaired, resulting in an omitted variable.

Another concern with the Supnithadnaporn analysis is the model-year distribution of the sample. The study, although published in 2011, only included 1996 through 2002 model-year vehicles. Lyons & McCarthy (2009) indicate that the on-board diagnostic system on 1996 through 1999 model-year vehicles was not fully functional. This creates an additional error in that the regression model does not account for this lack of functionality in the system. In addition to these issues, Supnithadnaporn et al. (2011) incorrectly identify supporting information such as listing that the on-board diagnostic systems were mandated to be installed beginning in the 1994 model-year and that the system is capable of identifying if the fuel cap has been left off. Lyons & McCarthy (2009) correctly indicate the systems were mandated beginning in 1996 and that although the system is able to identify a vapor leak in the fuel system; it is not able to pinpoint a cause, such as a missing fuel cap. Neither of these errors is as significant as the specification errors and is not likely to affect the regression model.

The problems identified with the Supnithadnaporn study do not diminish its usefulness for this research. The Bureau of Automotive Repair mitigated much of this concern by specifying the new smog check inspection program applies to 2000 and newer vehicles only, likely in response to the Lyons and McCarthy study. Consequently, the research conducted in this study is relevant and necessary for identifying model-year 2000 and newer vehicles that are highly likely to fail a smog check inspection consisting of only a visual inspection of the emissions components and a functional test of the OBD II system.

Conclusion

The literature clearly demonstrates a need for a modern smog check inspection program that takes advantage of the technology employed on modern vehicles. Additionally, the literature outlines the statutory requirement of the Bureau of Automotive Repair to identify a certain portion of the vehicles subject to smog check certification and direct those vehicles to specific facilities for testing. The combination of these two factors identifies the need for a new model of identifying and classifying vehicles as directed vehicles that accounts for a technology based testing program.

The literature demonstrates that over the years, various research projects have sought to create an effective model for identifying these directed vehicles. However, previous research fails to identify a model capable of identifying vehicles likely to fail a smog check inspection that consists of only a visual inspection and scan of the OBD II diagnostic system. The functionality and reliability of the OBD II system as described in the literature supports the development of a model that evaluates the data collected from the OBD II functional test portion of the current smog check inspection procedure and operationalizing that data for the purposes of identifying vehicles highly likely to fail the imminent new smog check inspection procedure.

Chapter 3

METHODOLOGY

To answer the research question of which vehicles are highly likely to fail the OBD II functional portion and the visual inspection portion of the current smog check inspection procedure, I used binomial logistic regression. Binomial logistic regression was the best method to answer this question because of the fact that both dependent variables are binary variables. Both OBD II functional test failure and visual inspection failure are yes (1) or no (0) possibilities. Specifically, I identified the dependent variables as follows: the dependent variable for the regression to identify vehicles highly likely to fail the OBD II functional test portion of the current smog check inspection procedure was "FailOBD" and the dependent variable for the regression model employed to identify vehicles highly likely to fail the visual inspection portion of the current smog check inspection procedure was "FailVisual". Table 2 below details the number and percentage of vehicles failing each of these two portions of the current procedure.

Table 2

Distribution of Failing Vehicles in Current Inspection Procedure

Dependent Variable (Component of Current Smog Check Inspection Procedure)	**Number of Vehicles Failing**	**Number of Vehicles Passing**	**Total Observations**
OBD II Functional Test	389,398	6,894,829	7,284,227
Visual Inspection	54,950	7,229,277	7,284,277

At first glance, the percentages of vehicles failing the OBD II functional test and visual inspection, 5.6% and 0.75% respectively, were lower than desirable for statistical validity. However, evaluating the validity of these values requires consideration of two important factors. First, the overall failure rate for the smog check inspection program in the 2012 calendar year was

13.1% (Bureau of Automotive Repair, 2013). As such, the values are consistent with overall program results. Second, and most importantly, the purpose of this thesis is to identify which vehicles are most likely to fail when compared to other vehicles subject to inspection. Consequently, the regression model compared each of the failure groups and identified the vehicles within each group that are most likely to fail the test or inspection. These facts supported the use of the binomial regression analysis with the current dataset to answer the primary thesis question.

The remainder of this chapter discusses the data used in the analysis, the coding of the data, and the process utilized in selecting variables. Finally, I conclude with a description of the regression models used to answer the research questions.

Smog Check Test Data

The primary data source for this thesis is the Smog Check Test Record data. These data are required to be maintained by the California State Bureau of Automotive Repair pursuant to section 44024.5 of the California Health and Safety Code. I requested and obtained the test data for the nearly 13.3 million smog check inspections performed in the state during the 2012 calendar year. Each inspection is considered one observation and each observation consists of 152 categories of information related to vehicle characteristics such as engine size and manufacturer; inspection characteristics such as the technician performing the inspection and the date and time of the inspection; weather conditions at the time of inspection; the results of the inspection; and other information related to the inspection performed on each vehicle.

Pursuant to public disclosure laws prohibiting the release of personal identifying information, the Bureau redacted the vehicle license plate numbers and vehicle identification numbers from the dataset prior to providing me with the data. This limited my ability to identify and remove duplicate tests performed on the same vehicle in the dataset. A vehicle receives multiple tests in the same calendar year under two circumstances. First, the vehicle fails the initial test, is repaired, and then retested for certification. In limited instances, the vehicle may receive multiple retests. The second circumstance is change of ownership during the same calendar year the vehicle was tested for biennial registration purposes. Both of these circumstances potentially may skew the results, with the first increasing the number of test failures for vehicles in that category and the second decreasing the number of failures for vehicles in that category. However, unless only a select group of vehicles fall within these circumstances, the size of the dataset overcomes any skewed values caused by these circumstances.

The 2012 Smog Check Test Record contains data for all inspections performed, including those not subjected to the new inspection procedures (model-year 1999 and older vehicles). Consequently, I deleted all vehicles not subject to the new inspection procedures from the dataset, leaving approximately 7.9 million observations relevant to only model-year 2000 and newer vehicles. From the 152 categories of information and based on the reviewed literature, I selected only those items capable of identifying those vehicles highly likely to fail the OBD II functional test portion or the visual inspection portion of the current smog check inspection procedure.

Regression Models: OBD II Test Failure

The first set of regression models sought to predict which vehicles or vehicle combinations of make, model-year, model, engine size, and transmission type are most likely to fail the OBD II test. Problems such as manufacturing defects, computer diagnostic strategies, and defective components can all lead to an increase in the likelihood of a vehicle in any or all of the categories above failing the OBD II functional test.

Additionally, although the federal and state requirements for OBD II system functionality vary somewhat, both require that the system identify faults that may cause an increase in vehicle emissions. Consequently, and as the body of literature indicates, each vehicle manufacturer is free to develop specific criteria and algorithms for the OBD II system to follow when performing self-diagnostic tests aimed at identifying potential emissions failures. This leads to a variation between manufacturers in the functionality and reliability of the OBD II system. Often, there will even be differences in functionality and reliability between model-years of the same manufacturer, as exhibited by the OBD II reference guide the Bureau provides to industry (Bureau of Automotive Repair, 2010b).

This variation in design and functionality creates the potential that certain vehicles will demonstrate a higher likelihood of failing the OBD II portion of the smog check. In order to address this issue, it was necessary for me to not only employ categorical variables identifying each vehicle manufacturer as an individual categorical variable, I also needed to include individual categorical variables that identify each vehicle in detail; specifically model-year, manufacturer (make), and engine size, among other characteristics. This led to a large number of explanatory variables; however, this was necessary to specifically identify, with statistical validity, vehicles likely to fail the OBD II functional test. Consideration of these factors led to the following functional form for the first set of regression models:

Failure of the OBD II Functional Test (FailOBD) = *f* (Vehicle Design Characteristics, Vehicle Manufacturer, Year of Manufacture)

Previously, I discussed the fact that the dataset contains 152 different categories of information gathered during the smog check inspection procedure. Of these, three were necessary to create the explanatory variables needed to operationalize the three causal categories above. These three categories were VLT REC NO, recoded to evaluate Vehicle Design Characteristics; VEH MODEL YR, recoded into categorical variables to quantify the manufacturer-designated vehicle Model-Year; and VEH MAKE, which I separated into individual categorical variables to describe Vehicle Manufacturer. I discuss the process used to create these variables below.

The most important of the explanatory variables from the base dataset was the “VLT REC NO”, which is used to describe Vehicle Design Characteristics. The Vehicle Look-Up Table (VLT) Record (Row) Number (“VLT ID”) identifies the manufacturer of the vehicle (vehicle make), the model-year, the vehicle model, engine size, transmission type, and other factors specific to that vehicle and provides the greatest level of detail about each vehicle.. The Vehicle Look-Up Table is a database programmed into each emissions inspection system throughout the state and is maintained and updated by the Bureau on a regular basis (Bureau of Automotive Repair, 2009). Each specific vehicle configuration, with some exceptions, receives a unique VLT ID used to specifically identify that vehicle. By using each VLT ID as a unique and separate explanatory variable, the analysis will identify specific vehicle configurations likely to fail the new smog check inspection procedures.

The specific numerical VLT IDs within the table extend from 00001 to 53084, indicating that there are potentially 53084 specific vehicle configurations identified in the VLT. However, after removing incomplete and invalid observations, the current dataset only contained 2925 VLT ID numbers accounting for approximately 7.5 million observations. There are three probable reasons for only 2925 of 53084 VLT ID numbers remaining in the dataset. First, since the inception of the smog check program in the 1980s, this is the method utilized for identifying vehicles in the program. Consequently, not all vehicle configurations remain in the program. Second, the Bureau frequently updates these identification numbers to identify new vehicle configurations; however, some of the 53084 potential numbers are not in use as of yet. Finally, filtering and cleaning of the dataset likely resulted in the deletion of some VLT ID numbers.

In addition to removing observations that were incomplete or invalid, I also deleted observations accounting for incomplete tests, aborted tests, or other irregularities causing a flawed record. The final number of observations for the dataset is 7,284,277. The most prevalent of the vehicle specific ID numbers was VLT ID 29434, which is a 2000 Honda with a 1.6 liter, four-cylinder engine. This vehicle accounts for nearly 50,000 of the smog check inspections performed in 2012. I used this dataset for all regression models in the current study. Appendix B contains a detail of the distribution of the VLT ID numbers in the dataset.

As stated above, nearly all of the VLT ID numbers apply to a specific vehicle configuration. However, there are some exceptions to this statement in that in certain situations, vehicles manufactured by a different corporation but with similar engine configurations, vehicle weight, identical model-years, and other categories were grouped together under one VLT ID number. An example of this is VLT ID 2270, which accounts for 51,434 observations. This VLT ID number encompasses model-year 2008 compact vehicles with four cylinder engines and manufactured by several different companies; including Honda, Toyota, Chevrolet, Nissan, and others. This grouping within the same VLT ID number of vehicles manufactured by different companies accounts for approximately 900,000 observations. I have accounted for this circumstance by running a second binomial logistic regression analyses aimed at determining which manufacturers within grouped VLT ID numbers are more likely than the other manufacturers in that group to fail the OBD II test portion or visual inspection portion of the current smog check inspection procedure.

In the first iterations of the regression analyses I conducted, I included vehicle make, vehicle model-year, and VLT ID number as the explanatory variables. However, because vehicle make is one of the factors identified in the VLT ID number, these iterations of the regression model resulted in significant multicollinearity. Studenmund (2011) defines multicollinearity in regression formulas as two or more variables that behave identical to one-another in the formula. In essence, the variables are one in the same and are incapable of individual evaluation as to their effect on the dependent variable. This is to be expected in the current analysis because of the fact that vehicle make is a component of VLT ID numbers. As an example, it is quite possible for the aforementioned VLT ID number 29434 as an explanatory variable to exert the same effect on the dependent variable as Honda as an explanatory variable. To remedy this situation and to account for grouped VLT ID numbers, I conducted three separate regression analyses on each dependent variable.

The first regression analysis was a binomial regression with failure of the OBD II functional test as the dependent variable and 2925 VLT ID numbers as the explanatory variables. To account for the VLT ID numbers containing multiple manufacturers and to determine if a specific vehicle manufacturer within a combined VLT ID is more likely than others to fail the OBD II functional test; I completed a second regression analysis with individual vehicle makes as the explanatory variables. Conducting the binomial regression with vehicle manufacturer as the explanatory variable sorts the manufacturers by likelihood of failure and created the ability to accurately classify each manufacturer within combined VLT ID numbers. There were 48 individual categorical variables created from the unique identifiers within the VEH MAKE category from the primary dataset. Table 3 below details the distribution of the vehicle manufacturers within the dataset.

Table 3

Distribution of Vehicle Manufacturers within the dataset

Manufacturer	Number of Observations	Percentage of Total Observations
ACURA	134,221	1.84
ASTON-MARTIN	114	0
AUDI	39,829	0.55
BENTLEY	92	0
BMW	230,074	3.16
BUICK	53,544	0.74
CADILLAC	76,206	1.05
CHEVROLET	819,246	11.25
CHRYSLER	181,412	2.49

DAEWOO	3,879	0.05
DODGE	363,085	4.98
FERRARI	325	0
FIAT	669	0.01
FORD	963,066	13.22
GMC	201,102	2.76
HONDA	796,354	10.93
HUMMER	12,500	0.17
HYUNDAI	122,244	1.68
INFINITI	80,954	1.11
ISUZU	9,034	0.12
JAGUAR	18,313	0.25
JEEP	134,006	1.84
KIA	81,529	1.12
LAMBORGHINI	48	0
LAND ROVER	24,374	0.33
LEXUS	197,881	2.72
LINCOLN	54,229	0.74
LOTUS	61	0
MASERATI	425	0.01
MAZDA	109,333	1.5
MERCEDES	189,849	2.61
MERCURY	34,258	0.47
MINI	23,060	0.32
MITSUBISHI	105,790	1.45
NISSAN	470,520	6.46
OLDSMOBILE	12,183	0.17
PLYMOUTH	5,633	0.08
PONTIAC	71,791	0.99
PORSCHE	20,590	0.28
SAAB	7,967	0.11
SATURN	87,776	1.21
SCION	69,453	0.95
SMART	512	0.01
SUBARU	59,938	0.82
SUZUKI	15,406	0.21
TOYOTA	1,159,923	15.92
VOLKSWAGEN	177,448	2.44
VOLVO	63,981	0.88
Total Observations		**7,284,227**

Finally, I conducted a third binomial regression analysis with the explanatory variables generated from the VEH MODEL YR category of information from the 2012 smog check dataset. Completion of this third regression analysis was necessary to provide further detail as to which vehicles will likely fail the OBD II functional test portion of the current smog check inspection procedure. The additional detail is necessary to clarify any discrepancies in the results of the primary regression model conducted using VLT ID Numbers. From the VEH MODEL YR category of information, I created 12 individual categorical variables, one for each model-year between 2000 and 2012. Table 4 below details the distribution of vehicle model-years within the primary dataset.

Table 4

Distribution of Vehicle Model-Years within the Dataset

Vehicle Model Year	Number of Observations	Percentage of Total Observations
2000	1,122,911	15.42
2001	556,844	7.64
2002	1,246,385	17.11
2003	508,263	6.98
2004	1,353,929	18.59
2005	417,171	5.73
2006	1,432,545	19.67
2007	210,009	2.88
2008	190,003	2.61
2009	63,743	0.88
2010	71,235	0.98
2011	73,767	1.01
2012	37,422	0.51
Total Observations		**7,284,227**

Regression Models: Visual Inspection Failure

The second dependent variable was "FailVisual", which is the overall pass or fail result for the visual inspection portion of the current smog check inspection procedure. The inclusion of a regression model to identify vehicles likely to fail to the visual inspection portion of the smog check inspection procedure was aimed at determining whether certain vehicles are likely to undergo modifications or incur deterioration of components that will cause failure of this inspection. The predominant reason for a failure of the visual inspection is modification of emission components with the goal of improving the performance, often associated with ‘street racing’, the illegal modification and racing of vehicles operated on public roadways. If certain vehicles are more prone to modification, it is appropriate to direct those vehicles for specialized testing procedures. The functional form for this regression model was as follows:

Visual Inspection Failure (FailVisual) = *f* (Vehicle Design Characteristics, Vehicle Manufacturer, Year of Manufacture)

For the second regression analysis evaluating the likelihood of a vehicle failing the visual inspection portion of the current smog check inspection procedure, I utilized the identical final dataset and sets of explanatory variables (See Tables 2, 3 and Appendix B). Additionally, I performed additional binomial logistic regression analyses on the dependent variable of failure of the visual inspection portion of the current smog check inspection procedures. This was for the same reason as performing additional regressions on the failure of the OBD II functional test, to determine if specific manufactures within the VLT ID numbers that contain multiple manufacturers result in a higher likelihood of failure of the visual inspection and to further define the results of the analyses.

The methodology and categorization described was the best approach for answering the research question. In the next chapter, I detail the results of the regression analyses just described.

Chapter 4

ANALYSIS

Completion of the regression analyses as described in Chapter 3 provided significant and meaningful results. The results accurately identify a specific group of vehicles significantly more likely to fail a smog check inspection consisting of a scan of the vehicle's OBD II diagnostic system and a visual inspection of the vehicle emission control devices. In review, I designed two separate but similar groups of regression models to identify which vehicles are highly likely to fail the revised smog check inspection procedure scheduled for implementation by the Bureau of Automotive Repair in 2014. One group of regression models focuses upon identifying vehicles likely to fail a scan of the OBD II diagnostic system present on nearly all passenger cars and light trucks produced for sale in the United States since 1996. The second group of regression models seeks to identify vehicles likely to fail the visual inspection portion of the smog check inspection.

I conducted binomial logistic regressions with the results reported as "odds ratios". This reporting method lists the coefficient for each explanatory variable as a prediction of the likelihood of an occurrence. In this reporting method, a coefficient of 1.000 is the base value, meaning the event or effect described by a variable with this value is equal to the event or effect described by the control variable. A variable with a coefficient value of 0.500 is 50% less likely to take place or exerts 50% less of an effect on the dependent variable as compared to the control variable. Finally, a variable with a coefficient value of 2.000 is 100% more likely to take place or exerts 100% greater of an effect on the dependent variable as compared to the control variable.

Although this reporting method enables me to predict the likelihood of a vehicle failing the inspection as compared to a reference vehicle, the goal of this thesis is to predict which vehicles are most likely to fail. Consequently, the result tables included later in this thesis and in the appendices attached display likelihood of failure expressed as odds ratios with the higher odds ratio values indicating a higher likelihood of failure.

It is important to note that I originally completed a fourth regression model wherein I combined the vehicle make with the vehicle model year, 2002 Chevrolet as an example. However, this methodology resulted in substantial collinearity, resulting in the omission of a large number of variables by the statistical software and compromising the validity of such an approach. Additionally, the Vehicle Look-Up Table identification numbers previously described provide far greater detail for analysis. The next paragraphs detail the results of the regression analyses.

Predicting OBD II Test Failures

I. First Regression: Fail OBD = *f* (VLT ID Numbers)

The three regressions I conducted to identify vehicles highly likely to fail the OBD II functional test portion of the current smog check inspection procedure, and subsequently the revised smog check inspection procedure consisting of a scan of the OBD II system and visual inspection, utilized failure of the OBD II functional test as the dependent variable. For the first of the three, the explanatory variables were the Vehicle Look-Up Table identification numbers. The final cleaned version of the VLT ID numbers consisted of 2925 individual identifiers (Appendix B). During previous iterations of the regression model I conducted in determining the preferred method for conducting this analysis; I discovered Stata, the statistical software used in the analysis, automatically selected the last explanatory variable as the control variable. This takes place regardless of whether I independently selected a control variable. Consequently, I allowed Stata to select the control variable, which in this regression model was VLT ID number 53079. This VLT ID number applies to a 2011 Chevrolet Silverado 2500 pick-up truck with a 6.6-liter diesel engine and either a manual or an automatic transmission. There were 657 observations associated with this vehicle, accounting for 0.01% of the nearly 7.3 million observations. I compared the remaining 2924 VLT ID numbers to this VLT ID.

Completion of the regression model provided meaningful results. Exactly 116 of the VLT ID numbers resulted in a lower likelihood of failing the OBD II functional test as compared to VLT ID 53079, a 2011 Chevrolet Silverado. Of the remaining group, 18 of VLT ID numbers demonstrated zero failures, meaning none of these vehicles resulted in a failure of the OBD II functional test. Finally, 2790 of the VLT ID numbers demonstrated a higher likelihood of failing the OBD II functional test as compared to a 2011 Chevrolet Silverado pick-up truck.

The 18 VLT ID numbers that demonstrated no failures of the OBD II functional test are all 2005 and newer vehicles. In theory, these vehicles will likely demonstrate future failures as they age. It is interesting to note that of the vehicles demonstrating zero failures the Toyota Corporation (Toyota and Lexus) manufactures 10 of the 18 vehicles, or 56%, while at the same time these makes only account for 18.7% of the dataset. Table 5 below provides information for these vehicles.

Table 5

List of Vehicles Demonstrating Zero OBD II Functional Test Failures

VLT ID	Model-Year	Make	Model	Engine Size
2487	2012	Volvo	S 60	2.5 liter
33036	2005	Lexus	LS 430	4.3 liter
33235	2005	Toyota	Sequoia 4WD	4.7 liter
33696	2006	Lexus	SC 430	4.3 liter
33768	2006	Mercury	Mariner	3.0 liter
34025	2007	Cadillac	DTS	4.6 liter
34081	2007	Chevrolet	K1500 Suburban	5.3 liter
34351	2007	Land Rover	Range Rover	4.4 liter
34359	2007	Lexus	GS 350	3.5 liter
34366	2007	Lexus	LS 460	4.6 liter
34370	2007	Lexus	RX 350 4WD	3.5 liter
34549	2007	Toyota	4 Runner 4WD	4.0 liter

34570	2007	Toyota	Rav 4 2WD	2.4 liter
34580	2007	Toyota	Tacoma 4WD	4.0 liter
34583	2007	Toyota	Tundra 2WD	4.7 liter
34597	2007	Volkswagen	Rabbit	2.5 liter
52982	2010	BMW	X5	3.0 liter
53038	2010	Ford	F350 Diesel	6.4 liter

Beyond the vehicles that demonstrated zero failures of the OBD II functional test, the actual odds ratios for the remaining variables, while significant and meaningful, are less important than the rank of each VLT ID number as compared to the remaining ID numbers. As stated throughout this thesis, the goal of the current research is to predict which vehicles are most likely to fail the OBD II functional test portion of the current smog check inspection procedure. Consequently, the following discussion and analysis of the regression results focuses on the distribution of the VLT ID numbers within the regression model.

The mean odds ratio value for the regression analysis was 10.981. In determining which vehicles are more likely to fail the OBD II functional test, any VLT ID number with an odds ratio above this value has a greater than average likelihood of failing the test. Reviewing the results of the analysis as detailed in Appendix C shows that 1636 VLT ID numbers were below this mean value, leaving 1288 VLT ID numbers with odds ratio values above the mean value. These 1288 VLT ID numbers account for 36.92% of the total observations in the dataset. The first of the vehicles identified by this group of VLT ID numbers range is a 2004 Toyota Tundra with a 3.4 liter engine and two-wheel drive. The vehicle identified by this VLT ID number is only slightly above average in terms of likelihood of failing the OBD II functional test with an odds ratio of 10.986. The vehicle identified by the VLT ID number most likely to fail the OBD II functional test is a 2001 Mazda MPV mini-van with a 2.5-liter engine. This vehicle is very highly likely to fail the OBD II functional test with a reported odds ratio for this VLT ID number of 43.542.

Appendix C contains a detailed list of the VLT ID numbers and associated vehicles with odds ratio values greater than the mean.

The binomial logistic regression with VLT ID numbers as the explanatory variables predicting which vehicles are highly likely to fail the OBD II functional test was very effective at identifying a group of vehicles likely to cause a failure of the test. This group of VLT ID numbers, especially those with the highest odds ratio values, identifies a very specific group of vehicles that are appropriate for identification as directed vehicles.

II. Second Regression: Fail OBD = *f* (Vehicle Make)

The second of the three regressions utilizing failure of the OBD II functional test portion of the current smog check inspection procedure encompassed vehicle make (manufacturer) as the explanatory variables. The regression model with VLT ID numbers as the explanatory variables resulted in the identification of approximately 65 VLT ID numbers that are attributable to multiple vehicle manufacturers. This made it necessary to run this second regression to determine if any manufacturer, or group of manufacturers, is more likely than the others to fail the OBD II functional test. These data enabled me to determine if specific manufacturers within a combined VLT ID number are more likely than the other manufacturers to fail. The next paragraphs discuss the results of this regression.

There were 48 individual vehicle makes remaining in the filtered and cleaned dataset. Completion of the regression resulted in all tests performed on vehicles manufactured by Lamborghini passing the OBD II functional test. Every other manufacturer had at least one observation resulting in failure of the OBD II functional test. Additionally, the regression software automatically selected a comparison variable for the regression model. In this model, Stata omitted the manufacturer Volvo as the comparison variable. . In this regression, the mean odds ratio was 1.062, meaning those manufacturers with a higher value than 1.062 have a higher likelihood of failure of the OBD II functional test as compared to the others. Table 6 below details the results of this regression model.

Table 6

Results of Regression Model with Vehicle Make as the Explanatory Variables

	Vehicle Make	Odds Ratio		Vehicle Make	Odds Ratio
1	FIAT	0.054	25	CADILLAC	1.103
2	ASTON-MARTIN	0.159	26	BUICK	1.121
3	LOTUS	0.300	27	MERCURY	1.123
4	SMART	0.359	28	JEEP	1.155
5	LEXUS	0.441	29	GMC	1.168
6	MINI	0.444	30	FERRARI	1.181
7	MASERATI	0.568	31	HUMMER	1.222
8	PORSCHE	0.578	32	HYUNDAI	1.235
9	ACURA	0.582	33	MAZDA	1.265
10	INFINITI	0.636	34	CHEVROLET	1.295
11	HONDA	0.641	35	LAND ROVER	1.326
12	SCION	0.645	36	SATURN	1.331
13	SAAB	0.685	37	VOLKSWAGEN	1.351
14	TOYOTA	0.796	38	CHRYSLER	1.394
15	BENTLEY	0.819	39	DODGE	1.430
16	MERCEDES	0.881	40	PONTIAC	1.521
17	SUBARU	0.986	41	KIA	1.556
18	LAMBORGHINI	Omitted	42	MITSUBISHI	1.631
19	BMW	1.019	43	PLYMOUTH	1.762
20	FORD	1.027	44	SUZUKI	1.795
21	NISSAN	1.039	45	ISUZU	1.847
22	LINCOLN	1.044	46	OLDSMOBILE	1.872
23	AUDI	1.089	47	DAEWOO	3.329
24	JAGUAR	1.096	Mean Odds Ratio		1.062

As Table 6 shows, the results of this regression model are evenly distributed. The mean odds ratio value of 1.062 is very close to the base value of 1.000 for binomial regression. Additionally, the reported odds ratio values for all but one of the manufacturers range from 0.054, which is 95% less likely than a Volvo to fail the OBD II functional test to a high of 1.872, which is 87% more likely than a Volvo to fail the OBD II functional test. The only exception to this is the manufacturer Daewoo, which is 3.3 times more likely than the Volvo to fail the OBD II functional test.

This regression model is very effective at showing that, with the exception of Daewoo; the vehicles are nearly identical in terms of likelihood of failure of the OBD II functional test. Consequently, only Daewoo vehicles contained within any of the combined VLT ID numbers have a greater likelihood of failure of the OBD II functional test. The remaining manufacturers, while showing noticeable differences in the results tables, cannot be labeled as “highly likely” to fail the OBD II functional test portion of the current smog check inspection procedure.

III. Third Regression: Fail OBD = *f* (Model-Year)

Finally, the third regression with failure of the OBD II functional portion of the current smog check inspection procedure as the dependent variable encompasses model-year as the explanatory variables. As a reminder, the model-year is identified by the manufacturer and is not necessarily the year of production. As an example, many 2012 model-year vehicles were manufactured in July or August, and occasionally earlier months, of 2011. This circumstance has always existed in automobile manufacturing.

Given the current study evaluated model-year 2000 and newer vehicles, the regression model consisted of 13 explanatory variables; model-year 2000 through model-year 2012. As always, Stata dropped the last explanatory variable as the control variable. In this instance, this was model-year 2012. The distribution of odds ratios details the expected results. The older a vehicle is, the more likely it is to fail the OBD II functional test. Model-years 2007 through 2011 are least likely to fail the test, while model-years 2000 through 2006 are clearly more likely to fail the test. For this regression, I did not include the mean odds ratio of 4.459 as the results in Table 7 clearly demonstrate the model-years most likely to fail the OBD II functional test.

Table 7
Odds Ratios for Vehicle Model-Years

Model-Year	Odds Ratio
MY2011	0.948
MY2010	1.023
MY2009	1.550
MY2008	1.640
MY2007	1.818
MY2006	2.908
MY2004	4.376
MY2005	4.610
MY2002	7.415
MY2003	7.549
MY2000	7.551
MY2001	12.120

It is important to note that in the first six model-years, the odd year is more likely to fail than the even year; despite the fact the even year vehicles are one year older. This is likely because the smog check is required every other year once a vehicle is six years old or when a transfer of ownership occurs. Consequently, in even calendar years, even model-year vehicles are undergoing inspection as a requirement for renewal of registration while odd model-year vehicles are undergoing an inspection primarily for change of ownership.

The dataset in this analysis is for the 2012 calendar year. Consequently, it is reasonable to assume that a substantial portion of the model-year 2001 vehicles received inspections for change of ownership purposes, and as Table 7 shows, these vehicles are likely to fail the OBD II test at a significantly higher rate than other model-years. The fact that vehicles inspected for change of ownership purposes demonstrate a higher likelihood of failure is significant for the purposes of identifying directed vehicles.

Predicting Visual Inspection Failures

I. First Regression: Fail Visual = *f* (VLT ID Numbers)

As stated previously, I conducted two sets of regression analyses in determining which vehicles are highly likely to fail the new smog check inspection procedure scheduled for implementation in 2014. The first set of analyses sought to predict vehicles highly likely to fail the OBD II functional test portion of the current smog check inspection procedure. The new inspection procedure mirrors this test. The second set of three regression analyses seek to predict which vehicles will fail the visual inspection portion of the current smog check inspection procedure, which will mirror the new inspection procedure as well. All three of the regression models in this group utilize “Fail Visual” as the dependent variable. Each of the three models applies a set of explanatory variables against this variable to determine which of the explanatory variables identifies vehicles highly likely to result in a visual inspection failure.

The first regression analysis in this group utilizes the same set of VLT ID numbers as explanatory variables as utilized in the first OBD II regression model. Stata once again selected VLT ID number 53079 as the control variable. As stated earlier, this VLT ID number applies to a 2011 Chevrolet Silverado 2500 pick-up truck with a 6.6-liter diesel engine and either a manual or an automatic transmission. However, there are little similarities beyond the same control variable for the two regression models utilizing VLT ID numbers as explanatory variables. Although the comparison of the explanatory variables to one-another is again more important than the actual odds ratio values, there is a substantial difference between the two models as far as this comparison is concerned.

This regression model identified 2435 VLT ID numbers less likely to fail the visual inspection as compared to the control variable, which is nearly the exact opposite of the results with OBD II failure as the dependent variable. Additionally, there were 211 VLT ID numbers demonstrating zero failures of the visual inspection as compared to only 18 demonstrating zero failures in the OBD II functional test. Appendix D lists the VLT ID numbers and associated vehicles that demonstrated zero failures of the visual inspection portion of the smog check inspection in the 2012 calendar year.

As with the regression model with OBD II failure as the dependent variable, the actual values of the odds ratios reported in this regression model are less important that the distribution of the VLT ID numbers in the list. In the visual inspection failure model, the mean value of the odds ratios was 0.624. The fact that the mean value is noticeably below the base value of 1.000 for logistic regression is likely because of the fact that, as discussed in Chapter 3 of this thesis, only 0.75% of vehicles failed the visual inspection in the 2012 calendar year. This low failure rate leads to the fact that the substantial majority of vehicles are unlikely to fail the visual inspection, in turn causing the low mean value for the odds ratios of visual inspection failure.

The aforementioned circumstances led me to select only the VLT ID numbers that demonstrated statistical significance in the regression results as those VLT ID numbers with a higher likelihood of failure of the visual inspection portion of the smog check inspection procedure. In the current analysis, there were 153 VLT ID numbers with statistically significant results demonstrating a higher likelihood of failure of the visual inspection. These VLT ID numbers account for 3.71% of the inspections performed in 2012. The lowest of these, but measurably higher than the mean, was VLT ID number 50022 with a reported odds ratio of 1.605, indicating this vehicle is nearly 100% more likely than the mean and 60% more likely than the control variable to fail the visual inspection. VLT ID number 50022 is a grouped VLT ID number that applies to heavy duty light trucks with diesel engines and built by domestic manufacturers (Chevrolet, Dodge, GM, and Ford). The VLT ID number demonstrating the highest likelihood of failure of the visual inspection is VLT ID 31158, with a reported odds ratio of 4.331. This VLT ID number applies to a 2002 Volkswagen Cabrio with a 2.0-liter engine and manual transmission. Appendix E provides details for the 153 VLT ID numbers demonstrating a significant likelihood of failure of the visual inspection portion of the current smog check inspection procedure.

II. Second Regression: Fail Visual = *f* (Vehicle Make)

As with the second regression model to identify vehicles highly likely to fail the OBD II functional test, the second regression model to identify vehicles highly likely to fail the visual inspection portion of the smog check inspection procedure utilizes vehicle make as the explanatory variables. The set of explanatory variables consisted of the same 48 individual vehicle manufacturers as the OBD II set, and Stata again dropped Volvo as the control variable.

Although there are similarities between the two regression models with different dependent variables, there are also noticeable differences in the results of the regression analysis. As with the fail OBD regression model, the manufacturer Lamborghini demonstrated zero failures of the visual inspection. However, in this model, the manufacturers Aston Martin, Bentley, Ferrari, Lotus, and Maserati also demonstrated zero failures of the visual inspection. The fact that these are all high-end luxury car manufacturers is worth noting.

Another notable difference between the two models is that this regression model demonstrated a greater number of manufacturers with a higher likelihood of failure of the visual inspection. In spite of this greater number of manufacturers demonstrating a higher likelihood of failure, the manufacturer Daewoo is once again the most likely manufacturer to fail the visual inspection portion of the current smog check inspection procedure. However, the manufacturers Pontiac, Mitsubishi, Dodge, Oldsmobile, Volkswagen, and Plymouth also demonstrate higher odds ratio values, thus indicating a higher likelihood of failure. Table 8 below details the odds ratio values generated in the regression analysis.

Table 8

Results of Regression Model with Vehicle Make as the Explanatory Variables

	Vehicle Make	Odds Ratio		Vehicle Make	Odds Ratio
1	FIAT	0.237	25	HYUNDAI	1.080
2	PORSCHE	0.285	26	GMC	1.091
3	SMART	0.310	27	ISUZU	1.096
4	MERCEDES	0.409	28	SAAB	1.122
5	LEXUS	0.413	29	SCION	1.150
6	LAND ROVER	0.581	30	SATURN	1.232
7	MINI	0.677	31	BUICK	1.347

8	TOYOTA	0.683	32	SUZUKI	1.360
9	BMW	0.700	33	AUDI	1.369
10	HONDA	0.746	34	CHEVROLET	1.438
11	INFINITI	0.773	35	SUBARU	1.487
12	CADILLAC	0.801	36	FORD	1.561
13	JAGUAR	0.844	37	MAZDA	1.580
14	LINCOLN	0.920	38	MERCURY	1.637
15	ACURA	0.996	39	CHRYSLER	1.790
16	ASTON-MARTIN	Omitted	40	JEEP	1.855
17	BENTLEY	Omitted	41	PONTIAC	2.201
18	FERARI	Omitted	42	MITSUBISHI	2.325
19	LAMBORGHINI	Omitted	43	DODGE	2.351
20	LOTUS	Omitted	44	OLDSMOBILE	2.606
21	MASERATI	Omitted	45	VOLKSWAGEN	2.651
22	NISSAN	1.030	46	PLYMOUTH	4.041
23	KIA	1.069	47	DAEWOO	4.714
24	HUMMER	1.073	Mean Odds Ratio		1.305

The results of the binomial logistic regression analysis clearly identify a set of vehicle manufacturers with a higher likelihood of failing the visual inspection portion of the current smog check inspection procedure. This information will again prove useful at identifying specific vehicle makes within combined VLT ID numbers that are more likely to fail the visual inspection.

III. Third Regression: Fail Visual = *f* (Model-Year)

The final regression model in the second group encompassed vehicle model-year as the set of explanatory variables utilized to describe which vehicles are highly likely to fail the visual inspection portion of the smog check inspection. Stata again dropped model-year 2012 from the dataset as the control variable. Another similarity to the regression conducted to predict which vehicles are highly likely to fail the OBD II inspection as explained by vehicle model-years is that older vehicles are substantially more likely to fail the visual inspection portion of the smog check inspection procedure. A final similarity is that over the first six model-years in the dataset, the odd model-year vehicles exhibit a higher likelihood of failure than the even model-year in spite of the fact that the even model-year vehicles are one year older. Again, this supports the theory that vehicles inspected for the purposes of change of ownership are more likely to fail the inspection. One difference between these regression results and those for the OBD II failure regression with model-years as the dependent variable is the odds ratio values are substantially higher in the visual inspection regression model. This indicates that vehicle model-year is quite significant in terms of predicting which vehicles are highly likely to fail the visual inspection portion of the smog check inspection procedure. Table 9 details the results of the regression analysis.

Table 9
Results of Regression Model with Model-Year as the Explanatory Variables

Model-Year	Odds Ratio
MY2011	1.488311
MY2010	3.400279
MY2009	3.643585
MY2008	4.523026
MY2007	6.906138
MY2006	9.775916
MY2004	14.06943
MY2005	15.0705
MY2002	23.86911
MY2003	25.09562
MY2000	31.61048
MY2001	32.40856

Reliability and Validity

In any study, the implementation of measures to insure the reliability and validity of the conclusions drawn from the analysis is an important step. In order to draw valid conclusions from a regression analysis, reliability of measurement is essential. According to Singleton and Straits (2010), reliability of a measurement means whatever is under measurement in the analysis is consistently and dependably measured. Validity means the predictions made by the analysis are a true reflection of the potential actual outcome of the event (Singleton and Strait, 2010).

Reliability of measurement in regression analysis is generally a concern because most regression analyses analyze a sample of data from a much larger dataset. However, this is not a concern in this analysis because the model did not examine a sample of the smog check inspection data. I specifically decided to apply the regression model to the entire dataset of smog check inspections to overcome reliability concerns. Additionally, the large number of potential explanatory variables required inclusion of all valid and applicable observations to ensure sufficient data for each variable. Finally, because of the fact that a small portion of the vehicles in the dataset received multiple inspections in the reporting period, inclusion of all possible observations was necessary to overcome any skewed values created by the multiple inspections. These factors cause me to have a high confidence level in the reliability of the dataset and subsequent regression analyses.

The question asked in evaluating the validity of this model is whether it accurately identified those vehicles with the highest likelihood of failing either the OBD II functional test or the visual inspection portions of the current smog check inspection procedure. A potential cause for failure of the model to accurately identify these vehicles is the omission of an important variable or variables. In the current study, two potential omitted variables were vehicle condition and testing behaviors. A poorly maintained vehicle may cause an unexpected failure of either portion of the inspection procedure while similar vehicles are less likely to fail the inspection. At the same time, a less-than-scrupulous smog check technician or station may, for whatever reason, take steps to allow a vehicle to pass the inspection when it should not. Both of these conditions can skew the results of the analysis but were addressed by the methodology selected.

In regard to the issue of an unscrupulous technician or station, the volume of observations in the dataset sufficiently minimizes any risk to validity. There were 7,962 active smog check stations in 2012 and 11,921 active technicians (Bureau of Automotive Repair, 2013). The average percentage of tests in the dataset of 7,284,277 tests performed by each station was approximately 0.11% while the average percentage of tests performed by each technician was 0.16%. Consequently, the likelihood of any technician or station performing a large number of tests on a specific category of vehicle within the dataset is very minimal and constitutes an acceptable level of risk.

Maintenance of vehicles is not a risk to the validity of the analysis simply because a major goal of the smog check program is to encourage the improved maintenance of vehicles, resulting in lower emissions (Eisinger, 2010). Smog check programs are often referred to as "I/M" programs, meaning "inspection and maintenance" programs. The theory is that if consumers are aware of the maintenance requirements that must be met for their vehicle to pass the inspection, they are more likely to have the necessary repairs performed. Consequently, if a vehicle is less likely to fail the inspection as a result the maintenance practices of the owner, that is precisely the type of vehicle this study seeks to identify. Again, the risk to the validity of the study created by this potential omitted variable is minimal.

Another common test for validity is hypothesis testing. Although none of the models were seeking to prove or disprove a hypothesis, the principles of hypothesis testing still apply to the models. Hypothesis testing employs the use of a calculated "t-statistic" or "z-test", which are compared to a chart containing a critical value for the t-statistic or a normal distribution chart for the z-test. If the calculated value exceeds the critical value, the researcher must accept the hypothesis proposed by the variable. For logistic regression, determination of validity of the hypothesis encompasses the z-test. Using the regression model with OBD II failure as the dependent variable and VLT ID numbers as the explanatory variables as an example, all 1288 VLT ID numbers above the mean value reported a z-value of greater than 4.30 while the normal distribution value for the z-value is 3.013 at a significance of less than .01. This means there is a 99% probability that the actual failure rate of the vehicles will be within the range specified in the analysis. In five of the six regression models conducted as part of this study, the explanatory variables demonstrating the greatest likelihood of failing the OBD II functional test or the visual inspection all demonstrated a significance level of greater than 99%. The only exception was the model predicting failure of the visual inspection based upon VLT ID number.

As discussed above, there were 153 explanatory variables demonstrating statistical significance in the model utilizing failure of the visual inspection as the dependent variable. Of these, 50 were significant at the 99% level, 57 were significant at the 95% level, and 46% were significant at the 90% level. This means that there is a 99%, 95%, and 90% probability, respectively, that the actual failure rates of these vehicles fall within the range specified in the analysis. Again, the low number of failures as a portion of the overall dataset leads to the low number of statistically significant explanatory variables.

A final test for validity conducted on the regression models was the chi-squared test. This test assesses the validity of the entire regression model by calculating the likelihood of results generated by random chance. The lower the likelihood of random chance, the greater the validity of the regression model as a whole (Adcock, 2010). The chi-squared calculation is similar to the t-statistic and z-test in that the regression model calculates a chi-squared value to compare to a value contained in the "Critical Values of Chi-squared" table. Obtaining the critical chi-squared value requires identifying the intercept of rows labeled "degrees of freedom" and columns labeled "probability". The degrees of freedom equates to the number of valid explanatory variables. The probability ranges from .001 (99.9% likelihood that the results are not random chance) to .10 (90% likelihood that the results are not random chance). For the current regression analyses, the calculated chi-squared values ranged from 11569.80 to 183315.20, well above the critical chi-squared values and indicating a 99.9% likelihood the results of each regression model were not a result of random chance. Table 8 below details the chi-squared values for the current analysis.

Table 10

Detail of Chi-Squared Values for Regression Model

Dependent Variable	**Fail OBD II Test**			**Fail Visual Inspection**		
Explanatory Variables	**VLT ID**	**Vehicle Make**	**Model-Year**	**VLT ID**	**Vehicle Make**	**Model-Year**
Degrees of Freedom	2906	46	12	2173	41	12
Critical Chi-squared Value	149.45	86.66	32.91	149.45	80.08	32.91
Calculated Chi-squared Value	183315.20	31335.43	93242.97	43818.82	11569.80	14038.44
Likelihood of Random Chance	< .001%	< .001%	< .001%	< .001%	< .001%	< .001%

As stated in the introduction to this section, the results of the regression models were significant and meaningful. In the next chapter, I will detail the conclusions drawn from the analysis and make recommendations for future policy actions.

Chapter 5

CONCLUSION

The regression analyses conducted in this thesis provide insight into alternative methods of identifying vehicles highly likely to fail the California smog check inspection procedure. The required inspection procedure is undergoing substantial change, with the elimination of the emissions measurement portion of the inspection procedure for a large portion of the fleet being the most significant change. One of the reasons for this thesis is the fact that the current model for identifying vehicles, referred to as directed vehicles, highly likely to fail the smog check inspection is predominately predicated on the emissions measurements obtained during the inspection. Consequently, transition to a different inspection procedure requires transition to a different model for identifying directed vehicles.

Historically, the Bureau of Automotive Repair has directed, for specialized testing, approximately 30% of the entire fleet of vehicles subject to inspection. All vehicles, regardless of model-year, were subject to evaluation for directed vehicle status. However, beginning in 2014, vehicles model-year 2000 and newer will no longer be subject to an emissions measurement as part of their smog check inspection. The inspection procedure for these vehicles will consist solely of a scan of the vehicle's on-board diagnostic (OBD II) system and a visual inspection of the emission control devices on the vehicle. Consequently, the existing method for identifying directed vehicles will no longer apply to this group of vehicles, which comprises nearly 60% of the vehicles inspected each year, and this percentage grows each year. To say a system of identifying vehicles for specialized testing by applying the model to less than half of the vehicles subject to inspection lacks validity is an understatement at best.

In 2011, 1999 and older vehicles accounted for approximately 41% of all inspections and in 2012, that number dropped to 35%. Based upon this pattern, in the very near future, the number of these vehicles subject to testing will be less than 30%. Although the Bureau has indicated the intention to identify all model-year 1999 and older vehicles as directed vehicles, the progressively decreasing volume of these vehicles necessitates the development of a model capable of identifying directed vehicles within the model-year 2000 and newer group

The regression models developed as part of this thesis proved highly effective at identifying vehicles in the model-year 2000 and newer group with a higher propensity for failure of the revised smog check inspection procedure scheduled for implementation in 2014. In the remainder of the chapter, I discuss the findings of the analysis, opportunities for improvement to the model, and recommendations for continued effectiveness of the practice of identifying directed vehicles.

Predicting Likelihood of Failure of the OBD II Functional Test

The first set of regression models completed in support of this thesis sought to identify vehicles highly likely to fail the OBD II functional test portion of the current smog check inspection procedure. This test is equivalent to the diagnostic scan portion of the new smog check inspection procedure; as such, vehicles highly likely to fail this portion of the current inspection procedure are also likely to fail the new inspection procedure. The three regression models separately utilized vehicle look-up table identification (VLT ID) numbers, vehicle make (manufacturer), and vehicle model-year as explanatory variables with failure of the OBD II (Fail OBD) as the dependent variable in each. VLT ID numbers provide the most precise detail about the vehicles subject to inspection because, with a few exceptions, each VLT ID number is assigned to vehicles of the same make, model, model-year, engine size, transmission type, and other characteristics. The exceptions are a group of VLT ID numbers that group together vehicles of a similar configuration but manufactured by different companies.

The model utilizing VLT ID numbers as the explanatory variables effectively identified a group of 1288 vehicles that account for approximately 37% of the inspection volume and are more likely to fail the OBD II functional test. The vehicles identified range from only slightly more likely than other vehicles to fail the inspection to substantially more likely to fail the inspection. Given the progressively decreasing volume of vehicles in the model-year 1999 and older set, labeling the vehicles in the 2000 and newer set with the highest likelihood of failure as directed vehicles creates the ability to maintain the level of directed vehicles at approximately 30%.

The results of the regression with vehicle-model year as the explanatory variables yielded expected results in that older vehicles were significantly more likely to fail the OBD II functional test. This is expected because as vehicles age and are driven more miles, they develop malfunctions leading to emissions failures. A notable finding in this regression model is the observation that odd model-year (2001, 2003, etc.) vehicles are apparently more likely to fail the functional test than the next older even model-year vehicles. This is notable because vehicles that are more than six model-years old are required to undergo biennial inspection. This is based upon actual model-year, meaning that most model-year 2006 vehicles were required to undergo their first smog check inspection in 2012. This pattern would continue with 2004, 2002, 2000 and so-on model-year vehicles requiring a biennial inspection in 2012. Odd model-year vehicles, for the most part, likely underwent inspections in 2012 for change of ownership purposes. This suggests that vehicles undergoing a change of ownership are significantly more likely to fail an OBD II functional test.

The regression model based on vehicle make yielded expected results as well. Only one vehicle manufacturer, Daewoo, demonstrated a significantly higher likelihood of failing the OBD

II functional test. The other manufacturers represented in the dataset were all relatively close to one another in likelihood of failure.

As stated in the introduction to this chapter, these results provide substantial foundation for identifying which vehicles, when compared to the other vehicles subject to inspection, have a higher likelihood of failing the OBD II functional test of the current inspection procedure and, subsequently, the revised smog check inspection procedure predicated upon a diagnostic scan of the OBD II system.

Predicting Likelihood of Failure of the Visual Inspection

The set of regression models to identify which vehicles are highly likely to fail the visual inspection portion of the current smog check inspection procedure utilized the same sets of explanatory variables as the previous set of models: VLT ID numbers, vehicle make, and vehicle model-year. The dependent variable for this set of models was failure of the visual inspection (Fail Visual) portion of the current smog check inspection procedure.

The model with VLT ID numbers as the explanatory variables produced meaningful results as well. This model identified 153 VLT ID numbers with a higher likelihood of failing the visual inspection portion of the current smog check inspection procedure. The vehicles identified by this group account for nearly 4% of the volume of inspections in the dataset.

The regression model for visual failures with vehicle make as the explanatory variables produced results similar to the same model for OBD II failure, with the exception that the distribution of odds ratio values for the visual inspection was greater than that of the OBD II test failure. This increased variance in the results points to variances of consistency in vehicle durability or maintenance practices. Additionally, the manufacturer Daewoo again demonstrated the highest likelihood of failure of the visual inspection.

Finally, the regression with vehicle model-years as the explanatory variables for visual inspection failure also produced results similar to the OBD II regression models. Older vehicles are significantly more likely to fail the visual inspection portion of the current smog check inspection procedure, indicating likely failure of the visual inspection portion of the new smog check inspection procedure.

Significance of Findings

It is important to point out that this thesis focused upon identifying vehicles highly likely to fail the smog check inspection as compared to all other vehicles in the fleet and subject to inspection. I did not seek to predict failure rates for individual VLT ID numbers, specific makes, or individual calendar years. As such, although each of the regression models produced variables with a significantly higher likelihood of failure, my focus was on the overall ranking as compared to the other variables.

The binomial logistic regressions performed in this thesis clearly identified a valid method for ranking vehicles based upon their likelihood of failing either the OBD II functional test or visual inspection portion of the smog check inspection. Those vehicles identified by the VLT ID numbers with the highest likelihood of failure are appropriate for designation as directed vehicles to supplement the model-year 1999 and older group and to maintain a directed vehicle set of approximately 30% of the vehicles subject to inspection.

There is less support in the data to employ vehicle manufacturer as a basis for identification as directed vehicles. Although some manufacturers demonstrated a higher likelihood of failure, the results are not significant enough to identify vehicles from any single manufacturer as directed vehicles.

The data related to vehicle model-year clearly demonstrates that older vehicles are significantly more likely to fail either test or inspection. However, the ability to identify a sufficient number of specific vehicles through the use of VLT ID numbers is far more equitable and appropriate than a blanket policy of directing all older vehicles for specialized testing. Additionally, as the body of literature indicated, older vehicles are often driven less miles, resulting in less of an emissions impact (Moghadam & Livernois, 2010). A more significant result arising from the regression models utilizing vehicle model-year as the as explanatory variables is the fact that it appears vehicles undergoing inspection for change of ownership purposes are substantially more likely to fail the smog check inspection.

Recommendations for Identifying Directed Vehicles

The process of directing vehicles for specialized testing based upon the likelihood of the vehicle failing the inspection is a necessary and important component of the smog check inspection program. Directing vehicles based upon broad categories such as age or manufacturer while appropriate in some circumstances, compromises the legitimacy of the program by failing to effectively scrutinize the potentially highest polluting vehicles. The binomial logistic regression analysis employed in this thesis creates a methodology for continued identification of the potentially highest polluting vehicles. This model, or a similar model, should be employed by the Bureau to continue the process of selecting only the appropriate vehicles as directed vehicles. Consideration of the following recommendations would support that endeavor.

1. Improve the identification of like vehicles by assigning VLT ID numbers through a process of decoding the vehicle identification number (VIN) to ascertain the correct make, model, model-year, engine size, transmission type, and other factors. It may be possible to eliminate VLT ID numbers entirely by creating tables based upon the first 11 characters in the VIN, which are the characters used to specifically identify a vehicle.
2. On an annual basis, conduct binomial logistic regression analyses of the initial inspections performed on all vehicles over the preceding two years. Analyzing the initial

inspections only will overcome any skewness caused by multiple tests on the same vehicle. Additionally, the initial inspection evaluates the vehicle based upon its most recent operating condition.

3. Failure of the OBD II functional test and failure of the visual inspection are the appropriate dependent variables for the regression analyses described in item two above. The VLT ID numbers or VIN assigned identification categories are the appropriate explanatory variables.
4. Also run binomial logistic regressions with inspection reason (change of ownership or biennial) as the explanatory variables and failure of the OBD II test and visual inspection as the dependent variables. These regressions, also performed on an annual basis, should only evaluate the preceding one year of data, than compared to the prior year's results to identify variances in likelihood of failure of the inspection based upon inspection reason.
5. At the same time of the regression models described in item four, conduct regression models with model-year as the explanatory variables to evaluate the accuracy of the technician entries of inspection reason. As described previously, it can be reasonably assumed that odd model-year vehicles tested in even calendar years are undergoing inspection for change of ownership purposes, and vice-versa.
6. If the determination is that vehicles undergoing inspection for change of ownership have a significantly higher likelihood of failure of the inspection, those vehicles would be appropriate as directed vehicles. Implementation of this policy may require amendments to the California Health and Safety Code.
7. The data does not support the use of vehicle make (manufacturer) as a criterion for identification of directed vehicles. Although some manufacturers stood out in the regression models, only one, Daewoo, did so with any significance. That level of

significance is insufficient to support the use of manufacturer as a criterion. As the body of literature indicates, all manufacturers experience design flaws or failures that lead to failure of one of the tests or inspections.

Suggestions for Improved Statistical Modeling

In totality, the binomial logistic regression model was quite effective at ranking each set of explanatory variables in order of likelihood of failure. Additionally, performing the regression on the entire dataset rather than a sample of the data produced meaningful and valid results. However, an opportunity for improvement of the model exists. I recommend future research include measures to address the following item.

An area for improvement is the assignment of VLT ID numbers. According to the *Smog Check Inspection Procedures Manual* (Bureau of Automotive Repair, 2009) technicians are required to verify and correct data entries such as the vehicle make, model, engine size, etc. Based upon these entries, the appropriate VLT ID number is assigned to the vehicle under inspection (Bureau of Automotive Repair, 2009). Also during the inspection procedure, the technicians are required to enter the vehicle identification number (VIN), a 17-digit number equating to the serial number of the vehicle. Numerous VIN ‘decoders’ exist on the internet and certainly the software is available for purchase. Programming the vehicle identification database to utilize VIN decoding software and assigning the VLT ID number based upon the VIN would remove the opportunity for human error in data entry. Such a process would ensure the validity of the inspection record for future analysis.

Conclusion

In this thesis, I sought to develop a methodology for the continued identification of directed vehicles based upon their likelihood of failure as compared to all other vehicles subject to inspection. The six regression models conducted in support of this analysis clearly support the use of binomial logistic regression in the evaluation of the fleet of vehicles. Using failure of the OBD II functional test and visual inspection portion of the current smog check inspection procedure as the dependent variables and VLT ID numbers as the explanatory variables enabled me to identify a highly effective model for identifying directed vehicles without relying upon emissions measurements. Implementation of this model would enable officials to continue directing vehicles based upon the actual likelihood of failure, rather than based upon broad, general categories such as age or manufacturer.

Appendix A: Test Volume for Pre-Model-Year 2000 Vehicles

	Calendar Year											
Model Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Up to 1976	122,494	103,658	60,561	32,728	19,417	20,887	18,047	17,738	14,427	12,692	11,383	10,359
1977	74,131	62,615	51,622	42,934	35,167	29,512	25,410	21,721	19,862	17,723	15,647	13,908
1978	87,837	73,387	60,139	49,903	40,132	34,196	28,692	24,888	22,636	20,203	17,834	15,816
1979	99,475	83,117	67,845	55,867	45,174	37,637	32,655	27,219	25,408	22,017	19,718	17,416
1980	74,269	59,088	46,495	37,610	29,335	24,067	20,111	17,265	15,342	13,330	11,871	10,422
1981	89,647	71,615	56,079	45,150	35,242	28,677	23,747	20,285	18,008	15,533	13,584	12,120
1982	112,385	89,679	70,099	55,597	42,097	34,588	28,237	23,733	20,776	18,085	15,687	13,788
1983	155,947	124,505	97,110	77,455	58,484	47,579	38,373	32,575	28,076	24,187	20,906	18,138
1984	275,873	225,153	178,454	142,733	108,973	87,417	71,236	59,519	51,447	44,241	37,761	32,610
1985	356,604	296,758	238,247	192,885	148,126	119,140	96,967	80,991	69,618	59,702	50,836	44,045
1986	454,687	385,767	316,763	261,552	205,539	168,222	138,276	115,660	99,174	84,947	72,238	63,072
1987	516,031	445,684	372,070	311,037	244,867	201,643	165,370	137,478	118,046	100,004	84,267	72,691
1988	554,593	491,953	417,575	357,337	285,785	239,788	197,940	166,109	142,785	122,332	102,690	88,396
1989	643,548	585,923	510,698	447,567	367,390	313,440	263,551	223,210	194,515	167,146	141,579	122,694
1990	626,273	586,711	525,079	475,250	403,116	352,860	304,411	262,996	233,044	205,538	175,110	153,305
1991	651,496	618,129	562,694	518,859	449,202	398,576	349,721	308,498	275,209	245,795	211,920	186,416
1992	586,843	563,485	523,753	488,960	432,451	387,325	342,621	304,411	275,520	248,567	215,275	191,201
1993	676,034	639,814	612,988	569,064	515,600	457,472	413,751	364,315	336,360	302,914	267,107	236,487
1994	629,098	769,550	606,536	687,338	539,705	561,923	450,534	455,387	380,486	386,791	312,719	311,089
1995	1,079,486	572,717	956,236	589,536	814,703	524,224	661,575	448,549	551,981	401,845	453,245	333,467
1996	399,765	996,133	452,187	871,049	464,151	714,842	421,534	591,217	386,543	513,482	341,603	426,162
1997	1,191,184	547,867	1,057,711	588,941	932,452	567,689	791,433	512,028	689,331	485,418	594,431	432,426
1998	381,038	1,208,695	554,818	1,088,934	580,712	953,315	568,786	814,094	532,383	740,376	497,446	647,217
1999	278,018	417,603	1,298,216	601,860	1,166,874	615,687	1,030,559	592,924	914,148	591,268	819,753	559,600
Pre 2000 MY Tests	10,116,756	10,019,606	9,693,975	8,590,146	7,964,694	6,920,706	6,483,537	5,622,810	5,415,125	4,844,136	4,504,610	4,012,845
Total Annual Tests	10,441,518	10,597,594	10,737,282	11,050,541	9,018,521	9,360,649	9,319,693	9,554,028	9,825,967	10,571,730	10,776,597	11,290,816
Percentage of Fleet	96.89%	94.55%	90.28%	77.74%	88.31%	73.93%	69.57%	58.85%	55.11%	45.82%	41.80%	35.54%

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
1838	3,242	0.04	1955	1,828	0.03
1840	4,693	0.06	1956	773	0.01
1841	1,209	0.02	1957	1,520	0.02
1847	1,115	0.02	1964	995	0.01
1849	744	0.01	1966	6,218	0.09
1856	1,497	0.02	1967	20,887	0.29
1858	6,726	0.09	1968	2,224	0.03
1859	14,344	0.2	1973	8,422	0.12
1860	2,618	0.04	1974	753	0.01
1865	5,320	0.07	1975	7,591	0.1
1867	4,446	0.06	1976	8,668	0.12
1868	4,594	0.06	1977	392	0.01
1869	1,038	0.01	1984	3,823	0.05
1876	2,079	0.03	1993	811	0.01
1885	1,323	0.02	1994	5,252	0.07
1886	6,124	0.08	1995	731	0.01
1887	729	0.01	2000	4,947	0.07
1892	3,179	0.04	2002	3,485	0.05
1894	2,838	0.04	2003	1,066	0.01
1895	704	0.01	2009	1,035	0.01
1901	634	0.01	2011	464	0.01
1903	512	0.01	2018	430	0.01
1910	774	0.01	2020	2,413	0.03
1912	2,881	0.04	2021	9,062	0.12
1913	9,338	0.13	2022	990	0.01
1914	1,675	0.02	2027	2,565	0.04
1919	2,634	0.04	2029	4,582	0.06
1920	591	0.01	2030	5,763	0.08
1921	2,598	0.04	2038	712	0.01
1922	3,217	0.04	2047	477	0.01
1930	1,790	0.02	2048	2,955	0.04
1939	546	0.01	2049	434	0.01
1940	3,065	0.04	2054	9,328	0.13
1941	444	0.01	2055	959	0.01
1946	7,010	0.1	2056	21,681	0.3
1947	1,027	0.01	2057	3,948	0.05
1948	5,924	0.08	2063	2,602	0.04
1949	2,622	0.04	2064	1,030	0.01

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations		VLT ID	Frequency	% of Observations
2065	1,160	0.02		2192	8,405	0.12
2072	1,359	0.02		2198	581	0.01
2073	406	0.01		2200	3,008	0.04
2074	4,178	0.06		2209	397	0.01
2075	27,056	0.37		2210	5,573	0.08
2076	1,737	0.02		2211	628	0.01
2081	10,180	0.14		2216	2,409	0.03
2083	14,302	0.2		2218	2,990	0.04
2084	13,783	0.19		2219	1,270	0.02
2092	3,396	0.05		2225	1,261	0.02
2101	759	0.01		2236	527	0.01
2102	6,047	0.08		2237	3,594	0.05
2103	696	0.01		2243	829	0.01
2108	4,960	0.07		2245	1,851	0.03
2110	4,955	0.07		2246	1,689	0.02
2111	1,943	0.03		2254	459	0.01
2117	763	0.01		2264	786	0.01
2119	1,271	0.02		2269	537	0.01
2128	1,108	0.02		2270	51,464	0.71
2129	6,110	0.08		2271	2,932	0.04
2130	384	0.01		2272	38,394	0.53
2135	893	0.01		2273	9,503	0.13
2137	4,448	0.06		2274	397	0.01
2138	3,255	0.04		2279	4,340	0.06
2146	1,599	0.02		2281	1,070	0.01
2156	2,207	0.03		2288	1,878	0.03
2162	10,361	0.14		2289	517	0.01
2163	437	0.01		2290	5,038	0.07
2164	16,712	0.23		2291	12,154	0.17
2165	4,551	0.06		2297	8,096	0.11
2171	4,734	0.06		2299	21,845	0.3
2173	1,230	0.02		2300	9,732	0.13
2180	881	0.01		2308	5,333	0.07
2182	2,885	0.04		2318	2,042	0.03
2183	18,027	0.25		2324	23,586	0.32
2184	683	0.01		2325	1,408	0.02
2189	3,398	0.05		2326	12,106	0.17
2191	7,667	0.11		2327	2,396	0.03

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations		VLT ID	Frequency	% of Observations
2333	1,878	0.03		2488	4,331	0.06
2335	389	0.01		2489	969	0.01
2342	587	0.01		2495	820	0.01
2344	996	0.01		2506	708	0.01
2345	2,303	0.03		2507	1,600	0.02
2351	3,164	0.04		2513	2,152	0.03
2353	6,203	0.09		2515	4,977	0.07
2354	1,696	0.02		2516	1,505	0.02
2362	1,582	0.02		2524	2,165	0.03
2372	504	0.01		2534	1,333	0.02
2378	27,491	0.38		29100	7,962	0.11
2379	925	0.01		29101	1,739	0.02
2380	9,674	0.13		29102	4,504	0.06
2381	1,891	0.03		29117	409	0.01
2387	1,779	0.02		29118	405	0.01
2396	507	0.01		29123	570	0.01
2398	907	0.01		29124	393	0.01
2399	2,716	0.04		29137	2,484	0.03
2405	4,415	0.06		29138	6,497	0.09
2407	6,318	0.09		29141	1,204	0.02
2408	1,411	0.02		29142	2,847	0.04
2416	2,578	0.04		29143	4,888	0.07
2426	577	0.01		29144	415	0.01
2432	27,244	0.37		29145	466	0.01
2433	699	0.01		29146	1,402	0.02
2434	9,235	0.13		29148	869	0.01
2435	2,061	0.03		29149	1,505	0.02
2441	2,017	0.03		29152	471	0.01
2450	364	0		29155	574	0.01
2452	1,190	0.02		29158	642	0.01
2453	2,714	0.04		29159	752	0.01
2459	5,756	0.08		29161	4,070	0.06
2461	8,170	0.11		29162	4,807	0.07
2462	2,000	0.03		29163	1,251	0.02
2470	3,137	0.04		29164	2,340	0.03
2480	1,076	0.01		29165	699	0.01
2486	13,784	0.19		29166	3,897	0.05
2487	741	0.01		29167	1,023	0.01

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations		VLT ID	Frequency	% of Observations
29168	2,886	0.04		29236	1,989	0.03
29169	1,633	0.02		29238	735	0.01
29170	2,474	0.03		29239	674	0.01
29171	8,535	0.12		29240	671	0.01
29173	483	0.01		29241	634	0.01
29174	4,670	0.06		29243	678	0.01
29175	2,666	0.04		29244	2,191	0.03
29179	3,752	0.05		29245	1,935	0.03
29180	7,197	0.1		29246	1,766	0.02
29181	13,520	0.19		29249	1,029	0.01
29182	527	0.01		29250	987	0.01
29184	1,815	0.02		29252	756	0.01
29188	1,652	0.02		29256	509	0.01
29189	1,590	0.02		29267	2,735	0.04
29190	1,507	0.02		29268	487	0.01
29191	4,650	0.06		29269	10,906	0.15
29192	499	0.01		29270	806	0.01
29193	2,137	0.03		29273	3,170	0.04
29194	607	0.01		29274	1,728	0.02
29196	700	0.01		29277	831	0.01
29200	2,356	0.03		29281	3,874	0.05
29201	3,451	0.05		29282	2,029	0.03
29206	709	0.01		29283	3,394	0.05
29207	5,964	0.08		29285	2,301	0.03
29209	2,453	0.03		29286	2,852	0.04
29211	2,264	0.03		29287	897	0.01
29212	1,167	0.02		29289	5,552	0.08
29213	575	0.01		29290	664	0.01
29214	814	0.01		29291	1,608	0.02
29215	701	0.01		29292	1,495	0.02
29217	6,194	0.09		29294	611	0.01
29219	1,258	0.02		29297	570	0.01
29220	1,408	0.02		29298	2,117	0.03
29222	4,124	0.06		29299	1,003	0.01
29223	1,938	0.03		29305	624	0.01
29224	461	0.01		29306	917	0.01
29229	520	0.01		29307	1,089	0.01
29235	2,425	0.03		29309	1,532	0.02

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
29313	1,082	0.01	29366	927	0.01
29314	630	0.01	29367	2,198	0.03
29315	524	0.01	29370	443	0.01
29317	716	0.01	29372	1,097	0.02
29318	596	0.01	29373	406	0.01
29321	750	0.01	29375	1,171	0.02
29322	2,675	0.04	29377	509	0.01
29323	822	0.01	29378	10,346	0.14
29324	9,581	0.13	29379	820	0.01
29325	14,781	0.2	29381	958	0.01
29326	2,776	0.04	29383	7,013	0.1
29327	12,681	0.17	29390	882	0.01
29328	2,588	0.04	29391	2,490	0.03
29330	507	0.01	29392	3,998	0.05
29331	1,702	0.02	29398	657	0.01
29332	1,272	0.02	29407	1,429	0.02
29333	902	0.01	29408	1,024	0.01
29334	1,718	0.02	29411	1,971	0.03
29335	739	0.01	29417	1,161	0.02
29336	1,148	0.02	29418	882	0.01
29337	860	0.01	29419	1,204	0.02
29338	553	0.01	29420	715	0.01
29340	4,184	0.06	29421	2,646	0.04
29341	3,902	0.05	29424	1,216	0.02
29342	6,991	0.1	29425	396	0.01
29345	971	0.01	29430	37,528	0.52
29346	8,659	0.12	29431	18,244	0.25
29347	1,724	0.02	29433	843	0.01
29349	2,917	0.04	29434	48,573	0.67
29350	1,333	0.02	29437	2,841	0.04
29352	3,515	0.05	29438	4,261	0.06
29353	826	0.01	29439	15,515	0.21
29354	1,863	0.03	29440	1,287	0.02
29355	5,470	0.08	29441	566	0.01
29356	2,380	0.03	29442	2,035	0.03
29357	1,113	0.02	29443	1,165	0.02
29358	1,184	0.02	29444	1,500	0.02
29363	884	0.01	29445	666	0.01

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
29446	3,292	0.05	29524	2,510	0.03
29447	537	0.01	29526	1,093	0.02
29449	422	0.01	29533	423	0.01
29450	1,438	0.02	29543	4,945	0.07
29453	1,567	0.02	29544	1,644	0.02
29454	4,755	0.07	29545	3,588	0.05
29455	476	0.01	29546	1,261	0.02
29456	779	0.01	29547	3,442	0.05
29465	1,956	0.03	29548	1,182	0.02
29466	679	0.01	29551	1,232	0.02
29467	643	0.01	29553	1,011	0.01
29470	1,664	0.02	29555	5,550	0.08
29471	1,277	0.02	29558	598	0.01
29477	730	0.01	29559	1,410	0.02
29485	1,750	0.02	29562	5,276	0.07
29487	2,341	0.03	29563	1,661	0.02
29488	7,033	0.1	29566	2,662	0.04
29489	1,605	0.02	29567	3,386	0.05
29490	2,375	0.03	29568	761	0.01
29491	3,994	0.05	29570	753	0.01
29493	707	0.01	29573	1,545	0.02
29494	3,291	0.05	29574	3,340	0.05
29495	3,457	0.05	29575	504	0.01
29497	2,302	0.03	29576	1,250	0.02
29499	1,602	0.02	29580	2,167	0.03
29503	459	0.01	29582	637	0.01
29504	6,607	0.09	29583	2,267	0.03
29505	3,587	0.05	29584	2,795	0.04
29508	696	0.01	29585	4,704	0.06
29509	1,458	0.02	29586	1,002	0.01
29510	1,616	0.02	29587	845	0.01
29511	4,951	0.07	29588	3,268	0.04
29512	3,804	0.05	29591	4,246	0.06
29517	815	0.01	29592	739	0.01
29518	1,139	0.02	29593	1,305	0.02
29519	2,407	0.03	29598	10,944	0.15
29520	3,897	0.05	29599	7,295	0.1
29521	2,808	0.04	29600	6,120	0.08

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
29602	1,320	0.02	29661	413	0.01
29603	13,118	0.18	29662	480	0.01
29604	1,904	0.03	29663	538	0.01
29605	1,006	0.01	29664	3,567	0.05
29606	6,095	0.08	29670	452	0.01
29607	5,442	0.07	29671	737	0.01
29608	743	0.01	29683	4,185	0.06
29610	5,549	0.08	29684	8,602	0.12
29611	3,097	0.04	29686	5,424	0.07
29612	1,154	0.02	29687	12,119	0.17
29613	1,398	0.02	29688	35,579	0.49
29614	478	0.01	29689	12,158	0.17
29615	1,717	0.02	29691	2,635	0.04
29616	825	0.01	29692	3,731	0.05
29620	2,507	0.03	29695	6,190	0.08
29622	878	0.01	29696	25,961	0.36
29624	1,253	0.02	29697	6,017	0.08
29627	1,146	0.02	29698	2,081	0.03
29628	564	0.01	29699	720	0.01
29629	677	0.01	29700	4,211	0.06
29630	1,840	0.03	29701	876	0.01
29631	2,757	0.04	29704	21,166	0.29
29632	809	0.01	29705	9,365	0.13
29633	2,291	0.03	29706	2,533	0.03
29634	1,229	0.02	29707	6,361	0.09
29635	1,189	0.02	29708	997	0.01
29637	1,251	0.02	29709	2,678	0.04
29639	810	0.01	29710	1,557	0.02
29641	580	0.01	29711	11,120	0.15
29645	554	0.01	29713	3,862	0.05
29646	449	0.01	29714	512	0.01
29653	2,958	0.04	29719	1,825	0.03
29654	1,913	0.03	29723	409	0.01
29656	617	0.01	29724	831	0.01
29657	1,227	0.02	29725	8,765	0.12
29658	6,958	0.1	29726	3,101	0.04
29659	733	0.01	29727	1,209	0.02
29660	1,688	0.02	29728	1,178	0.02

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
29729	3,614	0.05	29835	1,719	0.02
29730	1,770	0.02	29836	414	0.01
29731	2,094	0.03	29837	1,278	0.02
29732	735	0.01	29839	1,990	0.03
29733	1,449	0.02	29842	650	0.01
29734	573	0.01	29843	820	0.01
29735	378	0.01	29844	1,712	0.02
29736	432	0.01	29847	1,766	0.02
29737	442	0.01	29848	969	0.01
29746	2,016	0.03	29852	2,389	0.03
29747	621	0.01	29853	5,358	0.07
29749	2,702	0.04	29854	5,178	0.07
29752	1,206	0.02	29855	3,765	0.05
29753	1,658	0.02	29857	5,917	0.08
29754	806	0.01	29858	876	0.01
29758	1,389	0.02	29859	582	0.01
29759	1,054	0.01	29860	2,683	0.04
29760	2,617	0.04	29863	1,249	0.02
29762	2,137	0.03	29870	1,711	0.02
29764	1,297	0.02	29871	1,588	0.02
29765	2,204	0.03	29878	2,277	0.03
29774	597	0.01	29880	1,961	0.03
29776	375	0.01	29882	3,612	0.05
29780	554	0.01	29883	513	0.01
29794	600	0.01	29884	3,829	0.05
29802	1,054	0.01	29885	800	0.01
29803	615	0.01	29886	663	0.01
29804	4,305	0.06	29887	841	0.01
29810	1,532	0.02	29888	1,049	0.01
29812	2,057	0.03	29890	2,365	0.03
29814	1,332	0.02	29891	644	0.01
29816	1,484	0.02	29903	1,301	0.02
29817	603	0.01	29904	1,012	0.01
29819	883	0.01	29909	4,027	0.06
29820	1,313	0.02	29910	611	0.01
29827	1,754	0.02	29912	394	0.01
29828	1,219	0.02	29914	498	0.01
29834	1,854	0.03	29915	1,237	0.02

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations		VLT ID	Frequency	% of Observations
29918	457	0.01		30010	475	0.01
29921	598	0.01		30011	412	0.01
29922	429	0.01		30012	1,730	0.02
29926	586	0.01		30013	536	0.01
29927	3,710	0.05		30014	2,018	0.03
29928	690	0.01		30015	2,948	0.04
29931	1,232	0.02		30016	1,190	0.02
29932	802	0.01		30017	3,030	0.04
29935	387	0.01		30018	5,324	0.07
29937	2,146	0.03		30019	915	0.01
29939	1,361	0.02		30021	2,017	0.03
29940	675	0.01		30022	814	0.01
29941	1,890	0.03		30024	1,476	0.02
29946	2,741	0.04		30026	458	0.01
29947	541	0.01		30027	430	0.01
29948	2,371	0.03		30028	2,595	0.04
29949	1,458	0.02		30029	1,059	0.01
29951	902	0.01		30030	1,296	0.02
29952	749	0.01		30038	468	0.01
29965	909	0.01		30039	854	0.01
29966	367	0.01		30045	1,041	0.01
29968	477	0.01		30047	507	0.01
29974	1,563	0.02		30049	6,133	0.08
29979	614	0.01		30051	449	0.01
29985	755	0.01		30052	1,735	0.02
29990	3,799	0.05		30053	1,722	0.02
29991	1,533	0.02		30059	1,747	0.02
29992	411	0.01		30060	1,487	0.02
29993	4,239	0.06		30063	1,657	0.02
29994	5,399	0.07		30064	952	0.01
29995	3,726	0.05		30072	572	0.01
29996	2,209	0.03		30080	670	0.01
29998	2,224	0.03		30084	1,172	0.02
30002	953	0.01		30085	716	0.01
30003	558	0.01		30086	819	0.01
30004	504	0.01		30087	701	0.01
30005	667	0.01		30089	760	0.01
30008	477	0.01		30092	656	0.01

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
30096	16,771	0.23	30168	454	0.01
30097	7,187	0.1	30169	1,806	0.02
30099	24,924	0.34	30172	3,165	0.04
30101	1,323	0.02	30173	1,538	0.02
30102	1,624	0.02	30175	2,127	0.03
30103	6,203	0.09	30176	1,259	0.02
30104	662	0.01	30178	513	0.01
30106	1,327	0.02	30180	1,008	0.01
30107	615	0.01	30181	1,816	0.02
30108	534	0.01	30182	1,204	0.02
30109	1,447	0.02	30184	1,222	0.02
30110	2,676	0.04	30211	1,532	0.02
30111	467	0.01	30212	926	0.01
30112	873	0.01	30213	741	0.01
30113	446	0.01	30215	797	0.01
30114	586	0.01	30217	1,363	0.02
30117	704	0.01	30218	1,128	0.02
30118	495	0.01	30220	1,517	0.02
30119	2,031	0.03	30224	587	0.01
30121	737	0.01	30226	487	0.01
30122	665	0.01	30229	2,690	0.04
30127	927	0.01	30233	806	0.01
30128	396	0.01	30236	2,065	0.03
30136	552	0.01	30237	581	0.01
30137	502	0.01	30239	1,200	0.02
30148	1,124	0.02	30240	1,319	0.02
30149	2,283	0.03	30245	443	0.01
30150	607	0.01	30247	647	0.01
30151	1,253	0.02	30250	552	0.01
30152	1,770	0.02	30251	1,129	0.02
30155	1,425	0.02	30254	1,179	0.02
30156	526	0.01	30256	405	0.01
30158	1,534	0.02	30258	422	0.01
30159	1,583	0.02	30259	1,448	0.02
30160	885	0.01	30260	492	0.01
30161	419	0.01	30262	794	0.01
30163	886	0.01	30263	2,879	0.04
30166	1,851	0.03	30264	876	0.01

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations		VLT ID	Frequency	% of Observations
30265	449	0.01		30348	1,475	0.02
30266	1,425	0.02		30355	1,396	0.02
30268	776	0.01		30376	2,888	0.04
30271	1,319	0.02		30377	1,576	0.02
30272	415	0.01		30378	3,013	0.04
30274	506	0.01		30379	11,511	0.16
30278	5,874	0.08		30380	2,909	0.04
30280	1,304	0.02		30382	1,211	0.02
30281	1,384	0.02		30383	994	0.01
30282	1,996	0.03		30386	2,449	0.03
30283	432	0.01		30388	14,314	0.2
30284	3,568	0.05		30389	2,538	0.03
30287	1,803	0.02		30390	514	0.01
30288	1,288	0.02		30391	1,238	0.02
30290	2,224	0.03		30393	711	0.01
30291	4,382	0.06		30396	588	0.01
30292	1,053	0.01		30397	2,316	0.03
30294	2,317	0.03		30398	977	0.01
30295	1,067	0.01		30399	1,577	0.02
30296	674	0.01		30400	1,129	0.02
30298	674	0.01		30401	5,913	0.08
30299	450	0.01		30402	3,524	0.05
30302	465	0.01		30403	1,701	0.02
30304	948	0.01		30404	2,962	0.04
30311	539	0.01		30407	1,417	0.02
30312	410	0.01		30408	1,519	0.02
30315	1,091	0.01		30409	2,938	0.04
30317	1,446	0.02		30411	958	0.01
30318	717	0.01		30412	603	0.01
30319	1,037	0.01		30417	615	0.01
30320	607	0.01		30418	498	0.01
30321	775	0.01		30419	427	0.01
30323	728	0.01		30421	1,805	0.02
30325	369	0.01		30422	5,161	0.07
30341	1,193	0.02		30423	1,579	0.02
30342	902	0.01		30424	615	0.01
30345	1,472	0.02		30427	1,376	0.02
30346	3,105	0.04		30428	1,985	0.03

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
30429	871	0.01	30531	3,420	0.05
30430	1,559	0.02	30532	880	0.01
30431	1,863	0.03	30533	2,103	0.03
30440	1,851	0.03	30534	898	0.01
30442	1,576	0.02	30535	1,100	0.02
30445	529	0.01	30536	4,040	0.06
30446	384	0.01	30537	591	0.01
30447	451	0.01	30538	1,976	0.03
30448	1,056	0.01	30539	5,235	0.07
30452	666	0.01	30540	1,131	0.02
30454	7,936	0.11	30542	1,359	0.02
30455	1,495	0.02	30543	1,565	0.02
30456	6,679	0.09	30544	3,534	0.05
30460	3,916	0.05	30547	2,021	0.03
30463	698	0.01	30548	1,636	0.02
30469	947	0.01	30549	2,286	0.03
30470	626	0.01	30550	1,049	0.01
30471	1,010	0.01	30554	603	0.01
30472	498	0.01	30555	3,571	0.05
30475	418	0.01	30556	13,595	0.19
30482	452	0.01	30557	9,196	0.13
30490	693	0.01	30558	8,950	0.12
30494	2,049	0.03	30559	3,884	0.05
30495	1,229	0.02	30560	11,174	0.15
30496	1,213	0.02	30561	1,278	0.02
30500	1,698	0.02	30562	2,046	0.03
30501	1,010	0.01	30563	6,328	0.09
30503	2,362	0.03	30565	1,646	0.02
30507	3,596	0.05	30566	1,265	0.02
30509	931	0.01	30569	567	0.01
30511	1,885	0.03	30573	3,279	0.05
30512	1,154	0.02	30574	2,596	0.04
30516	945	0.01	30578	387	0.01
30517	432	0.01	30580	612	0.01
30518	461	0.01	30581	4,300	0.06
30520	904	0.01	30583	4,368	0.06
30522	1,065	0.01	30584	425	0.01
30530	4,244	0.06	30585	6,873	0.09

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
30586	5,018	0.07	30661	415	0.01
30587	807	0.01	30668	1,331	0.02
30588	1,513	0.02	30669	471	0.01
30589	964	0.01	30671	781	0.01
30590	993	0.01	30677	1,422	0.02
30592	3,318	0.05	30684	1,100	0.02
30593	693	0.01	30686	409	0.01
30594	528	0.01	30689	1,392	0.02
30605	6,563	0.09	30693	389	0.01
30606	3,097	0.04	30694	8,351	0.11
30610	2,223	0.03	30695	2,756	0.04
30611	1,543	0.02	30696	781	0.01
30614	685	0.01	30697	4,710	0.06
30617	12,066	0.17	30698	5,714	0.08
30618	2,174	0.03	30699	4,320	0.06
30620	377	0.01	30700	19,103	0.26
30622	817	0.01	30701	2,784	0.04
30624	2,145	0.03	30703	5,310	0.07
30626	469	0.01	30704	2,211	0.03
30627	850	0.01	30706	3,014	0.04
30628	395	0.01	30707	618	0.01
30635	1,388	0.02	30708	450	0.01
30636	7,675	0.11	30709	1,538	0.02
30637	1,777	0.02	30710	972	0.01
30642	2,416	0.03	30711	685	0.01
30644	1,596	0.02	30712	615	0.01
30647	656	0.01	30713	743	0.01
30649	3,242	0.04	30714	886	0.01
30650	418	0.01	30715	815	0.01
30651	1,583	0.02	30719	1,138	0.02
30652	631	0.01	30720	934	0.01
30653	2,832	0.04	30721	3,756	0.05
30654	722	0.01	30722	1,141	0.02
30655	4,916	0.07	30723	4,584	0.06
30657	6,164	0.08	30724	5,317	0.07
30658	2,317	0.03	30725	3,088	0.04
30659	680	0.01	30726	5,201	0.07
30660	930	0.01	30727	10,074	0.14

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
30728	2,159	0.03	30803	933	0.01
30729	468	0.01	30807	1,157	0.02
30730	732	0.01	30810	39,144	0.54
30731	643	0.01	30811	16,337	0.22
30734	2,701	0.04	30813	44,043	0.6
30735	1,018	0.01	30814	1,632	0.02
30736	718	0.01	30817	3,263	0.04
30737	4,789	0.07	30818	5,017	0.07
30738	1,468	0.02	30819	18,001	0.25
30739	2,642	0.04	30820	454	0.01
30742	417	0.01	30823	1,348	0.02
30743	1,467	0.02	30825	998	0.01
30749	2,769	0.04	30826	3,045	0.04
30751	566	0.01	30827	6,263	0.09
30753	850	0.01	30828	1,102	0.02
30754	612	0.01	30829	3,091	0.04
30755	1,231	0.02	30830	1,081	0.01
30757	568	0.01	30831	1,408	0.02
30759	9,748	0.13	30832	3,209	0.04
30760	572	0.01	30835	1,166	0.02
30761	2,395	0.03	30836	1,985	0.03
30762	2,003	0.03	30837	3,738	0.05
30763	548	0.01	30838	1,020	0.01
30764	3,155	0.04	30840	802	0.01
30768	788	0.01	30841	721	0.01
30770	3,818	0.05	30842	693	0.01
30771	3,070	0.04	30846	1,113	0.02
30773	1,325	0.02	30854	691	0.01
30774	3,502	0.05	30855	550	0.01
30775	2,268	0.03	30858	1,543	0.02
30776	3,174	0.04	30860	1,360	0.02
30777	1,899	0.03	30869	3,842	0.05
30793	1,406	0.02	30870	1,342	0.02
30794	489	0.01	30871	1,630	0.02
30797	2,061	0.03	30872	2,985	0.04
30798	3,399	0.05	30874	3,656	0.05
30799	917	0.01	30876	3,751	0.05
30800	1,137	0.02	30880	555	0.01

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
30882	2,639	0.04	30955	1,186	0.02
30883	650	0.01	30959	3,355	0.05
30884	872	0.01	30963	964	0.01
30885	2,823	0.04	30967	3,894	0.05
30886	3,092	0.04	30968	1,389	0.02
30887	3,551	0.05	30970	2,694	0.04
30888	1,247	0.02	30971	2,132	0.03
30889	472	0.01	30974	435	0.01
30892	1,228	0.02	30976	413	0.01
30893	854	0.01	30979	549	0.01
30894	476	0.01	30982	868	0.01
30895	9,743	0.13	30983	1,879	0.03
30897	553	0.01	30984	1,382	0.02
30898	2,677	0.04	30985	662	0.01
30901	5,352	0.07	30986	503	0.01
30902	3,750	0.05	30987	767	0.01
30903	770	0.01	30989	2,712	0.04
30904	5,260	0.07	30991	656	0.01
30905	2,366	0.03	30992	1,229	0.02
30908	522	0.01	30993	1,427	0.02
30909	1,299	0.02	30994	377	0.01
30910	2,178	0.03	30996	455	0.01
30911	2,445	0.03	30997	5,079	0.07
30912	1,415	0.02	30998	949	0.01
30918	1,855	0.03	31000	7,070	0.1
30920	559	0.01	31001	496	0.01
30926	560	0.01	31004	1,173	0.02
30938	404	0.01	31005	2,154	0.03
30939	2,565	0.04	31006	1,107	0.02
30940	1,210	0.02	31008	1,368	0.02
30941	6,658	0.09	31013	14,679	0.2
30943	2,797	0.04	31014	3,707	0.05
30944	3,029	0.04	31015	2,659	0.04
30945	5,324	0.07	31016	2,397	0.03
30948	2,627	0.04	31017	5,266	0.07
30949	676	0.01	31018	1,143	0.02
30950	800	0.01	31019	6,086	0.08
30953	1,562	0.02	31021	2,091	0.03

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations		VLT ID	Frequency	% of Observations
31022	1,553	0.02		31103	1,729	0.02
31024	2,979	0.04		31104	564	0.01
31025	9,104	0.12		31105	794	0.01
31026	702	0.01		31106	445	0.01
31027	717	0.01		31115	1,192	0.02
31028	627	0.01		31116	774	0.01
31029	5,098	0.07		31123	8,003	0.11
31030	1,974	0.03		31124	3,522	0.05
31031	678	0.01		31125	7,149	0.1
31032	705	0.01		31126	36,482	0.5
31036	394	0.01		31127	14,215	0.2
31048	655	0.01		31128	1,973	0.03
31049	435	0.01		31129	1,874	0.03
31050	715	0.01		31131	812	0.01
31051	1,600	0.02		31132	3,374	0.05
31052	2,087	0.03		31134	19,336	0.27
31053	1,610	0.02		31135	3,511	0.05
31054	1,625	0.02		31136	3,261	0.04
31056	797	0.01		31137	7,882	0.11
31057	1,098	0.02		31138	718	0.01
31060	601	0.01		31139	1,565	0.02
31067	514	0.01		31141	665	0.01
31068	464	0.01		31142	722	0.01
31073	718	0.01		31143	8,545	0.12
31074	427	0.01		31144	1,439	0.02
31077	452	0.01		31145	8,620	0.12
31082	3,351	0.05		31146	3,914	0.05
31083	1,707	0.02		31147	13,966	0.19
31084	438	0.01		31148	8,938	0.12
31085	531	0.01		31149	5,887	0.08
31087	2,997	0.04		31150	10,219	0.14
31088	8,600	0.12		31152	822	0.01
31090	1,356	0.02		31153	4,044	0.06
31092	638	0.01		31154	5,221	0.07
31093	3,081	0.04		31155	10,701	0.15
31095	2,096	0.03		31157	3,093	0.04
31098	1,213	0.02		31158	1,042	0.01
31099	1,001	0.01		31160	798	0.01

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
31162	1,625	0.02	31291	1,411	0.02
31163	1,020	0.01	31293	722	0.01
31165	674	0.01	31294	1,762	0.02
31166	7,661	0.11	31295	536	0.01
31167	1,041	0.01	31299	622	0.01
31169	720	0.01	31300	1,050	0.01
31171	681	0.01	31303	673	0.01
31172	3,451	0.05	31304	388	0.01
31173	689	0.01	31306	505	0.01
31174	4,050	0.06	31309	1,820	0.02
31177	398	0.01	31310	5,515	0.08
31185	1,685	0.02	31311	3,174	0.04
31189	612	0.01	31312	2,920	0.04
31190	1,383	0.02	31313	2,476	0.03
31192	499	0.01	31314	3,960	0.05
31199	3,917	0.05	31317	2,886	0.04
31201	2,382	0.03	31319	609	0.01
31205	1,076	0.01	31320	549	0.01
31211	997	0.01	31336	2,788	0.04
31213	416	0.01	31337	1,341	0.02
31217	709	0.01	31345	1,673	0.02
31219	474	0.01	31347	1,387	0.02
31246	664	0.01	31349	2,532	0.03
31248	499	0.01	31350	2,927	0.04
31252	502	0.01	31351	519	0.01
31255	1,071	0.01	31352	726	0.01
31259	1,483	0.02	31356	2,190	0.03
31264	803	0.01	31370	2,838	0.04
31265	1,276	0.02	31372	1,068	0.01
31268	434	0.01	31377	1,280	0.02
31272	539	0.01	31386	3,578	0.05
31275	717	0.01	31387	699	0.01
31282	566	0.01	31394	408	0.01
31284	2,018	0.03	31397	469	0.01
31285	1,306	0.02	31401	595	0.01
31287	694	0.01	31402	525	0.01
31289	592	0.01	31411	3,323	0.05
31290	3,046	0.04	31412	616	0.01

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
31416	733	0.01	31526	1,962	0.03
31418	471	0.01	31527	606	0.01
31423	1,585	0.02	31528	1,540	0.02
31425	729	0.01	31529	454	0.01
31428	796	0.01	31539	763	0.01
31430	3,190	0.04	31548	5,253	0.07
31432	1,349	0.02	31550	400	0.01
31434	444	0.01	31551	525	0.01
31435	2,459	0.03	31552	2,695	0.04
31450	718	0.01	31553	455	0.01
31452	394	0.01	31555	1,349	0.02
31461	2,451	0.03	31556	1,078	0.01
31468	579	0.01	31558	736	0.01
31476	3,087	0.04	31559	1,618	0.02
31480	4,738	0.07	31560	979	0.01
31481	5,518	0.08	31561	1,493	0.02
31483	798	0.01	31563	540	0.01
31484	2,586	0.04	31565	440	0.01
31485	421	0.01	31586	524	0.01
31486	1,478	0.02	31591	883	0.01
31488	1,328	0.02	31592	1,634	0.02
31489	660	0.01	31593	454	0.01
31491	885	0.01	31594	478	0.01
31493	805	0.01	31596	417	0.01
31494	692	0.01	31600	624	0.01
31495	631	0.01	31605	2,144	0.03
31501	526	0.01	31606	6,428	0.09
31511	1,004	0.01	31607	866	0.01
31513	1,530	0.02	31609	14,328	0.2
31514	1,455	0.02	31610	558	0.01
31515	1,147	0.02	31613	1,033	0.01
31516	1,587	0.02	31614	1,973	0.03
31517	2,250	0.03	31615	2,659	0.04
31519	4,161	0.06	31616	6,238	0.09
31520	763	0.01	31620	3,703	0.05
31522	462	0.01	31621	550	0.01
31523	1,070	0.01	31624	1,442	0.02
31525	421	0.01	31625	3,658	0.05

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
31626	516	0.01	31766	826	0.01
31627	1,010	0.01	31767	1,146	0.02
31630	728	0.01	31769	1,779	0.02
31631	1,113	0.02	31773	778	0.01
31633	1,222	0.02	31781	524	0.01
31639	6,350	0.09	31788	2,654	0.04
31640	917	0.01	31794	1,702	0.02
31641	415	0.01	31798	470	0.01
31669	751	0.01	31799	998	0.01
31688	1,370	0.02	31800	445	0.01
31690	612	0.01	31802	864	0.01
31691	658	0.01	31803	677	0.01
31693	1,322	0.02	31808	1,480	0.02
31695	1,308	0.02	31818	835	0.01
31698	1,520	0.02	31825	814	0.01
31702	1,233	0.02	31830	1,655	0.02
31703	1,376	0.02	31831	429	0.01
31704	695	0.01	31833	592	0.01
31706	1,904	0.03	31834	3,306	0.05
31711	844	0.01	31835	489	0.01
31713	437	0.01	31837	3,329	0.05
31714	1,003	0.01	31844	667	0.01
31716	2,634	0.04	31851	1,181	0.02
31719	867	0.01	31853	2,658	0.04
31722	684	0.01	31854	9,319	0.13
31723	1,629	0.02	31855	2,153	0.03
31724	968	0.01	31856	725	0.01
31727	1,058	0.01	31857	714	0.01
31728	463	0.01	31858	1,675	0.02
31731	563	0.01	31860	1,704	0.02
31736	540	0.01	31861	1,018	0.01
31737	2,553	0.04	31862	712	0.01
31738	1,495	0.02	31864	667	0.01
31743	922	0.01	31865	406	0.01
31744	696	0.01	31868	3,321	0.05
31762	1,237	0.02	31872	1,665	0.02
31763	491	0.01	31873	555	0.01
31764	2,454	0.03	31874	723	0.01

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
31875	390	0.01	32004	3,175	0.04
31888	521	0.01	32005	1,353	0.02
31889	1,375	0.02	32006	3,339	0.05
31890	665	0.01	32009	1,225	0.02
31894	404	0.01	32010	2,309	0.03
31896	965	0.01	32011	2,978	0.04
31917	444	0.01	32013	847	0.01
31924	2,298	0.03	32018	860	0.01
31925	539	0.01	32019	795	0.01
31926	1,233	0.02	32021	754	0.01
31927	679	0.01	32022	4,557	0.06
31934	692	0.01	32023	641	0.01
31935	885	0.01	32028	1,716	0.02
31936	651	0.01	32029	484	0.01
31937	628	0.01	32030	2,544	0.03
31939	1,064	0.01	32041	643	0.01
31943	686	0.01	32057	818	0.01
31956	628	0.01	32058	8,617	0.12
31958	703	0.01	32061	3,615	0.05
31976	1,345	0.02	32062	9,544	0.13
31977	864	0.01	32063	7,234	0.1
31979	573	0.01	32065	2,300	0.03
31980	752	0.01	32066	510	0.01
31981	1,860	0.03	32069	1,337	0.02
31982	12,110	0.17	32070	694	0.01
31983	2,324	0.03	32073	427	0.01
31988	1,144	0.02	32079	524	0.01
31989	15,001	0.21	32090	1,563	0.02
31990	1,382	0.02	32091	749	0.01
31991	1,191	0.02	32094	587	0.01
31992	2,293	0.03	32099	1,682	0.02
31994	880	0.01	32100	2,238	0.03
31997	4,177	0.06	32101	2,132	0.03
31999	2,268	0.03	32102	2,887	0.04
32000	455	0.01	32103	1,144	0.02
32001	2,798	0.04	32105	734	0.01
32002	982	0.01	32106	669	0.01
32003	2,623	0.04	32107	1,767	0.02

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
32108	3,090	0.04	32174	654	0.01
32109	429	0.01	32175	7,726	0.11
32110	388	0.01	32176	12,924	0.18
32114	915	0.01	32177	1,844	0.03
32116	1,208	0.02	32179	6,715	0.09
32119	4,781	0.07	32181	2,349	0.03
32121	2,985	0.04	32183	1,870	0.03
32122	1,467	0.02	32185	817	0.01
32123	4,762	0.07	32187	421	0.01
32127	1,106	0.02	32188	1,552	0.02
32128	875	0.01	32191	2,300	0.03
32130	2,368	0.03	32192	1,822	0.03
32132	3,709	0.05	32193	11,190	0.15
32133	1,090	0.01	32194	2,639	0.04
32135	2,825	0.04	32195	4,087	0.06
32136	1,021	0.01	32196	436	0.01
32137	710	0.01	32198	559	0.01
32138	3,210	0.04	32199	775	0.01
32139	10,468	0.14	32208	1,651	0.02
32140	12,394	0.17	32209	859	0.01
32141	6,217	0.09	32211	2,255	0.03
32142	5,163	0.07	32212	1,871	0.03
32143	1,270	0.02	32214	667	0.01
32144	741	0.01	32215	536	0.01
32145	3,641	0.05	32216	1,551	0.02
32147	484	0.01	32217	2,090	0.03
32148	3,160	0.04	32218	1,110	0.02
32152	557	0.01	32219	1,733	0.02
32160	5,793	0.08	32220	1,674	0.02
32161	2,726	0.04	32221	427	0.01
32163	449	0.01	32222	5,578	0.08
32164	4,390	0.06	32224	987	0.01
32165	456	0.01	32225	5,834	0.08
32166	3,868	0.05	32226	10,881	0.15
32167	3,374	0.05	32228	534	0.01
32168	4,341	0.06	32229	2,169	0.03
32169	1,375	0.02	32232	2,698	0.04
32170	978	0.01	32233	1,435	0.02

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations		VLT ID	Frequency	% of Observations
32240	2,437	0.03		32292	1,148	0.02
32242	995	0.01		32295	4,512	0.06
32243	395	0.01		32297	1,523	0.02
32244	719	0.01		32311	1,936	0.03
32246	4,883	0.07		32314	643	0.01
32248	3,816	0.05		32316	3,493	0.05
32249	7,852	0.11		32317	7,468	0.1
32251	3,385	0.05		32318	1,524	0.02
32252	9,665	0.13		32319	12,960	0.18
32253	1,359	0.02		32320	2,387	0.03
32254	2,763	0.04		32321	36,796	0.51
32255	1,108	0.02		32322	828	0.01
32256	2,310	0.03		32324	3,804	0.05
32257	451	0.01		32325	1,710	0.02
32258	3,191	0.04		32326	15,569	0.21
32259	433	0.01		32327	14,913	0.2
32260	10,759	0.15		32328	1,107	0.02
32261	13,442	0.18		32330	3,419	0.05
32264	611	0.01		32333	5,927	0.08
32265	6,718	0.09		32334	1,154	0.02
32267	1,007	0.01		32335	1,704	0.02
32268	7,126	0.1		32336	1,818	0.02
32270	1,112	0.02		32337	2,168	0.03
32271	506	0.01		32338	4,655	0.06
32272	2,340	0.03		32340	822	0.01
32273	824	0.01		32341	1,618	0.02
32274	2,603	0.04		32342	1,299	0.02
32275	5,821	0.08		32343	1,392	0.02
32276	3,261	0.04		32345	14,473	0.2
32277	1,959	0.03		32346	465	0.01
32278	6,009	0.08		32347	1,440	0.02
32279	1,415	0.02		32350	486	0.01
32281	775	0.01		32351	591	0.01
32283	6,407	0.09		32362	503	0.01
32285	1,222	0.02		32366	1,718	0.02
32287	983	0.01		32367	398	0.01
32288	2,871	0.04		32375	5,340	0.07
32289	4,219	0.06		32376	1,817	0.02

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
32377	2,552	0.04	32434	3,531	0.05
32378	2,673	0.04	32436	1,253	0.02
32380	3,650	0.05	32437	4,487	0.06
32382	2,565	0.04	32438	2,861	0.04
32384	4,532	0.06	32441	1,380	0.02
32385	1,627	0.02	32446	2,035	0.03
32386	1,595	0.02	32447	1,417	0.02
32387	1,087	0.01	32449	5,204	0.07
32388	3,272	0.04	32450	780	0.01
32389	2,906	0.04	32451	2,200	0.03
32390	1,916	0.03	32452	416	0.01
32391	831	0.01	32455	2,169	0.03
32392	1,110	0.02	32456	472	0.01
32393	3,284	0.05	32457	1,230	0.02
32396	1,514	0.02	32458	1,209	0.02
32398	2,154	0.03	32461	1,484	0.02
32399	10,135	0.14	32467	1,780	0.02
32400	1,723	0.02	32469	706	0.01
32403	437	0.01	32470	586	0.01
32404	4,907	0.07	32474	1,189	0.02
32405	4,467	0.06	32477	945	0.01
32406	1,037	0.01	32478	718	0.01
32407	12,113	0.17	32479	3,637	0.05
32408	4,831	0.07	32480	2,979	0.04
32409	1,581	0.02	32481	923	0.01
32410	1,625	0.02	32482	3,526	0.05
32411	507	0.01	32483	1,025	0.01
32412	1,263	0.02	32485	348	0
32413	998	0.01	32486	482	0.01
32414	4,952	0.07	32488	1,371	0.02
32415	2,395	0.03	32489	5,956	0.08
32426	1,513	0.02	32490	8,238	0.11
32427	4,468	0.06	32491	1,364	0.02
32428	1,998	0.03	32492	5,728	0.08
32429	2,127	0.03	32493	5,282	0.07
32431	799	0.01	32494	722	0.01
32432	806	0.01	32495	8,834	0.12
32433	2,323	0.03	32496	3,543	0.05

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
32497	1,842	0.03	32559	1,296	0.02
32498	1,073	0.01	32560	838	0.01
32499	394	0.01	32565	1,388	0.02
32501	2,879	0.04	32566	825	0.01
32502	1,153	0.02	32567	819	0.01
32503	6,180	0.08	32568	1,731	0.02
32504	13,540	0.19	32571	1,014	0.01
32505	1,174	0.02	32574	6,227	0.09
32506	7,154	0.1	32575	1,584	0.02
32507	2,279	0.03	32576	2,953	0.04
32508	680	0.01	32577	1,938	0.03
32509	6,071	0.08	32578	4,843	0.07
32510	1,213	0.02	32579	32,402	0.44
32511	760	0.01	32580	6,946	0.1
32512	545	0.01	32581	2,188	0.03
32520	895	0.01	32582	2,445	0.03
32521	3,305	0.05	32583	3,070	0.04
32522	4,496	0.06	32584	921	0.01
32523	988	0.01	32585	1,179	0.02
32525	602	0.01	32586	37,032	0.51
32526	734	0.01	32588	3,587	0.05
32527	2,246	0.03	32589	7,725	0.11
32528	720	0.01	32591	2,857	0.04
32530	630	0.01	32592	3,335	0.05
32532	383	0.01	32593	577	0.01
32534	394	0.01	32594	8,342	0.11
32535	1,998	0.03	32597	6,332	0.09
32537	1,817	0.02	32598	1,271	0.02
32541	7,547	0.1	32599	7,102	0.1
32542	485	0.01	32600	2,323	0.03
32543	1,022	0.01	32601	31,860	0.44
32547	1,700	0.02	32602	1,536	0.02
32548	1,875	0.03	32603	10,112	0.14
32549	2,554	0.04	32604	3,617	0.05
32550	3,844	0.05	32605	11,466	0.16
32551	6,654	0.09	32606	626	0.01
32553	2,608	0.04	32607	3,731	0.05
32558	556	0.01	32608	3,520	0.05

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
32609	11,631	0.16	32707	927	0.01
32611	3,374	0.05	32708	942	0.01
32613	1,593	0.02	32709	562	0.01
32614	873	0.01	32717	657	0.01
32616	2,751	0.04	32718	752	0.01
32617	5,561	0.08	32732	613	0.01
32621	1,604	0.02	32734	1,302	0.02
32622	3,807	0.05	32737	392	0.01
32623	3,643	0.05	32739	419	0.01
32624	1,076	0.01	32740	473	0.01
32625	787	0.01	32742	1,035	0.01
32633	633	0.01	32744	916	0.01
32634	1,310	0.02	32746	2,148	0.03
32635	1,270	0.02	32749	1,120	0.02
32636	499	0.01	32750	2,059	0.03
32638	1,535	0.02	32751	3,714	0.05
32639	867	0.01	32752	998	0.01
32640	553	0.01	32753	540	0.01
32642	404	0.01	32754	1,239	0.02
32644	1,224	0.02	32755	571	0.01
32645	2,165	0.03	32757	1,730	0.02
32646	590	0.01	32759	884	0.01
32647	1,137	0.02	32760	1,840	0.03
32648	617	0.01	32763	1,197	0.02
32652	525	0.01	32765	2,519	0.03
32653	782	0.01	32777	2,476	0.03
32654	1,132	0.02	32778	660	0.01
32655	2,539	0.03	32781	1,475	0.02
32656	2,831	0.04	32783	631	0.01
32658	1,835	0.03	32785	1,429	0.02
32661	694	0.01	32786	2,068	0.03
32662	1,331	0.02	32787	508	0.01
32663	3,284	0.05	32792	1,604	0.02
32664	1,552	0.02	32793	2,583	0.04
32667	869	0.01	32795	1,635	0.02
32675	412	0.01	32797	1,194	0.02
32696	555	0.01	32799	636	0.01
32705	467	0.01	32801	1,106	0.02

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations		VLT ID	Frequency	% of Observations
32802	1,853	0.03		32887	2,962	0.04
32803	1,515	0.02		32888	4,271	0.06
32812	575	0.01		32890	2,011	0.03
32813	1,062	0.01		32895	1,355	0.02
32815	521	0.01		32896	5,271	0.07
32816	4,387	0.06		32898	640	0.01
32817	785	0.01		32904	1,011	0.01
32818	910	0.01		32906	3,383	0.05
32823	1,383	0.02		32907	1,518	0.02
32824	1,174	0.02		32908	630	0.01
32826	2,615	0.04		32909	1,552	0.02
32827	1,394	0.02		32913	2,613	0.04
32830	732	0.01		32918	536	0.01
32831	649	0.01		32919	1,442	0.02
32835	505	0.01		32923	530	0.01
32836	646	0.01		32926	797	0.01
32837	402	0.01		32940	531	0.01
32838	518	0.01		32946	692	0.01
32842	1,362	0.02		32947	1,645	0.02
32843	1,084	0.01		32949	1,209	0.02
32846	3,543	0.05		32950	3,747	0.05
32848	409	0.01		32951	1,049	0.01
32849	1,561	0.02		32952	11,811	0.16
32850	2,724	0.04		32955	3,050	0.04
32853	604	0.01		32956	1,528	0.02
32855	1,230	0.02		32957	4,462	0.06
32856	674	0.01		32958	3,456	0.05
32865	1,881	0.03		32959	582	0.01
32866	510	0.01		32961	1,415	0.02
32873	791	0.01		32964	2,657	0.04
32874	1,803	0.02		32966	385	0.01
32876	967	0.01		32968	492	0.01
32878	1,935	0.03		32969	939	0.01
32879	868	0.01		32973	731	0.01
32880	1,525	0.02		32975	404	0.01
32882	1,026	0.01		32976	542	0.01
32884	563	0.01		32978	4,049	0.06
32886	935	0.01		33001	1,003	0.01

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
33002	678	0.01	33102	372	0.01
33003	554	0.01	33116	394	0.01
33004	525	0.01	33117	543	0.01
33005	737	0.01	33119	790	0.01
33007	997	0.01	33124	1,836	0.03
33009	1,082	0.01	33125	12,237	0.17
33011	1,762	0.02	33126	1,969	0.03
33012	640	0.01	33127	1,204	0.02
33013	478	0.01	33130	1,810	0.02
33015	1,030	0.01	33131	496	0.01
33016	1,819	0.02	33132	2,671	0.04
33017	833	0.01	33133	604	0.01
33019	1,387	0.02	33134	932	0.01
33026	551	0.01	33135	1,395	0.02
33028	705	0.01	33136	609	0.01
33029	2,474	0.03	33138	1,426	0.02
33034	768	0.01	33139	5,161	0.07
33036	947	0.01	33141	2,095	0.03
33038	1,538	0.02	33142	584	0.01
33039	430	0.01	33143	1,399	0.02
33044	887	0.01	33144	552	0.01
33045	799	0.01	33148	742	0.01
33057	704	0.01	33150	696	0.01
33058	1,553	0.02	33151	1,218	0.02
33059	913	0.01	33157	434	0.01
33060	463	0.01	33158	842	0.01
33064	605	0.01	33166	482	0.01
33065	871	0.01	33170	476	0.01
33067	462	0.01	33175	1,795	0.02
33069	2,579	0.04	33179	389	0.01
33070	492	0.01	33182	621	0.01
33079	747	0.01	33183	514	0.01
33080	508	0.01	33184	3,879	0.05
33082	1,123	0.02	33185	1,346	0.02
33084	601	0.01	33186	3,301	0.05
33089	702	0.01	33188	664	0.01
33095	661	0.01	33193	407	0.01
33099	514	0.01	33196	431	0.01

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
33199	1,189	0.02	33282	444	0.01
33202	801	0.01	33284	6,725	0.09
33209	1,387	0.02	33285	1,422	0.02
33211	781	0.01	33286	4,837	0.07
33212	402	0.01	33287	12,265	0.17
33214	1,180	0.02	33288	6,453	0.09
33215	9,144	0.13	33293	2,036	0.03
33216	2,080	0.03	33295	717	0.01
33217	414	0.01	33296	2,927	0.04
33218	444	0.01	33300	1,635	0.02
33219	479	0.01	33303	509	0.01
33222	13,238	0.18	33305	622	0.01
33224	744	0.01	33321	662	0.01
33225	2,002	0.03	33322	2,763	0.04
33227	645	0.01	33324	696	0.01
33228	624	0.01	33328	592	0.01
33230	2,860	0.04	33332	886	0.01
33232	1,472	0.02	33333	738	0.01
33233	411	0.01	33335	3,383	0.05
33234	1,641	0.02	33336	3,197	0.04
33235	527	0.01	33337	1,271	0.02
33236	5,779	0.08	33339	460	0.01
33238	2,115	0.03	33340	661	0.01
33240	3,605	0.05	33341	403	0.01
33242	1,050	0.01	33342	2,399	0.03
33243	957	0.01	33343	1,703	0.02
33244	3,311	0.05	33344	856	0.01
33245	825	0.01	33351	877	0.01
33247	471	0.01	33357	1,318	0.02
33249	541	0.01	33360	2,645	0.04
33250	1,239	0.02	33361	580	0.01
33251	2,399	0.03	33362	1,656	0.02
33255	1,204	0.02	33365	1,053	0.01
33256	600	0.01	33367	929	0.01
33264	388	0.01	33369	573	0.01
33266	789	0.01	33374	1,896	0.03
33271	453	0.01	33375	413	0.01
33281	769	0.01	33376	3,676	0.05

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
33377	3,348	0.05	33447	14,877	0.2
33378	9,072	0.12	33448	1,479	0.02
33379	12,400	0.17	33449	2,378	0.03
33380	1,324	0.02	33453	458	0.01
33381	1,406	0.02	33454	4,898	0.07
33382	427	0.01	33455	2,484	0.03
33383	7,842	0.11	33456	831	0.01
33385	2,960	0.04	33457	4,422	0.06
33386	3,354	0.05	33458	2,750	0.04
33388	607	0.01	33459	2,837	0.04
33390	2,837	0.04	33460	4,791	0.07
33391	583	0.01	33461	5,440	0.07
33393	4,299	0.06	33462	564	0.01
33394	1,018	0.01	33463	1,929	0.03
33398	1,447	0.02	33464	1,689	0.02
33406	2,655	0.04	33467	629	0.01
33407	3,516	0.05	33468	1,298	0.02
33408	6,638	0.09	33469	1,216	0.02
33409	1,941	0.03	33470	808	0.01
33410	932	0.01	33471	585	0.01
33412	468	0.01	33472	2,411	0.03
33413	4,078	0.06	33473	1,867	0.03
33416	976	0.01	33474	1,391	0.02
33417	3,002	0.04	33475	542	0.01
33418	4,261	0.06	33478	1,289	0.02
33420	781	0.01	33479	3,307	0.05
33421	490	0.01	33480	5,992	0.08
33425	4,457	0.06	33482	402	0.01
33426	3,596	0.05	33483	1,980	0.03
33428	430	0.01	33484	2,414	0.03
33429	2,402	0.03	33485	578	0.01
33432	2,442	0.03	33490	2,101	0.03
33435	1,719	0.02	33493	2,747	0.04
33436	2,643	0.04	33494	568	0.01
33437	8,389	0.12	33500	2,045	0.03
33438	762	0.01	33501	3,820	0.05
33444	3,324	0.05	33503	1,438	0.02
33446	774	0.01	33504	5,177	0.07

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations
33505	2,210	0.03
33506	5,076	0.07
33507	1,045	0.01
33508	2,220	0.03
33509	949	0.01
33510	2,013	0.03
33511	3,573	0.05
33512	7,177	0.1
33513	13,129	0.18
33514	566	0.01
33515	5,707	0.08
33520	2,597	0.04
33522	8,534	0.12
33524	965	0.01
33526	401	0.01
33528	1,042	0.01
33529	462	0.01
33530	1,642	0.02
33531	425	0.01
33532	3,260	0.04
33533	3,966	0.05
33535	8,113	0.11
33536	6,531	0.09
33537	2,334	0.03
33538	3,608	0.05
33539	696	0.01
33541	404	0.01
33545	5,142	0.07
33547	1,149	0.02
33548	2,568	0.04
33549	5,436	0.07
33552	836	0.01
33553	1,102	0.02
33557	1,976	0.03
33558	669	0.01
33559	640	0.01
33560	462	0.01
33570	1,880	0.03
33575	2,049	0.03
33576	655	0.01
33577	2,451	0.03
33578	31,069	0.43
33579	11,786	0.16
33580	40,408	0.55
33581	2,035	0.03
33585	14,865	0.2
33586	5,601	0.08
33587	23,144	0.32
33588	11,636	0.16
33589	6,621	0.09
33590	8,582	0.12
33591	1,192	0.02
33592	5,068	0.07
33593	1,565	0.02
33594	1,545	0.02
33595	5,876	0.08
33597	614	0.01
33598	421	0.01
33601	2,712	0.04
33602	6,349	0.09
33603	558	0.01
33604	865	0.01
33605	770	0.01
33606	1,534	0.02
33608	434	0.01
33609	1,328	0.02
33610	637	0.01
33612	9,549	0.13
33613	3,673	0.05
33614	1,545	0.02
33616	739	0.01
33617	486	0.01
33624	607	0.01
33627	430	0.01
33629	573	0.01
33638	1,534	0.02

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
33639	1,391	0.02	33695	1,689	0.02
33640	418	0.01	33696	1,321	0.02
33641	489	0.01	33697	553	0.01
33642	909	0.01	33698	1,376	0.02
33643	1,304	0.02	33700	2,763	0.04
33644	2,140	0.03	33701	1,935	0.03
33645	849	0.01	33711	3,936	0.05
33646	500	0.01	33712	5,386	0.07
33647	960	0.01	33713	1,428	0.02
33648	1,002	0.01	33714	2,527	0.03
33649	897	0.01	33715	1,781	0.02
33651	3,599	0.05	33719	1,487	0.02
33653	2,756	0.04	33720	1,420	0.02
33655	4,520	0.06	33722	739	0.01
33656	381	0.01	33723	1,115	0.02
33657	1,025	0.01	33724	464	0.01
33658	875	0.01	33728	8,515	0.12
33659	2,812	0.04	33729	1,462	0.02
33660	2,192	0.03	33730	738	0.01
33661	2,484	0.03	33736	2,743	0.04
33663	4,711	0.06	33737	979	0.01
33664	477	0.01	33739	3,238	0.04
33665	1,426	0.02	33740	478	0.01
33670	524	0.01	33741	10,742	0.15
33671	1,786	0.02	33743	863	0.01
33674	4,835	0.07	33748	4,650	0.06
33680	647	0.01	33749	1,450	0.02
33681	4,676	0.06	33750	1,597	0.02
33682	7,768	0.11	33751	658	0.01
33684	531	0.01	33752	616	0.01
33686	1,799	0.02	33753	1,051	0.01
33687	3,535	0.05	33754	1,111	0.02
33688	6,185	0.08	33758	883	0.01
33689	408	0.01	33762	1,138	0.02
33690	4,664	0.06	33763	954	0.01
33691	2,826	0.04	33766	952	0.01
33692	952	0.01	33768	452	0.01
33694	3,551	0.05	33771	465	0.01

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations		VLT ID	Frequency	% of Observations
33772	802	0.01		33832	972	0.01
33777	321	0		33834	438	0.01
33784	3,551	0.05		33837	477	0.01
33785	4,442	0.06		33839	512	0.01
33786	1,377	0.02		33840	1,467	0.02
33787	1,054	0.01		33841	1,028	0.01
33788	653	0.01		33844	1,121	0.02
33790	1,382	0.02		33845	483	0.01
33792	2,506	0.03		33852	5,825	0.08
33794	1,580	0.02		33853	773	0.01
33796	698	0.01		33856	377	0.01
33799	4,980	0.07		33857	1,347	0.02
33800	28,476	0.39		33858	2,721	0.04
33801	3,300	0.05		33859	3,141	0.04
33802	5,339	0.07		33861	15,222	0.21
33803	2,974	0.04		33862	8,134	0.11
33804	7,103	0.1		33863	15,721	0.22
33805	1,219	0.02		33865	2,560	0.04
33806	5,252	0.07		33866	2,478	0.03
33807	4,439	0.06		33867	1,208	0.02
33808	5,718	0.08		33868	645	0.01
33809	1,238	0.02		33872	3,238	0.04
33810	3,077	0.04		33873	543	0.01
33811	15,749	0.22		33875	1,338	0.02
33812	852	0.01		33876	618	0.01
33813	7,460	0.1		33877	2,131	0.03
33814	1,774	0.02		33878	971	0.01
33815	4,774	0.07		33881	402	0.01
33816	1,575	0.02		33884	6,663	0.09
33817	973	0.01		33885	783	0.01
33818	4,031	0.06		33886	3,043	0.04
33819	783	0.01		33887	1,253	0.02
33820	2,951	0.04		33888	9,614	0.13
33822	1,361	0.02		33889	20,230	0.28
33826	1,264	0.02		33890	3,940	0.05
33828	1,156	0.02		33891	1,007	0.01
33829	2,071	0.03		33892	2,227	0.03
33831	590	0.01		33893	2,007	0.03

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations		VLT ID	Frequency	% of Observations
33894	2,378	0.03		33955	1,014	0.01
33895	47,651	0.65		33956	465	0.01
33897	2,889	0.04		33958	718	0.01
33898	7,157	0.1		33959	429	0.01
33900	2,365	0.03		33960	574	0.01
33901	453	0.01		33965	924	0.01
33902	9,048	0.12		33969	409	0.01
33903	6,164	0.08		33989	605	0.01
33904	2,016	0.03		34005	700	0.01
33905	2,194	0.03		34025	386	0.01
33906	1,312	0.02		34027	1,448	0.02
33907	4,733	0.06		34039	789	0.01
33908	1,750	0.02		34043	895	0.01
33909	27,986	0.38		34044	551	0.01
33910	11,854	0.16		34045	1,714	0.02
33911	20,365	0.28		34047	616	0.01
33913	5,201	0.07		34050	1,530	0.02
33914	6,784	0.09		34052	464	0.01
33915	16,352	0.22		34053	414	0.01
33916	4,228	0.06		34057	606	0.01
33921	1,278	0.02		34059	527	0.01
33923	1,061	0.01		34070	1,667	0.02
33924	7,395	0.1		34075	805	0.01
33926	4,206	0.06		34081	431	0.01
33927	4,683	0.06		34083	806	0.01
33928	684	0.01		34084	444	0.01
33932	518	0.01		34091	602	0.01
33933	793	0.01		34092	3,540	0.05
33936	2,455	0.03		34093	387	0.01
33937	528	0.01		34099	516	0.01
33941	1,769	0.02		34104	415	0.01
33942	524	0.01		34116	1,779	0.02
33944	416	0.01		34117	772	0.01
33950	513	0.01		34123	476	0.01
33951	477	0.01		34132	663	0.01
33952	1,335	0.02		34133	416	0.01
33953	822	0.01		34134	1,048	0.01
33954	1,486	0.02		34135	871	0.01

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
34136	442	0.01	34279	615	0.01
34154	792	0.01	34280	420	0.01
34159	487	0.01	34290	1,653	0.02
34160	784	0.01	34291	385	0.01
34166	649	0.01	34318	625	0.01
34168	1,048	0.01	34326	391	0.01
34173	703	0.01	34330	522	0.01
34174	494	0.01	34331	1,202	0.02
34183	600	0.01	34341	1,028	0.01
34184	1,097	0.02	34351	409	0.01
34185	1,395	0.02	34358	1,981	0.03
34187	852	0.01	34359	625	0.01
34188	399	0.01	34363	1,688	0.02
34190	2,650	0.04	34365	408	0.01
34199	944	0.01	34366	848	0.01
34200	535	0.01	34369	1,070	0.01
34202	1,572	0.02	34370	493	0.01
34203	975	0.01	34374	380	0.01
34205	518	0.01	34375	478	0.01
34206	644	0.01	34385	870	0.01
34211	788	0.01	34386	715	0.01
34218	523	0.01	34387	1,018	0.01
34254	1,339	0.02	34389	553	0.01
34258	1,067	0.01	34399	1,590	0.02
34259	5,515	0.08	34403	401	0.01
34260	2,317	0.03	34408	1,359	0.02
34261	6,439	0.09	34413	697	0.01
34262	945	0.01	34414	432	0.01
34263	3,480	0.05	34420	1,147	0.02
34264	700	0.01	34445	431	0.01
34265	1,223	0.02	34452	371	0.01
34266	2,919	0.04	34455	3,253	0.04
34267	1,259	0.02	34456	541	0.01
34268	664	0.01	34457	489	0.01
34269	639	0.01	34459	815	0.01
34271	480	0.01	34461	929	0.01
34272	455	0.01	34462	725	0.01
34274	924	0.01	34463	485	0.01

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
34465	776	0.01	34737	2,095	0.03
34466	2,014	0.03	34738	970	0.01
34467	628	0.01	34739	5,880	0.08
34469	1,647	0.02	34741	656	0.01
34470	531	0.01	34742	1,557	0.02
34475	681	0.01	34743	2,429	0.03
34478	522	0.01	34744	904	0.01
34509	554	0.01	34745	761	0.01
34512	985	0.01	34746	893	0.01
34523	2,765	0.04	34747	1,082	0.01
34525	532	0.01	34748	434	0.01
34531	401	0.01	34749	1,705	0.02
34547	722	0.01	34751	471	0.01
34549	415	0.01	34752	1,346	0.02
34551	925	0.01	34753	828	0.01
34553	7,769	0.11	34756	2,453	0.03
34554	2,490	0.03	34758	3,462	0.05
34558	6,355	0.09	34759	1,690	0.02
34559	747	0.01	34760	777	0.01
34560	1,400	0.02	34761	486	0.01
34563	490	0.01	34762	692	0.01
34568	884	0.01	34763	1,823	0.03
34570	1,218	0.02	34764	457	0.01
34571	480	0.01	34765	565	0.01
34573	388	0.01	34766	2,645	0.04
34574	454	0.01	34767	769	0.01
34576	1,494	0.02	34768	1,434	0.02
34577	1,370	0.02	34769	2,287	0.03
34578	2,156	0.03	34770	1,077	0.01
34580	682	0.01	34772	1,530	0.02
34583	541	0.01	34775	387	0.01
34585	3,441	0.05	34776	1,331	0.02
34588	483	0.01	34778	624	0.01
34590	1,932	0.03	34779	1,060	0.01
34591	630	0.01	34780	627	0.01
34592	495	0.01	34781	9,287	0.13
34597	646	0.01	34782	668	0.01
34736	3,220	0.04	34783	1,403	0.02

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
34784	550	0.01	34848	449	0.01
34785	1,621	0.02	34863	1,108	0.02
34789	702	0.01	34865	427	0.01
34790	407	0.01	34869	498	0.01
34791	940	0.01	34877	648	0.01
34792	540	0.01	34878	760	0.01
34793	562	0.01	34888	685	0.01
34794	4,483	0.06	34889	580	0.01
34795	20,995	0.29	34894	475	0.01
34796	10,261	0.14	34908	489	0.01
34799	6,084	0.08	34915	2,233	0.03
34800	2,003	0.03	34916	5,511	0.08
34801	1,478	0.02	34922	456	0.01
34803	539	0.01	34924	1,201	0.02
34807	1,597	0.02	34926	941	0.01
34808	918	0.01	34928	686	0.01
34810	643	0.01	34931	913	0.01
34811	1,685	0.02	34932	1,431	0.02
34815	3,031	0.04	34941	1,267	0.02
34816	2,493	0.03	34942	1,066	0.01
34817	432	0.01	34944	452	0.01
34818	1,451	0.02	34958	779	0.01
34819	1,043	0.01	34959	727	0.01
34820	395	0.01	34962	439	0.01
34824	478	0.01	34972	2,624	0.04
34825	389	0.01	34976	390	0.01
34828	1,083	0.01	34977	613	0.01
34829	1,306	0.02	34978	400	0.01
34830	538	0.01	34989	463	0.01
34834	677	0.01	34991	671	0.01
34837	605	0.01	34992	505	0.01
34838	419	0.01	34993	623	0.01
34839	512	0.01	34994	3,333	0.05
34842	1,101	0.02	35006	762	0.01
34843	1,209	0.02	35011	805	0.01
34845	715	0.01	35023	486	0.01
34846	638	0.01	35039	459	0.01
34847	2,356	0.03	35041	390	0.01

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations		VLT ID	Frequency	% of Observations
35045	548	0.01		35191	584	0.01
35053	660	0.01		35194	1,607	0.02
35055	417	0.01		35197	4,293	0.06
35058	1,017	0.01		35198	6,982	0.1
35059	2,336	0.03		35199	2,447	0.03
35061	849	0.01		35201	979	0.01
35062	975	0.01		35203	1,358	0.02
35063	1,184	0.02		35204	1,654	0.02
35065	897	0.01		35206	3,469	0.05
35068	483	0.01		35209	888	0.01
35072	2,561	0.04		35211	417	0.01
35074	1,236	0.02		35218	1,049	0.01
35077	669	0.01		35221	503	0.01
35078	1,392	0.02		35222	1,333	0.02
35079	677	0.01		35226	1,059	0.01
35080	474	0.01		35228	2,434	0.03
35087	971	0.01		35229	390	0.01
35090	674	0.01		35233	1,284	0.02
35092	447	0.01		35237	443	0.01
35101	549	0.01		35243	452	0.01
35103	1,346	0.02		35245	439	0.01
35104	1,109	0.02		35248	815	0.01
35105	1,095	0.02		35249	548	0.01
35113	1,086	0.01		35251	1,296	0.02
35126	666	0.01		35257	436	0.01
35134	476	0.01		35276	464	0.01
35142	441	0.01		35277	601	0.01
35157	4,438	0.06		35278	431	0.01
35158	1,797	0.02		35279	400	0.01
35162	545	0.01		35290	2,413	0.03
35168	692	0.01		35291	428	0.01
35169	717	0.01		35292	2,879	0.04
35177	631	0.01		35293	916	0.01
35178	492	0.01		35294	439	0.01
35179	9,674	0.13		35295	577	0.01
35181	735	0.01		35296	546	0.01
35183	6,711	0.09		35297	515	0.01
35187	2,704	0.04		35298	1,096	0.02

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
35299	639	0.01	51899	1,083	0.01
35301	1,213	0.02	51943	558	0.01
50009	394	0.01	51959	3,521	0.05
50010	2,509	0.03	51967	2,415	0.03
50013	400	0.01	51985	597	0.01
50014	3,212	0.04	52045	693	0.01
50017	577	0.01	52059	2,295	0.03
50018	3,782	0.05	52063	449	0.01
50021	690	0.01	52087	1,536	0.02
50022	4,962	0.07	52095	718	0.01
50025	659	0.01	52111	398	0.01
50026	6,106	0.08	52135	487	0.01
50029	780	0.01	52171	2,390	0.03
50030	5,318	0.07	52175	1,369	0.02
50033	896	0.01	52197	1,736	0.02
50034	8,261	0.11	52199	853	0.01
50035	556	0.01	52209	1,001	0.01
50036	4,531	0.06	52255	940	0.01
50038	3,901	0.05	52265	2,756	0.04
50039	457	0.01	52269	608	0.01
50040	606	0.01	52293	2,514	0.03
50041	899	0.01	52305	929	0.01
50042	545	0.01	52341	570	0.01
50043	4,139	0.06	52361	4,645	0.06
50044	3,308	0.05	52369	2,739	0.04
50045	940	0.01	52387	1,065	0.01
50046	1,397	0.02	52461	3,251	0.04
51497	981	0.01	52469	663	0.01
51549	509	0.01	52493	2,078	0.03
51565	3,183	0.04	52505	925	0.01
51581	2,358	0.03	52517	487	0.01
51687	550	0.01	52545	660	0.01
51703	2,407	0.03	52561	3,697	0.05
51715	576	0.01	52565	1,648	0.02
51751	538	0.01	52585	1,091	0.01
51767	2,722	0.04	52645	3,571	0.05
51775	2,208	0.03	52649	834	0.01
51859	1,695	0.02	52669	3,682	0.05

Appendix B: VLT ID Number Distribution

VLT ID	Frequency	% of Observations	VLT ID	Frequency	% of Observations
52677	1,381	0.02	52891	2,235	0.03
52685	682	0.01	52895	648	0.01
52693	576	0.01	52961	524	0.01
52701	5,065	0.07	52982	389	0.01
52705	3,728	0.05	52998	795	0.01
52719	1,339	0.02	53016	587	0.01
52759	641	0.01	53022	1,191	0.02
52765	2,757	0.04	53024	592	0.01
52767	613	0.01	53031	599	0.01
52783	1,308	0.02	53037	1,130	0.02
52791	839	0.01	53038	540	0.01
52807	1,603	0.02	53060	2,765	0.04
52809	1,220	0.02	53061	1,447	0.02
52817	938	0.01	53062	548	0.01
52853	1,644	0.02	53064	1,901	0.03
52855	508	0.01	53067	970	0.01
52871	1,407	0.02	53069	856	0.01
52875	673	0.01	53079	657	0.01
52887	3,191	0.04	**Total Observations**		**7,284,227**

Appendix C: VLT ID Numbers Most Likely to Fail the OBD II Functional Test

VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
32608	10.986	2004	TOYOTA	TUNDRA 2WD	003.4
35126	10.988	2005	CHEVROLET	SILVERADO 2500 2WD	006.0
30700	10.997	2002	FORD	EXPLORER 4DR	004.0
30047	10.998	2001	FORD	RANGER SUPER CAB 4DR	004.0
32750	11.002	2005	CHEVROLET	SILVERADO 1500 2WD	004.8
32330	11.002	2004	HYUNDAI	ACCENT	001.6
30739	11.011	2002	FORD	MUSTANG COUPE	004.6
33150	11.017	2005	PONTIAC	GRAND AM	003.4
32521	11.020	2004	PONTIAC	GRAND AM	003.4
32243	11.030	2004	FORD	E150	005.4
31704	11.034	2003	KIA	SORENTO 2WD	003.5
31856	11.060	2003	NISSAN	FRONTIER 2WD	002.4
30797	11.069	2002	GMC	K1500 YUKON 4WD	005.3
31523	11.079	2003	FORD	MUSTANG CONVERTIBLE	003.8
32380	11.081	2004	JEEP	LIBERTY 2WD	003.7
31494	11.085	2003	FORD	F150 2WD	004.6
30940	11.095	2002	MAZDA	MX-5 MIATA	001.8
30583	11.096	2002	CHEVROLET	K1500 SUBURBAN 4WD	005.3
32827	11.125	2005	DODGE	CARAVAN 2WD	003.8
31476	11.128	2003	FORD	ESCAPE	003.0
29701	11.149	2000	TOYOTA	RAV4 4WD	002.0
29660	11.159	2000	SUBARU	FORESTER AWD	002.5
35296	11.182	2004	BMW	645CI	004.4
50017	11.186	2002	Multiple Light Truck Makes and Models		8 Cylinder Diesel
35059	11.187	2004	BMW	325CI COUPE	002.5
30617	11.187	2002	CHRYSLER	PT CRUISER (Auto)	002.4
33303	11.200	2006	AUDI	A6	003.1
29421	11.204	2000	GMC	SAFARI 2WD PASSENGER	004.3
51715	11.206	2001	DODGE	RAM 3500 DIESEL	005.9
33417	11.209	2006	CHEVROLET	MALIBU	002.2
50030	11.218	2005	Multiple Heavy Duty Light Truck Makes and Models		8 Cylinder Diesel
32812	11.227	2005	CHRYSLER	CROSSFIRE	003.2
1957	11.235	2002	Multiple Station Wagon Makes and Models		6 Cylinder Gasoline
30941	11.238	2002	MAZDA	PROTEGE/PROTEGE 5	002.0
30560	11.242	2002	CHEVROLET	C1500 TAHOE 2WD	005.3
30341	11.254	2001	SATURN	L100/200	002.2

Appendix C: VLT ID Numbers Most Likely to Fail the OBD II Functional Test

VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
29327	11.254	2000	FORD	EXPLORER 4DR	004.0
32148	11.266	2004	CHEVROLET	CORVETTE	005.7
29445	11.268	2000	HYUNDAI	ACCENT (Manual)	001.5
30539	11.268	2002	CADILLAC	ESCALADE AWD	006.0
32543	11.270	2004	SATURN	L300	003.0
30581	11.275	2002	CHEVROLET	SILVERADO 1500 4WD	005.3
2003	11.276	2003	Multiple Full-Size Passenger Car Makes and Models		8 Cylinder Gasoline
29273	11.276	2000	DODGE	DAKOTA 2WD	003.9
30831	11.280	2002	HYUNDAI	SONATA	002.4
33453	11.285	2006	CHRYSLER	SRT-8	006.1
29736	11.286	2000	VOLKSWAGEN	PASSAT WAGON	001.8
32389	11.292	2004	KIA	SEDONA	003.5
50033	11.299	2006	Multiple Light Truck Makes and Models		8 Cylinder Diesel
32824	11.300	2005	CHRYSLER	TOWN & COUNTRY 2WD	003.8
31143	11.337	2002	TOYOTA	RAV4 2WD	002.0
34924	11.339	2002	CHEVROLET	SILVERADO 2500 2WD	006.0
32787	11.342	2005	CHEVROLET	MONTE CARLO	003.4
29612	11.347	2000	OLDSMOBILE	ALERO	002.4
29285	11.374	2000	DODGE	DURANGO 4WD	005.9
33382	11.399	2006	CHEVROLET	COBALT	002.0
31515	11.400	2003	FORD	F150 SUPER CREWCAB	004.6
33810	11.405	2006	NISSAN	QUEST	003.5
32259	11.408	2004	FORD	F150 2WD	004.6
30557	11.409	2002	CHEVROLET	SILVERADO 1500 2WD	005.3
32367	11.410	2004	JAGUAR	XJR	004.2
31303	11.420	2003	CHEVROLET	AVALANCHE 1500 2WD	005.3
30698	11.431	2002	FORD	EXPEDITION	005.4
29294	11.436	2000	DODGE	RAM 1500 4WD	005.9
29707	11.451	2000	TOYOTA	TACOMA 2WD	003.4
29317	11.469	2000	FORD	E250 ECONOLINE	005.4
31319	11.476	2003	CHEVROLET	CORVETTE (Auto)	005.7
32199	11.484	2004	CHRYSLER	TOWN & COUNTRY	003.8
30584	11.485	2002	CHEVROLET	K1500 TAHOE 4WD	004.8
33119	11.487	2005	MITSUBISHI	LANCER	002.0
30103	11.492	2001	HONDA	ODYSSEY	003.5
30798	11.510	2002	GMC	K1500 YUKON DENALI AWD	006.0

Appendix C: VLT ID Numbers Most Likely to Fail the OBD II Functional Test

VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
32101	11.532	2004	BMW	X3	003.0
30537	11.534	2002	CADILLAC	ELDORADO	004.6
31144	11.539	2002	TOYOTA	RAV4 AWD	002.0
30793	11.545	2002	GMC	SIERRA 1500 4WD	005.3
35078	11.553	2004	FORD	F250 SUPER DUTY	005.4
34742	11.564	2000	FORD	RANGER REG CAB SHORT	003.0
33804	11.566	2006	NISSAN	FRONTIER 2WD	004.0
31084	11.575	2002	SATURN	LW200	002.2
1947	11.576	2002	Multiple European Compact Passenger Car Makes and Models		4 Cylinder Gasoline
30618	11.580	2002	CHRYSLER	PT CRUISER (Manual)	002.4
31014	11.593	2002	NISSAN	ALTIMA	003.5
29281	11.599	2000	DODGE	DURANGO 2WD	005.2
32209	11.603	2004	DODGE	CARAVAN 2WD	003.8
32398	11.609	2004	LAND ROVER	RANGE ROVER	004.4
31005	11.609	2002	MITSUBISHI	MONTERO SPORT 2WD	003.0
29729	11.609	2000	VOLKSWAGEN	NEW BEETLE (Auto)	002.0
1976	11.619	2002	Multiple Full-Size SUV Makes and Models		8 Cylinder Gasoline
30901	11.628	2002	LEXUS	IS 300	003.0
29699	11.661	2000	TOYOTA	MR2	001.8
29219	11.671	2000	CHEVROLET	METRO	001.3
31594	11.687	2003	GMC	K1500 YUKON XL 4WD	005.3
34926	11.687	2002	CHEVROLET	SILVERADO 2500 4WD	006.0
2092	11.690	2004	Multiple Mini-Van Makes and Models		6 Cylinder Gasoline
31528	11.693	2003	FORD	MUSTANG COUPE	004.6
30710	11.699	2002	FORD	F150 REG CAB LONG	004.6
29270	11.707	2000	DODGE	CARAVAN 2WD	003.8
30389	11.720	2001	TOYOTA	ECHO	001.5
30874	11.722	2002	JEEP	LIBERTY 2WD	003.7
2101	11.726	2004	Multiple Mid-Size Van Makes and Models		6 Cylinder Gasoline
1995	11.729	2002	Multiple Ford Vans and Light Truck Models		006.8
31854	11.732	2003	NISSAN	ALTIMA	002.5
32803	11.734	2005	CHRYSLER	300C	005.7
29706	11.735	2000	TOYOTA	TACOMA 2WD	002.7
31312	11.742	2003	CHEVROLET	C1500 SUBURBAN 2WD	005.3
30742	11.751	2002	FORD	RANGER PICKUP 4WD	004.0

Appendix C: VLT ID Numbers Most Likely to Fail the OBD II Functional Test

VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
29349	11.759	2000	FORD	FOCUS ZX3 3DR	002.0
30518	11.769	2002	BMW	M5	004.9
51687	11.774	2001	CHEVROLET	SILVERADO 2500 DIESEL	006.6
31693	11.784	2003	JEEP	LIBERTY 2WD	003.7
33820	11.796	2006	PONTIAC	GRAND PRIX	003.8
34959	11.798	2002	FORD	E350 ECONOLINE	005.4
31844	11.811	2003	MITSUBISHI	MONTERO SPORT 2WD	003.0
29370	11.830	2000	FORD	RANGER SUPER CAB 2DR	004.0
34915	11.840	2002	ACURA	RSX	002.0
32549	11.847	2004	SATURN	VUE FWD	003.5
32121	11.849	2004	CADILLAC	DEVILLE	004.6
30968	11.850	2002	MERCEDES	ML500	005.0
32377	11.871	2004	JEEP	GRAND CHEROKEE 4WD	004.0
29671	11.881	2000	SUZUKI	GRAND VITARA 4WD	002.5
30920	11.884	2002	MAZDA	626	002.5
30926	11.884	2002	MAZDA	B2300 REG CAB SHORT	002.3
1867	11.891	2000	Multiple Compact SUV Makes and Models		6 Cylinder Gasoline
33247	11.900	2005	VOLKSWAGEN	GTI	001.8
30011	11.904	2001	FORD	F150 SUPER CAB LONG	005.4
32165	11.908	2004	CHEVROLET	SILVERADO 1500 AWD	006.0
31155	11.912	2002	TOYOTA	TUNDRA 2WD	004.7
31794	11.933	2003	MERCEDES	E500	005.0
29292	11.945	2000	DODGE	RAM 1500 2WD	005.9
32152	11.953	2004	CHEVROLET	EXPRESS 1500	004.3
33300	11.955	2006	AUDI	A4 QUATTRO	002.0
31830	11.963	2003	MITSUBISHI	ECLIPSE	002.4
30775	11.970	2002	GMC	C1500 YUKON XL 2WD	005.3
29188	11.971	2000	CHEVROLET	C2500 SILVERADO 2WD	006.0
33256	11.974	2005	VOLKSWAGEN	PASSAT	001.8
34807	11.996	2005	CADILLAC	CTS	003.6
32338	12.005	2004	HYUNDAI	SONATA	002.7
29277	12.007	2000	DODGE	DAKOTA 4WD	004.7
29670	12.021	2000	SUZUKI	GRAND VITARA 2WD	002.5
30647	12.023	2002	DODGE	DAKOTA 4WD	004.7
31190	12.032	2002	VOLVO	S80/S80 EXECUTIVE	002.9
31556	12.032	2003	GMC	SIERRA 1500 2WD	005.3
31019	12.035	2002	NISSAN	MAXIMA	003.5

Appendix C: VLT ID Numbers Most Likely to Fail the OBD II Functional Test

VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
30097	12.044	2001	HONDA	ACCORD	003.0
29663	12.056	2000	SUBARU	LEGACY AWD	002.5
30774	12.061	2002	GMC	C1500 YUKON 2WD	005.3
34846	12.072	2000	FORD	EXCURSION	005.4
29335	12.084	2000	FORD	F150 REG CAB SHORT	004.6
2129	12.088	2005	Multiple Full-Size Light Truck Makes and Models		8 Cylinder Gasoline
32090	12.101	2004	BMW	3-SERIES	002.5
32918	12.105	2005	GMC	SIERRA 1500 2WD	004.8
32163	12.107	2004	CHEVROLET	SILVERADO 1500 4WD	004.8
30696	12.126	2002	FORD	ESCORT ZX2	002.0
33730	12.127	2006	MERCEDES	C350	003.5
32273	12.132	2004	FORD	FREESTAR WAGON FWD	004.2
31606	12.134	2003	HONDA	ACCORD	003.0
29309	12.135	2000	FORD	CROWN VICTORIA POLICE	004.6
29749	12.138	2000	VOLVO	S70	002.4
30753	12.146	2002	FORD	RANGER SUPER CAB 2DR SH	003.0
30538	12.155	2002	CADILLAC	ESCALADE 2WD	005.3
30064	12.161	2001	GMC	C1500 YUKON XL 2WD	005.3
32843	12.176	2005	DODGE	MAGNUM	005.7
32823	12.177	2005	CHRYSLER	TOWN & COUNTRY 2WD	003.3
32099	12.181	2004	BMW	M3	003.2
1919	12.189	2001	Multiple Compact SUV Makes and Models		4 Cylinder Gasoline
31304	12.210	2003	CHEVROLET	AVALANCHE 1500 4WD	005.3
33264	12.210	2005	VOLKSWAGEN	TOUAREG	003.2
31495	12.216	2003	FORD	F150 2WD	005.4
29656	12.230	2000	SATURN	LW	003.0
32138	12.242	2004	CHEVROLET	SILVERADO 1500 2WD	004.3
29149	12.244	2000	BMW	740IL	004.4
34093	12.244	2007	CHEVROLET	TRAILBLAZER 2WD	004.2
33255	12.244	2005	VOLKSWAGEN	NEW BEETLE	002.0
1859	12.252	2000	Multiple Full-Size Light Truck Makes and Models		8 Cylinder Gasoline
33117	12.260	2005	MITSUBISHI	GALANT	002.4
33815	12.281	2006	NISSAN	XTERRA 2WD	004.0
29487	12.292	2000	JEEP	CHEROKEE 4WD	004.0
31630	12.298	2003	HYUNDAI	SONATA	002.4

Appendix C: VLT ID Numbers Most Likely to Fail the OBD II Functional Test

VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
32130	12.301	2004	CHEVROLET	ASTRO 2WD	004.3
31162	12.317	2002	VOLKSWAGEN	GOLF	002.0
32634	12.321	2004	VOLKSWAGEN	TOUAREG	003.2
31738	12.332	2003	LINCOLN	TOWN CAR	004.6
29313	12.333	2000	FORD	E150 ECONOLINE	004.2
30548	12.343	2002	CHEVROLET	AVALANCHE 1500 4WD	005.3
31486	12.348	2003	FORD	EXPLORER 4DR	004.0
29645	12.363	2000	SAAB	9-3	002.0
32585	12.363	2004	TOYOTA	CELICA	001.8
31555	12.367	2003	GMC	SIERRA 1500 2WD	004.8
30532	12.373	2002	BUICK	PARK AVENUE	003.8
29719	12.402	2000	VOLKSWAGEN	GOLF	002.0
29447	12.407	2000	HYUNDAI	ELANTRA WAGON	002.0
34944	12.409	2002	FORD	F350 SUPER DUTY	006.8
29664	12.410	2000	SUBARU	LEGACY WAGON AWD	002.5
30530	12.418	2002	BUICK	CENTURY	003.1
30803	12.427	2002	GMC	SAFARI 2WD PASSENGER	004.3
2156	12.430	2005	Multiple Full-Size Van Makes and Models		8 Cylinder Gasoline
32469	12.443	2004	MERCURY	MONTEREY	004.2
33592	12.446	2006	HUMMER	H3	003.5
31099	12.463	2002	SUBARU	IMPREZA WAGON AWD	002.5
30108	12.482	2001	HYUNDAI	ACCENT	001.5
29998	12.485	2001	FORD	EXPLORER SPORT TRAC	004.0
33653	12.485	2006	JEEP	LIBERTY 4WD	003.7
50009	12.489	2000	Multiple Heavy Duty Light Truck Makes and Models		8 Cylinder Diesel
32853	12.491	2005	DODGE	RAM 1500 4WD	005.7
2002	12.492	2003	Multiple Mid-Size Passenger Car Makes and Models		6 Cylinder Gasoline
51775	12.496	2001	FORD	F350 DIESEL	007.3
31989	12.497	2003	TOYOTA	COROLLA	001.8
33447	12.519	2006	CHRYSLER	PT CRUISER	002.4
30096	12.521	2001	HONDA	ACCORD	002.3
31526	12.537	2003	FORD	MUSTANG COUPE (Auto)	003.8
29420	12.539	2000	GMC	SAFARI 2WD CARGO	004.3
29446	12.545	2000	HYUNDAI	ELANTRA SEDAN	002.0
30558	12.547	2002	CHEVROLET	C1500 SUBURBAN 2WD	005.3

Appendix C: VLT ID Numbers Most Likely to Fail the OBD II Functional Test

VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
31268	12.558	2003	BMW	M3	003.2
31835	12.558	2003	MITSUBISHI	GALANT	003.0
1856	12.558	2000	Multiple Compact Light Truck Makes and Models		4 Cylinder Gasoline
29697	12.562	2000	TOYOTA	ECHO	001.5
32826	12.568	2005	DODGE	CARAVAN 2WD	003.3
29138	12.574	2000	BMW	323I	002.5
32314	12.579	2004	GMC	SAFARI	004.3
32170	12.585	2004	CHEVROLET	MONTE CARLO	003.8
32019	12.592	2003	VOLKSWAGEN	GTI	001.8
33459	12.609	2006	DODGE	CHARGER	002.7
35058	12.611	2004	BMW	325CI CONVERTIBLE	002.5
30403	12.613	2001	TOYOTA	TACOMA 2WD	002.7
29439	12.614	2000	HONDA	ODYSSEY	003.5
31028	12.622	2002	NISSAN	XTERRA 2WD	002.4
31386	12.633	2003	CHRYSLER	PT CRUISER (Auto)	002.4
32137	12.634	2004	CHEVROLET	BLAZER 4WD	004.3
2018	12.652	2003	Multiple Compact Light Truck Makes and Models		4 Cylinder Gasoline
29754	12.658	2000	VOLVO	V40	001.9
30169	12.663	2001	LEXUS	GS 300	003.0
31293	12.670	2003	CADILLAC	ESCALADE 2WD	005.3
30659	12.677	2002	DODGE	RAM 1500 4WD	004.7
31831	12.684	2003	MITSUBISHI	ECLIPSE	003.0
31265	12.685	2003	BMW	745LI	004.4
29759	12.686	2000	VOLVO	V70 AWD	002.4
29683	12.697	2000	TOYOTA	4RUNNER 2WD	002.7
31021	12.707	2002	NISSAN	PATHFINDER 2WD	003.5
30714	12.710	2002	FORD	F150 REG CAB SHORT	005.4
30533	12.719	2002	BUICK	REGAL	003.8
31698	12.727	2003	JEEP	WRANGLER 4WD	004.0
2009	12.727	2003	Multiple Sub-Compact Passenger Car Makes and Models		4 Cylinder Gasoline
29753	12.737	2000	VOLVO	S80	002.9
31026	12.770	2002	NISSAN	SENTRA (Auto)	002.5
29375	12.777	2000	FORD	RANGER SUPER CAB 2DR	004.0
31432	12.778	2003	DODGE	RAM 1500 2WD	005.7
29358	12.786	2000	FORD	MUSTANG COUPE (Manual)	004.7

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
1966	12.795	2002	Multiple Compact Light Truck Makes and Models		6 Cylinder Gasoline
30846	12.813	2002	ISUZU	RODEO 2WD	003.2
32490	12.821	2004	NISSAN	ALTIMA	002.5
32831	12.825	2005	DODGE	DAKOTA 2WD	004.7
30469	12.829	2002	AUDI	A4 QUATTRO (Auto)	001.8
29236	12.837	2000	CHRYSLER	300M	003.5
33552	12.849	2006	GMC	CANYON 2WD	002.8
34808	12.853	2005	CHEVROLET	EXPRESS 2500	004.8
35191	12.857	2006	CHEVROLET	COBALT	002.4
31008	12.864	2002	MITSUBISHI	MONTERO SPORT 4WD	003.5
50029	12.870	2005	Multiple Light Truck Makes and Models		8 Cylinder Diesel
32433	12.884	2004	MAZDA	MPV	003.0
35142	12.888	2005	FORD	E350	005.4
2146	12.888	2005	Multiple Mini-Van Makes and Models		6 Cylinder Gasoline
29580	12.927	2000	MERCURY	SABLE	003.0
29615	12.929	2000	OLDSMOBILE	INTRIGUE	003.5
29124	12.935	2000	AUDI	A6 QUATTRO	002.8
29758	12.938	2000	VOLVO	V70	002.4
29282	12.938	2000	DODGE	DURANGO 2WD	005.9
30807	12.944	2002	GMC	SONOMA 2WD	004.3
30580	12.956	2002	CHEVROLET	SILVERADO 1500 4WD	004.8
31394	12.956	2003	CHRYSLER	SEBRING CONVERTIBLE	002.7
31189	12.956	2002	VOLVO	S60	002.4
29411	12.963	2000	GMC	K1500 SIERRA 4WD	005.3
29305	12.970	2000	FORD	CONTOUR	002.0
29819	12.972	2001	BMW	740I	004.4
29346	12.982	2000	FORD	FOCUS 4-DR SEDAN	002.0
29290	12.986	2000	DODGE	RAM 1500 2WD	3.9
31252	12.990	2003	BMW	330CI	003.0
31764	13.000	2003	MAZDA	PROTEGE/PROTEGE 5	002.0
31310	13.005	2003	CHEVROLET	SILVERADO 1500 2WD	004.8
31246	13.007	2003	BMW	325CI	002.5
29164	13.015	2000	BUICK	REGAL	003.8
32777	13.023	2005	CHEVROLET	IMPALA	003.4
29246	13.048	2000	CHRYSLER	TOWN & COUNTRY 2WD	003.8

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
34817	13.060	2006	CHEVROLET	EXPRESS 2500	006.0
31006	13.060	2002	MITSUBISHI	MONTERO SPORT 2WD	003.5
30404	13.093	2001	TOYOTA	TACOMA 2WD	003.4
32432	13.095	2004	MAZDA	MIATA	001.8
32849	13.096	2005	DODGE	RAM 1500 2WD	004.7
30994	13.097	2002	MITSUBISHI	ECLIPSE	003.0
33803	13.100	2006	NISSAN	FRONTIER 2WD	002.5
29700	13.109	2000	TOYOTA	RAV4 2WD	002.0
1948	13.121	2002	Multiple Mid-Size Passenger Car Makes and Models		6 Cylinder Gasoline
29863	13.133	2001	CHEVROLET	CORVETTE	005.7
32161	13.135	2004	CHEVROLET	IMPALA	003.8
1876	13.138	2000	Multiple Mini-Van Makes and Models		6 Cylinder Gasoline
2180	13.140	2006	Multiple Compact Light Truck Makes and Models		4 Cylinder Gasoline
33729	13.154	2006	MERCEDES	C280	003.0
31001	13.160	2002	MITSUBISHI	MIRAGE	001.5
29724	13.162	2000	VOLKSWAGEN	JETTA	001.8
29684	13.165	2000	TOYOTA	4RUNNER 2WD	003.4
29817	13.165	2001	BMW	540I	004.4
33881	13.165	2006	SUZUKI	RENO	002.0
29442	13.178	2000	HONDA	PRELUDE	002.2
31142	13.197	2002	TOYOTA	MR2	001.8
2102	13.206	2004	Multiple Full-Size Van Makes and Models		8 Cylinder Gasoline
30578	13.224	2002	CHEVROLET	K1500 AVALANCHE 4WD	005.3
30993	13.233	2002	MITSUBISHI	ECLIPSE	002.4
29662	13.236	2000	SUBARU	IMPREZA AWD	002.5
34758	13.245	2002	BMW	X5	003.0
29622	13.269	2000	PLYMOUTH	VOYAGER 2WD	002.4
29488	13.274	2000	JEEP	GRAND CHEROKEE 2WD	004.0
30348	13.275	2001	SUBARU	FORESTER AWD	002.5
52095	13.276	2003	DODGE	RAM 3500 DIESEL	005.9
31627	13.284	2003	HYUNDAI	SANTA FE 2WD	002.7
30882	13.309	2002	JEEP	WRANGLER 4WD	004.0
30689	13.319	2002	FORD	E250 ECONOLINE	005.4
29533	13.327	2000	MAZDA	B2500 REG CAB SHORT	002.5
33448	13.336	2006	CHRYSLER	SEBRING	002.4

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
29241	13.349	2000	CHRYSLER	LHS	003.5
2119	13.352	2005	Multiple Station Wagon Makes and Models		6 Cylinder Gasoline
31172	13.353	2002	VOLKSWAGEN	NEW BEETLE (Auto)	002.0
30380	13.356	2001	TOYOTA	CAMRY	003.0
29355	13.362	2000	FORD	MUSTANG COUPE (Auto)	003.8
33182	13.367	2005	SATURN	VUE FWD	002.2
34747	13.387	2000	GMC	SONOMA 2WD	002.2
33866	13.390	2006	SUBARU	IMPREZA	002.5
35065	13.391	2004	BMW	745LI	004.4
29449	13.395	2000	HYUNDAI	SONATA	002.4
32185	13.406	2004	CHRYSLER	300M	003.5
32749	13.407	2005	CHEVROLET	SILVERADO 1500 2WD	004.3
29453	13.416	2000	INFINITI	G20	002.0
30989	13.420	2002	MERCURY	SABLE	003.0
32297	13.459	2004	GMC	ENVOY 4WD	004.2
30411	13.466	2001	TOYOTA	TUNDRA 4WD	004.7
31211	13.471	2003	AUDI	A4	001.8
33728	13.472	2006	MERCEDES	C230	002.5
52059	13.476	2003	CHEVROLET	SILVERADO 2500 DIESEL	006.6
29730	13.479	2000	VOLKSWAGEN	NEW BEETLE (Manual)	002.0
32850	13.491	2005	DODGE	RAM 1500 2WD	005.7
34782	13.494	2003	MITSUBISHI	ECLIPSE	003.0
33591	13.495	2006	HONDA	S2000	002.2
30858	13.499	2002	JAGUAR	X-TYPE	002.5
31800	13.505	2003	MERCEDES	ML500	005.0
30383	13.515	2001	TOYOTA	CAMRY SOLARA	003.0
32233	13.532	2004	DODGE	STRATUS	002.7
31434	13.538	2003	DODGE	RAM 1500 2WD	003.7
33484	13.543	2006	DODGE	STRATUS	002.4
33131	13.545	2005	NISSAN	FRONTIER 4WD	004.0
31022	13.547	2002	NISSAN	PATHFINDER 4WD	003.5
34756	13.550	2002	BMW	525I	002.5
30566	13.558	2002	CHEVROLET	CORVETTE	005.7
30118	13.574	2001	INFINITI	G20	002.0
32638	13.585	2004	VOLVO	S40	001.9
32567	13.586	2004	SUZUKI	AERIO	002.3
30540	13.604	2002	CADILLAC	ESCALADE EXT AWD	006.0

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
34789	13.604	2004	CHEVROLET	EXPRESS 2500	004.8
29340	13.608	2000	FORD	F150 SUPER CAB SHORT	004.2
29245	13.612	2000	CHRYSLER	TOWN & COUNTRY 2WD	003.3
29274	13.613	2000	DODGE	DAKOTA 2WD	004.7
1868	13.623	2000	Multiple Full-Size SUV Makes and Models		8 Cylinder Gasoline
32961	13.625	2005	HYUNDAI	ACCENT	001.6
31205	13.632	2003	ACURA	RSX	002.0
29171	13.653	2000	CHEVROLET	ASTRO 2WD PASSENGER	004.3
1840	13.680	2000	Multiple Mid-Size Passenger Car Makes and Models		6 Cylinder Gasoline
31763	13.694	2003	MAZDA	MX-5 MIATA	001.8
1886	13.696	2000	Multiple Full-Size Van Makes and Models		8 Cylinder Gasoline
29614	13.697	2000	OLDSMOBILE	BRAVADA AWD	004.3
30799	13.701	2002	GMC	K1500 YUKON DENALI XL	006.0
30482	13.702	2002	AUDI	ALLROAD	002.7
30445	13.716	2001	VOLVO	S80/S80 EXECUTIVE	002.9
29163	13.722	2000	BUICK	PARK AVENUE	003.8
30943	13.731	2002	MAZDA	TRIBUTE	003.0
29726	13.747	2000	VOLKSWAGEN	JETTA	002.8
29291	13.751	2000	DODGE	RAM 1500 2WD	005.2
2030	13.753	2003	Multiple Full-Size SUV Makes and Models		8 Cylinder Gasoline
29169	13.758	2000	CADILLAC	SEVILLE	004.6
30708	13.768	2002	FORD	F150 REG CAB HD LONG	005.4
29544	13.775	2000	MAZDA	MX-5 MIATA	001.8
29688	13.778	2000	TOYOTA	CAMRY	002.2
29323	13.784	2000	FORD	ESCORT 4DR	002.0
32267	13.793	2004	FORD	FOCUS	002.0
34803	13.796	2005	BMW	525I	002.5
30229	13.812	2001	MERCEDES	E320	003.2
29518	13.837	2000	LINCOLN	LS	003.0
29267	13.841	2000	DODGE	CARAVAN 2WD	002.4
30017	13.843	2001	FORD	F150 SUPER CREWCAB	005.4
30855	13.846	2002	JAGUAR	S-TYPE 4.0 LITRE	004.0
31134	13.846	2002	TOYOTA	COROLLA	001.8
1955	13.854	2002	Multiple Station Wagon Makes and Models		4 and 6 Cylinder Gas

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
30686	13.857	2002	FORD	E150 ECONOLINE	004.6
34958	13.869	2002	FORD	EXCURSION	006.8
31320	13.873	2003	CHEVROLET	CORVETTE (Manual)	005.7
32160	13.877	2004	CHEVROLET	IMPALA	003.4
30460	13.887	2002	ACURA	RSX	002.0
29155	13.887	2000	BMW	X5	004.4
30694	13.890	2002	FORD	ESCAPE	003.0
30590	13.901	2002	CHEVROLET	C2500 2WD	006.0
35293	13.927	2004	BMW	545I	004.4
32559	13.946	2004	SUBARU	IMPREZA WRX	002.0
32622	13.957	2004	VOLKSWAGEN	NEW BEETLE	002.0
30463	13.964	2002	AUDI	A4	001.8
29283	13.982	2000	DODGE	DURANGO 4WD	004.7
52209	13.988	2003	GMC	SIERRA 2500 DIESEL	006.6
33553	13.993	2006	GMC	CANYON 2WD	003.5
30112	13.993	2001	HYUNDAI	SANTA FE	002.7
29695	13.995	2000	TOYOTA	CELICA	001.8
31015	13.999	2002	NISSAN	FRONTIER 2WD	002.4
1967	13.999	2002	Multiple Full-Size Light Truck Makes and Models		8 Cylinder Gasoline
30152	14.013	2001	JEEP	GRAND CHEROKEE 4WD	004.7
29635	14.014	2000	PONTIAC	SUNFIRE	002.2
32504	14.018	2004	NISSAN	SENTRA	001.8
29606	14.023	2000	NISSAN	QUEST	003.3
29363	14.039	2000	FORD	RANGER REG CAB LONG	002.5
30501	14.043	2002	BMW	330CI CONVERTIBLE	003.0
31894	14.043	2003	PONTIAC	SUNFIRE	002.2
30110	14.046	2001	HYUNDAI	ELANTRA	002.0
32136	14.052	2004	CHEVROLET	BLAZER 2WD	004.3
29331	14.055	2000	FORD	F150 REG CAB LONG	004.2
32696	14.057	2005	BMW	3-SERIES	002.5
30233	14.062	2001	MERCEDES	E430	004.3
29372	14.062	2000	FORD	RANGER SUPER CAB 2DR	002.5
29467	14.064	2000	ISUZU	TROOPER	003.5
29181	14.071	2000	CHEVROLET	SILVERADO 1500 2WD	005.3
30620	14.073	2002	CHRYSLER	SEBRING COUPE	003.0
32023	14.088	2003	VOLKSWAGEN	JETTA	002.8
33485	14.089	2006	DODGE	STRATUS	002.7

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
34976	14.097	2002	MAZDA	PROTEGE 5	002.0
31027	14.099	2002	NISSAN	SENTRA (Manual)	002.5
35011	14.100	2003	FORD	F250 SUPER DUTY	005.4
29298	14.119	2000	DODGE	STRATUS	002.4
29182	14.137	2000	CHEVROLET	C1500 SUBURBAN 2WD	005.7
33593	14.148	2006	HYUNDAI	ACCENT	001.6
35006	14.165	2003	CHEVROLET	SILVERADO 2500 2WD	006.0
29547	14.167	2000	MERCEDES	C230 KOMPRESSOR	002.3
29470	14.172	2000	JAGUAR	S-TYPE	003.0
32387	14.203	2004	KIA	OPTIMA	002.7
29392	14.203	2000	GMC	SIERRA 1500 2WD	005.3
29725	14.212	2000	VOLKSWAGEN	JETTA	002.0
29585	14.220	2000	MITSUBISHI	GALANT	002.4
33293	14.270	2006	AUDI	A3	002.0
29256	14.271	2000	DODGE	B1500 VAN	005.2
29828	14.272	2001	BMW	X5 (Manual)	004.4
32188	14.300	2004	CHRYSLER	CROSSFIRE	003.2
32029	14.307	2003	VOLKSWAGEN	NEW BEETLE (Manual)	002.0
30860	14.320	2002	JAGUAR	X-TYPE	003.0
29820	14.325	2001	BMW	740IL	004.4
32375	14.330	2004	JEEP	GRAND CHEROKEE 2WD	004.0
32616	14.330	2004	VOLKSWAGEN	JETTA	001.8
30997	14.336	2002	MITSUBISHI	GALANT	002.4
32842	14.336	2005	DODGE	MAGNUM	003.5
29586	14.342	2000	MITSUBISHI	GALANT	003.0
34770	14.346	2003	BMW	525I	002.5
31264	14.378	2003	BMW	745I	004.4
29367	14.385	2000	FORD	RANGER REG CAB SHORT	002.5
30517	14.392	2002	BMW	M3 CONVERTIBLE	003.2
29996	14.395	2001	FORD	EXPLORER 4DR	004.0
32648	14.396	2004	VOLVO	V40	001.9
31561	14.397	2003	GMC	ENVOY 2WD	004.2
33559	14.413	2006	GMC	ENVOY 4WD	004.2
31255	14.419	2003	BMW	330I	003.0
2020	14.420	2003	Multiple Mid-Size Light Truck Makes and Models		6 Cylinder Gasoline
29593	14.432	2000	MITSUBISHI	MONTERO SPORT 4WD	003.0
35299	14.437	2004	BMW	745I	004.4

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
30325	14.447	2001	PORSCHE	BOXSTER	002.7
31563	14.453	2003	GMC	ENVOY 4WD	004.2
33595	14.460	2006	HYUNDAI	ELANTRA	002.0
29338	14.461	2000	FORD	F150 SUPER CAB LONG	004.6
30512	14.477	2002	BMW	745LI	004.4
31372	14.478	2003	CHEVROLET	TRAILBLAZER 4WD	004.2
29269	14.480	2000	DODGE	CARAVAN 2WD	003.3
30251	14.483	2001	MERCURY	GRAND MARQUIS	004.6
29587	14.497	2000	MITSUBISHI	MIRAGE	001.5
31874	14.506	2003	OLDSMOBILE	ALERO	002.2
34739	14.506	2000	CHEVROLET	S10 PICKUP 2WD	002.2
2198	14.511	2006	Multiple Mini-Van Makes and Models		4 Cylinder Gasoline
30910	14.529	2002	LINCOLN	LS	003.9
32295	14.529	2004	GMC	ENVOY 2WD	004.2
29326	14.538	2000	FORD	EXPLORER 2DR	004.0
33651	14.542	2006	JEEP	LIBERTY 2WD	003.7
30500	14.555	2002	BMW	330CI	003.0
30407	14.556	2001	TOYOTA	TACOMA 4WD	003.4
34791	14.566	2004	CHEVROLET	EXPRESS 3500	006.0
31074	14.576	2002	SAAB	9-3 CONVERTIBLE	002.0
29444	14.582	2000	HYUNDAI	ACCENT (Auto)	001.5
32193	14.598	2004	CHRYSLER	PT CRUISER	002.4
30727	14.637	2002	FORD	FOCUS 4DR SEDAN	002.0
30840	14.639	2002	INFINITI	QX4 2WD	003.5
30496	14.641	2002	BMW	325I	002.5
31004	14.703	2002	MITSUBISHI	MONTERO	003.5
29727	14.720	2000	VOLKSWAGEN	NEW BEETLE	001.8
30872	14.727	2002	JEEP	GRAND CHEROKEE 4WD	004.7
31284	14.729	2003	BUICK	CENTURY	003.1
35039	14.735	2003	HONDA	ACCORD COUPE	003.0
32437	14.758	2004	MERCEDES	C230 KOMPRESSOR	001.8
29239	14.769	2000	CHRYSLER	CONCORDE	002.7
30355	14.771	2001	SUBARU	LEGACY WAGON AWD	002.5
31798	14.772	2003	MERCEDES	ML320	003.2
30495	14.775	2002	BMW	325CI CONVERTIBLE	002.5
31737	14.778	2003	LINCOLN	NAVIGATOR	005.4
29352	14.786	2000	FORD	MUSTANG CONVERTIBLE (Auto)	003.8

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
34767	14.799	2002	VOLKSWAGEN	NEW BEETLE	001.8
30592	14.802	2002	CHEVROLET	S10 PICKUP 2WD	004.3
31525	14.802	2003	FORD	MUSTANG CONVERTIBLE	004.6
31548	14.810	2003	FORD	TAURUS	003.0
32802	14.815	2005	CHRYSLER	300	003.5
32778	14.816	2005	CHEVROLET	IMPALA	003.8
31626	14.841	2003	HYUNDAI	SANTA FE 2WD	002.4
29620	14.841	2000	PLYMOUTH	NEON	002.0
29324	14.846	2000	FORD	EXPEDITION	004.6
32179	14.853	2004	CHEVROLET	TRAILBLAZER 2WD	004.2
29223	14.883	2000	CHEVROLET	S10 PICKUP 2WD FFV	002.2
30547	14.889	2002	CHEVROLET	AVALANCHE 2WD	005.3
31345	14.909	2003	CHEVROLET	SILVERADO 1500 4WD	005.3
29613	14.910	2000	OLDSMOBILE	ALERO	003.4
29583	14.919	2000	MITSUBISHI	ECLIPSE	002.4
29627	14.926	2000	PONTIAC	BONNEVILLE	003.8
30376	14.931	2001	TOYOTA	4RUNNER 2WD	003.4
31370	14.932	2003	CHEVROLET	TRAILBLAZER 2WD	004.2
30652	14.943	2002	DODGE	DURANGO 4WD	005.9
31596	14.957	2003	GMC	SAFARI 2WD PASSENGER	004.3
31024	14.965	2002	NISSAN	QUEST	003.3
1946	14.968	2002	Multiple Mid-Size Passenger Car Makes and Models		4 Cylinder Gasoline
31174	14.981	2002	VOLKSWAGEN	PASSAT	001.8
50021	14.982	2003	Multiple Light Truck Makes and Models		8 Cylinder Diesel
30239	14.989	2001	MERCEDES	S430	004.3
30982	14.990	2002	MERCURY	COUGAR	002.5
32181	15.027	2004	CHEVROLET	TRAILBLAZER 4WD	004.2
30661	15.036	2002	DODGE	RAM 2500	005.9
30172	15.041	2001	LEXUS	IS 300	003.0
32169	15.041	2004	CHEVROLET	MONTE CARLO	003.4
29334	15.048	2000	FORD	F150 REG CAB SHORT	004.2
32481	15.069	2004	MITSUBISHI	GALANT	003.8
52063	15.094	2003	CHEVROLET	SILVERADO 3500 DIESEL	006.6
30569	15.098	2002	CHEVROLET	G1500/2500 EXPRESS	005.7
30470	15.100	2002	AUDI	A4 QUATTRO (Manual)	001.8

Appendix C: VLT ID Numbers Most Likely to Fail the OBD II Functional Test

VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
2021	15.111	2003	Multiple Light Truck Makes and Models		8 Cylinder
31085	15.116	2002	SATURN	LW300	003.0
29211	15.120	2000	CHEVROLET	K1500 TAHOE 4WD	005.3
29322	15.126	2000	FORD	ESCORT	002.0
29190	15.131	2000	CHEVROLET	CAMARO	005.7
31073	15.134	2002	SAAB	9-3	002.0
30944	15.135	2002	MERCEDES	C230 KOMPRESSOR	002.3
31435	15.157	2003	DODGE	RAM 1500 2WD	004.7
29408	15.158	2000	GMC	JIMMY 4WD	004.3
30754	15.159	2002	FORD	RANGER SUPER CAB 2DR	002.3
29289	15.162	2000	DODGE	NEON	002.0
31287	15.168	2003	BUICK	REGAL	003.8
29418	15.172	2000	GMC	K1500 YUKON 4WD	005.7
32224	15.186	2004	DODGE	RAM 1500 2WD	003.7
30842	15.192	2002	ISUZU	AXIOM 2WD	003.5
29148	15.196	2000	BMW	740I/740I SPORT	004.4
33386	15.208	2006	CHEVROLET	COLORADO 2WD	003.5
31025	15.229	2002	NISSAN	SENTRA	001.8
33193	15.237	2005	SUBARU	IMPREZA STI	002.5
31185	15.255	2002	VOLVO	S40	001.9
34738	15.276	2000	CHEVROLET	C2500 SILVERADO 2WD	005.7
33130	15.289	2005	NISSAN	FRONTIER 2WD	004.0
31248	15.294	2003	BMW	325I	002.5
31586	15.305	2003	GMC	SIERRA 1500 4WD	005.3
30494	15.332	2002	BMW	325CI	002.5
29630	15.335	2000	PONTIAC	GRAND AM	002.4
30911	15.339	2002	LINCOLN	NAVIGATOR	005.4
34839	15.348	2000	CHRYSLER	VOYAGER	003.3
29353	15.352	2000	FORD	MUSTANG CONVERTABLE (manual)	003.8
32759	15.355	2005	CHEVROLET	COLORADO 2WD	002.8
32742	15.359	2005	CHEVROLET	ASTRO 2WD	004.3
33547	15.378	2006	GMC	SIERRA 1500 2WD	004.3
34752	15.383	2001	FORD	RANGER SUPER CAB 2DR	003.0
29217	15.397	2000	CHEVROLET	MALIBU	003.1
29485	15.397	2000	JEEP	CHEROKEE 2WD	004.0
30611	15.399	2002	CHRYSLER	300M	003.5
30554	15.407	2002	CHEVROLET	C1500 AVALANCHE 2WD	005.3

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
30826	15.422	2002	HYUNDAI	ACCENT	001.6
30155	15.422	2001	JEEP	WRANGLER 4WD	004.4
32558	15.425	2004	SUBARU	IMPREZA STI	002.5
33446	15.427	2006	CHRYSLER	PACIFICA AWD	003.5
30736	15.429	2002	FORD	MUSTANG CONVERTIBLE	004.6
30240	15.432	2001	MERCEDES	S500	005.0
32815	15.433	2005	CHRYSLER	PACIFICA AWD	003.5
30292	15.443	2001	NISSAN	SENTRA	002.0
31116	15.449	2002	SUZUKI	GRAND VITARA XL7 4WD	002.7
30015	15.458	2001	FORD	F150 SUPER CAB SHORT	005.4
30871	15.459	2002	JEEP	GRAND CHEROKEE 4WD	004.0
29207	15.459	2000	CHEVROLET	SILVERADO 1500 4WD	005.3
29794	15.463	2001	AUDI	TT COUPE QUATTRO	001.8
32480	15.473	2004	MITSUBISHI	GALANT	002.4
32334	15.489	2004	HYUNDAI	SANTA FE	002.4
33139	15.518	2005	NISSAN	SENTRA	001.8
29497	15.518	2000	KIA	SPORTAGE	002.0
2000	15.534	2003	Multiple Compact Passenger Car Makes and Models		4 Cylinder Gasoline
29215	15.535	2000	CHEVROLET	LUMINA/MONTECARLO	003.8
31173	15.548	2002	VOLKSWAGEN	NEW BEETLE (Manual)	002.0
33385	15.582	2006	CHEVROLET	COLORADO 2WD	002.8
30150	15.590	2001	JEEP	GRAND CHEROKEE 2WD	004.7
30658	15.592	2002	DODGE	RAM 1500 2WD	005.9
31387	15.609	2003	CHRYSLER	PT CRUISER (Manual)	002.4
32969	15.620	2005	HYUNDAI	SONATA	002.7
33016	15.637	2005	KIA	SEDONA	003.5
30614	15.647	2002	CHRYSLER	CONCORDE	003.5
29222	15.649	2000	CHEVROLET	S10 PICKUP 2WD	004.3
29608	15.651	2000	NISSAN	SENTRA	002.0
32926	15.676	2005	GMC	ENVOY 2WD	004.2
30991	15.676	2002	MERCURY	VILLAGER	003.3
33138	15.685	2005	NISSAN	QUEST	003.5
29166	15.696	2000	CADILLAC	DEVILLE	004.6
34994	15.698	2003	BMW	325I	002.5
1838	15.710	2000	Multiple Mid-Size Passenger Car Makes and Models		4 Cylinder Gasoline

Appendix C: VLT ID Numbers Most Likely to Fail the OBD II Functional Test

VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
1903	15.731	2001	Multiple Station Wagon Makes and Models		6 Cylinder Gasoline
29424	15.737	2000	GMC	SONOMA 2WD	004.3
30278	15.743	2001	NISSAN	ALTIMA	002.4
2128	15.747	2005	Multiple Compact Light Truck Makes and Models		6 Cylinder Gasoline
30759	15.752	2002	FORD	TAURUS	003.0
29441	15.758	2000	HONDA	PASSPORT 4WD	003.2
29691	15.761	2000	TOYOTA	CAMRY SOLARA	002.2
31631	15.762	2003	HYUNDAI	SONATA	002.7
30854	15.782	2002	JAGUAR	S-TYPE 3.0 LITRE	003.0
30885	15.786	2002	KIA	RIO	001.5
31128	15.790	2002	TOYOTA	CAMRY SOLARA	002.4
31163	15.798	2002	VOLKSWAGEN	GTI	001.8
29696	15.800	2000	TOYOTA	COROLLA	001.8
30544	15.808	2002	CHEVROLET	ASTRO 2WD PASSENGER	004.3
30880	15.809	2002	JEEP	WRANGLER	004.0
35023	15.810	2003	FORD	E350 ECONOLINE	005.4
29214	15.820	2000	CHEVROLET	LUMINA/MONTECARLO	003.4
30045	15.826	2001	FORD	RANGER SUPER CAB 2DR	004.0
31825	15.841	2003	MERCURY	SABLE	003.0
31166	15.844	2002	VOLKSWAGEN	JETTA	002.0
30447	15.850	2001	VOLVO	V70	002.3
29629	15.875	2000	PONTIAC	FIREBIRD/TRANS AM	005.7
31834	15.875	2003	MITSUBISHI	GALANT	002.4
33377	15.881	2006	CHEVROLET	SILVERADO 1500 2WD	004.3
29764	15.883	2001	ACURA	INTEGRA	001.8
29734	15.889	2000	VOLKSWAGEN	PASSAT (Manual)	002.8
31731	15.911	2003	LINCOLN	AVIATOR 2WD	004.6
29624	15.913	2000	PLYMOUTH	VOYAGER 2WD	003.3
32147	15.918	2004	CHEVROLET	COLORADO 4WD	003.5
29206	15.921	2000	CHEVROLET	SILVERADO 1500 4WD	004.8
2048	15.931	2003	Multiple Full-Size Van Makes and Models		8 Cylinder Gasoline
32522	15.938	2004	PONTIAC	GRAND PRIX	003.8
32482	15.959	2004	MITSUBISHI	LANCER	002.0
30534	15.966	2002	BUICK	RENDEZVOUS AWD	003.4
32028	15.980	2003	VOLKSWAGEN	NEW BEETLE (Auto)	002.0

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
30262	16.009	2001	MITSUBISHI	ECLIPSE SPYDER	003.0
31167	16.015	2002	VOLKSWAGEN	JETTA	002.8
31934	16.040	2003	SATURN	VUE AWD	003.0
30377	16.041	2001	TOYOTA	4RUNNER 4WD	003.4
31480	16.045	2003	FORD	EXPEDITION	004.6
32548	16.057	2004	SATURN	VUE FWD	002.2
30106	16.082	2001	HONDA	PRELUDE	002.2
30651	16.087	2002	DODGE	DURANGO 4WD	004.7
34778	16.095	2003	FORD	E250 ECONOLINE	005.4
32613	16.100	2004	VOLKSWAGEN	GOLF	002.0
1901	16.127	2001	Multiple Station Wagon Makes and Models		4 Cylinder Gasoline
30624	16.133	2002	CHRYSLER	SEBRING CONVERTIBLE	002.7
32192	16.138	2004	CHRYSLER	PACIFICA AWD	003.5
29659	16.154	2000	SATURN	SW	001.9
32617	16.160	2004	VOLKSWAGEN	JETTA	002.0
30503	16.181	2002	BMW	330I	003.0
30697	16.188	2002	FORD	EXPEDITION	004.6
32135	16.198	2004	CHEVROLET	AVEO	001.6
30507	16.215	2002	BMW	530I	003.0
29737	16.244	2000	VOLKSWAGEN	PASSAT WAGON	002.8
32287	16.252	2004	GMC	SIERRA 1500 2WD	004.3
33877	16.258	2006	SUZUKI	FORENZA	002.0
33144	16.260	2005	NISSAN	XTERRA 4WD	004.0
30998	16.268	2002	MITSUBISHI	GALANT	003.0
31714	16.289	2003	LAND ROVER	RANGE ROVER	004.4
29175	16.298	2000	CHEVROLET	BLAZER 4WD	004.3
33143	16.299	2005	NISSAN	XTERRA 2WD	004.0
29174	16.340	2000	CHEVROLET	BLAZER 2WD	004.3
32272	16.348	2004	FORD	FREESTAR WAGON FWD	003.9
30424	16.354	2001	VOLKSWAGEN	JETTA (Manual)	002.8
30669	16.363	2002	DODGE	STRATUS	003.0
29391	16.376	2000	GMC	SIERRA 1500 2WD	004.8
34737	16.376	2000	CHEVROLET	C1500 TAHOE 2WD	005.3
31289	16.386	2003	BUICK	RENDEZVOUS FWD	003.4
31132	16.389	2002	TOYOTA	CELICA	001.8
29880	16.389	2001	CHEVROLET	K1500 SUBURBAN 4WD	005.3
31154	16.414	2002	TOYOTA	TUNDRA 2WD	003.4

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
30586	16.432	2002	CHEVROLET	MALIBU	003.1
32021	16.444	2003	VOLKSWAGEN	JETTA	001.8
32030	16.459	2003	VOLKSWAGEN	PASSAT	001.8
29584	16.460	2000	MITSUBISHI	ECLIPSE	003.0
31136	16.474	2002	TOYOTA	HIGHLANDER 2WD	002.4
30212	16.500	2001	MAZDA	MX-5 MIATA	001.8
33151	16.502	2005	PONTIAC	GRAND PRIX	003.8
31350	16.515	2003	CHEVROLET	MALIBU	003.1
30224	16.539	2001	MERCEDES	CLK320	003.2
34765	16.548	2002	MITSUBISHI	ECLIPSE	003.0
31095	16.548	2002	SUBARU	IMPREZA AWD	002.0
32801	16.550	2005	CHRYSLER	300	002.7
29201	16.559	2000	CHEVROLET	IMPALA	003.8
31290	16.591	2003	CADILLAC	CTS	003.2
34869	16.614	2001	CHEVROLET	SILVERADO 2500 2WD	006.0
29440	16.618	2000	HONDA	PASSPORT 2WD	003.2
31013	16.625	2002	NISSAN	ALTIMA	002.5
30660	16.634	2002	DODGE	RAM 1500 4WD	005.9
31171	16.642	2002	VOLKSWAGEN	NEW BEETLE	001.8
1994	16.643	2002	Multiple Full-Size Van Makes and Models		8 Cylinder Gasoline
29212	16.649	2000	CHEVROLET	K1500 TAHOE 4WD	005.7
30828	16.652	2002	HYUNDAI	SANTA FE 2WD	002.4
31311	16.654	2003	CHEVROLET	SILVERADO 1500 2WD	005.3
30086	16.699	2001	GMC	K1500 YUKON XL 4WD	005.3
29297	16.703	2000	DODGE	STRATUS	002.0
29170	16.725	2000	CHEVROLET	ASTRO 2WD CARGO	004.3
34863	16.727	2000	MERCURY	VILLAGER	003.3
31177	16.732	2002	VOLKSWAGEN	PASSAT 4MOTION	002.8
29417	16.744	2000	GMC	K1500 YUKON 4WD	005.3
32018	16.744	2003	VOLKSWAGEN	GOLF	002.0
31087	16.757	2002	SATURN	SC	001.9
30516	16.763	2002	BMW	M3	003.2
31896	16.791	2003	PONTIAC	VIBE	001.8
29224	16.794	2000	CHEVROLET	S10 PICKUP 4WD	004.3
29526	16.803	2000	MAZDA	626	002.5
32191	16.818	2004	CHRYSLER	PACIFICA 2WD	003.5
34751	16.822	2001	FORD	RANGER REG CAB SHORT	003.0

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
29356	16.862	2000	FORD	MUSTANG COUPE (Manual)	003.8
33250	16.863	2005	VOLKSWAGEN	JETTA	002.0
32392	16.877	2004	KIA	SPECTRA	001.8
31083	16.884	2002	SATURN	L300	003.0
29350	16.893	2000	FORD	MUSTANG	003.8
30026	16.915	2001	FORD	MUSTANG CONV. (Auto)	004.6
29995	16.920	2001	FORD	EXPLORER 2DR	004.0
31104	16.932	2002	SUBARU	LEGACY WAGON AWD	002.5
29268	16.951	2000	DODGE	CARAVAN 2WD	003.0
30087	16.968	2001	GMC	K1500 YUKON XL 4WD	006.0
31192	16.975	2002	VOLVO	V40	001.9
31539	16.986	2003	FORD	RANGER REG CAB SHORT	002.3
30657	16.989	2002	DODGE	RAM 1500 2WD	004.7
31300	16.994	2003	CHEVROLET	ASTRO 2WD PASSENGER	004.3
33019	17.027	2005	KIA	SPECTRA	002.0
29407	17.031	2000	GMC	JIMMY 2WD	004.3
29752	17.043	2000	VOLVO	S80	002.8
29455	17.045	2000	INFINITI	Q45	004.1
34784	17.046	2003	VOLKSWAGEN	NEW BEETLE	001.8
32485	17.048	2004	MITSUBISHI	MONTERO	003.8
29383	17.060	2000	FORD	WINDSTAR 4DR WAGON	003.8
30237	17.070	2001	MERCEDES	ML430	004.3
34928	17.087	2002	CHEVROLET	EXPRESS 3500	005.7
30737	17.097	2002	FORD	MUSTANG COUPE (Auto)	003.8
29378	17.101	2000	FORD	TAURUS	003.0
30677	17.111	2002	FORD	CROWN VICTORIA	004.6
32003	17.123	2003	TOYOTA	SIENNA	003.0
31165	17.128	2002	VOLKSWAGEN	JETTA	001.8
1921	17.151	2001	Multiple Mid-Size SUV Makes and Models		6 Cylinder Gasoline
29654	17.164	2000	SATURN	LS	003.0
29173	17.184	2000	CHEVROLET	ASTRO AWD PASSENGER	004.3
33135	17.191	2005	NISSAN	PATHFINDER 2WD	004.0
30321	17.233	2001	PONTIAC	SUNFIRE	002.2
34783	17.238	2003	VOLKSWAGEN	JETTA	001.8
33557	17.247	2006	GMC	ENVOY 2WD	004.2
34837	17.247	2000	CHEVROLET	EXPRESS 3500	005.7
31423	17.304	2003	DODGE	DURANGO 2WD	004.7

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
29220	17.312	2000	CHEVROLET	PRIZM	001.8
1912	17.326	2001	Multiple Mid-Size Light Truck Makes and Models		6 Cylinder Gasoline
32813	17.327	2005	CHRYSLER	PACIFICA 2WD	003.5
30749	17.342	2002	FORD	RANGER REG CAB SHORT	2.3
31213	17.367	2003	AUDI	A4	003.0
34916	17.392	2002	BMW	325I	002.5
29286	17.414	2000	DODGE	INTREPID	002.7
31669	17.423	2003	JAGUAR	X-TYPE	002.5
1964	17.433	2002	Multiple Compact Light Truck Makes and Models		4 Cylinder Gasoline
33398	17.473	2006	CHEVROLET	EXPRESS 1500	004.3
29200	17.475	2000	CHEVROLET	IMPALA	003.4
30003	17.491	2001	FORD	F150 REG CAB LONG	004.6
31610	17.491	2003	HONDA	CIVIC	002.0
32393	17.497	2004	KIA	SPECTRA	002.0
33069	17.524	2005	MERCEDES	C230 KOMPRESSOR	001.8
30245	17.549	2001	MERCEDES	SLK230 KOMPRESSOR	002.3
30511	17.553	2002	BMW	745I	004.4
31691	17.560	2003	JEEP	GRAND CHEROKEE 4WD	004.7
29196	17.565	2000	CHEVROLET	G1500/2500 EXPRESS	005.7
31402	17.565	2003	CHRYSLER	VOYAGER/TOWN/CTRY	003.8
30397	17.566	2001	TOYOTA	RAV4 2WD	002.0
31309	17.576	2003	CHEVROLET	SILVERADO 1500 2WD	004.3
33421	17.581	2006	CHEVROLET	MONTE CARLO	003.9
31868	17.582	2003	NISSAN	SENTRA	001.8
29582	17.603	2000	MITSUBISHI	DIAMANTE SEDAN	003.5
29209	17.607	2000	CHEVROLET	K1500 SUBURBAN 4WD	005.3
32187	17.614	2004	CHRYSLER	CONCORDE	003.5
32145	17.620	2004	CHEVROLET	COLORADO 2WD	003.5
32333	17.641	2004	HYUNDAI	ELANTRA	002.0
30442	17.655	2001	VOLVO	S60	002.4
31418	17.669	2003	DODGE	DAKOTA 2WD	004.7
30021	17.670	2001	FORD	FOCUS ZX3 3DR	002.0
30543	17.677	2002	CHEVROLET	ASTRO 2WD CARGO	004.3
31050	17.690	2002	PONTIAC	FIREBIRD	005.7
30215	17.710	2001	MAZDA	PROTEGE/PROTEGE MPS	002.0
30760	17.717	2002	FORD	TAURUS WAGON	003.0

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
34775	17.724	2003	CHEVROLET	G3500 EXPRESS	006.0
29598	17.731	2000	NISSAN	ALTIMA	002.4
30886	17.736	2002	KIA	SEDONA	003.5
29180	17.753	2000	CHEVROLET	SILVERADO 1500 2WD	004.8
52045	17.762	2002	VOLKSWAGEN	JETTA TDI	001.9
33429	17.771	2006	CHEVROLET	TRAILBLAZER 4WD	004.2
35053	17.774	2003	VOLKSWAGEN	PASSAT	002.8
30016	17.784	2001	FORD	F150 SUPER CREWCAB	004.6
30398	17.789	2001	TOYOTA	RAV4 4WD	002.0
33659	17.794	2006	KIA	RIO	001.6
30236	17.798	2001	MERCEDES	ML320	003.2
30654	17.805	2002	DODGE	INTREPID	003.5
30019	17.809	2001	FORD	FOCUS WAGON	002.0
33426	17.815	2006	CHEVROLET	TRAILBLAZER 2WD	004.2
30448	17.815	2001	VOLVO	V70	002.4
32795	17.831	2005	CHEVROLET	TRAILBLAZER 2WD	004.2
29827	17.831	2001	BMW	X5 (Auto)	004.4
29425	17.834	2000	GMC	SONOMA 2WD FFV	002.2
33136	17.842	2005	NISSAN	PATHFINDER 4WD	004.0
29631	17.869	2000	PONTIAC	GRAND AM	003.4
30738	17.892	2002	FORD	MUSTANG COUPE (Manual)	003.8
32964	17.906	2005	HYUNDAI	ELANTRA	002.0
29495	17.918	2000	KIA	SEPHIA/SPECTRA	001.8
31527	17.940	2003	FORD	MUSTANG COUPE (Manual)	003.8
29213	17.964	2000	CHEVROLET	LUMINA/MONTECARLO	003.1
34810	17.983	2005	CHEVROLET	EXPRESS 3500	006.0
31048	17.985	2002	PONTIAC	BONNEVILLE	003.8
29855	18.000	2001	CHEVROLET	C1500 SUBURBAN 2WD	005.3
29238	18.002	2000	CHRYSLER	CIRRUS	002.5
50026	18.020	2004	Multiple Domestic Light Truck Makes and Models		8 Cylinder Diesel
29633	18.042	2000	PONTIAC	GRAND PRIX	003.8
30342	18.050	2001	SATURN	L300	003.0
29714	18.060	2000	VOLKSWAGEN	CABRIO	002.0
29746	18.069	2000	VOLVO	S40	001.9
29117	18.090	2000	AUDI	A4 QUATTRO	001.8
29337	18.092	2000	FORD	F150 SUPER CAB LONG	004.2
29390	18.093	2000	GMC	SIERRA 1500 2WD	004.3

Appendix C: VLT ID Numbers Most Likely to Fail the OBD II Functional Test

VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
31259	18.098	2003	BMW	530I	003.0
32144	18.112	2004	CHEVROLET	COLORADO 2WD	002.8
29379	18.114	2000	FORD	TAURUS WAGON	003.0
30027	18.139	2001	FORD	MUSTANG CONV. (Manual)	004.6
31425	18.167	2003	DODGE	DURANGO 4WD	004.7
29466	18.169	2000	ISUZU	RODEO 4WD	003.2
31147	18.171	2002	TOYOTA	SIENNA	003.0
34768	18.181	2002	VOLKSWAGEN	PASSAT	002.8
29588	18.188	2000	MITSUBISHI	MIRAGE	001.8
30734	18.206	2002	FORD	MUSTANG CONVERTIBLE	003.8
32797	18.223	2005	CHEVROLET	TRAILBLAZER 4WD	004.2
30247	18.232	2001	MERCEDES	SLK320	003.2
30650	18.235	2002	DODGE	DURANGO 2WD	005.9
29168	18.237	2000	CADILLAC	ESCALADE 4WD	005.7
30085	18.252	2001	GMC	K1500 YUKON 4WD	006.0
32221	18.281	2004	DODGE	INTREPID	003.5
29454	18.283	2000	INFINITI	I30	003.0
30644	18.303	2002	DODGE	DAKOTA 2WD	004.7
30535	18.322	2002	BUICK	RENDEZVOUS FWD	003.4
30010	18.351	2001	FORD	F150 SUPER CAB LONG	004.6
30588	18.366	2002	CHEVROLET	MONTE CARLO	003.8
30649	18.369	2002	DODGE	DURANGO 2WD	004.7
29885	18.391	2001	CHEVROLET	METRO	001.3
30628	18.394	2002	CHRYSLER	VOYAGER	003.8
1885	18.398	2000	Multiple Full-Size Van Makes and Models		6 Cylinder Gasoline
31299	18.398	2003	CHEVROLET	ASTRO 2WD CARGO	004.3
29419	18.407	2000	GMC	K1500 YUKON 4WD	005.3
30136	18.431	2001	JAGUAR	S-TYPE	003.0
29710	18.437	2000	TOYOTA	TUNDRA 2WD	003.4
30768	18.446	2002	GMC	SIERRA 1500 2WD	004.3
30137	18.461	2001	JAGUAR	S-TYPE 4.0 LITRE	004.0
31158	18.488	2002	VOLKSWAGEN	CABRIO	002.0
31461	18.526	2003	DODGE	STRATUS	002.4
31997	18.535	2003	TOYOTA	MATRIX	001.8
32022	18.542	2003	VOLKSWAGEN	JETTA	002.0
30122	18.595	2001	INFINITI	QX4 4WD	003.5
30594	18.598	2002	CHEVROLET	S10 PICKUP 4WD	004.3

Appendix C: VLT ID Numbers Most Likely to Fail the OBD II Functional Test

VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
31412	18.598	2003	DODGE	CARAVAN 2WD	003.8
31988	18.598	2003	TOYOTA	CELICA	001.8
30549	18.607	2002	CHEVROLET	BLAZER 2WD	004.3
30814	18.609	2002	HONDA	CIVIC	002.0
31377	18.612	2003	CHEVROLET	VENTURE FWD	003.4
29909	18.635	2001	CHRYSLER	PT CRUISER (Auto)	002.4
30555	18.637	2002	CHEVROLET	BLAZER 4WD	004.3
30731	18.673	2002	FORD	FOCUS ZX3	002.0
2047	18.690	2003	Multiple Mid-Size Van Makes and Models		6 Cylinder Gasoline
30419	18.706	2001	VOLKSWAGEN	GTI	001.8
30218	18.712	2001	MERCEDES	C240	002.6
29592	18.713	2000	MITSUBISHI	MONTERO SPORT 2WD	003.5
33658	18.717	2006	KIA	OPTIMA	002.7
30018	18.727	2001	FORD	FOCUS 4DR SEDAN	002.0
29731	18.746	2000	VOLKSWAGEN	PASSAT	001.8
30574	18.793	2002	CHEVROLET	IMPALA	003.8
30030	18.810	2001	FORD	MUSTANG COUPE	004.6
31624	18.812	2003	HYUNDAI	ACCENT	001.6
30820	18.852	2002	HONDA	PASSPORT 2WD	003.2
31032	18.856	2002	OLDSMOBILE	ALERO	003.4
31088	18.868	2002	SATURN	SL	001.9
32396	18.874	2004	LAND ROVER	DISCOVERY	004.6
30396	18.896	2001	TOYOTA	MR2	001.8
31625	18.925	2003	HYUNDAI	ELANTRA	002.0
31169	18.953	2002	VOLKSWAGEN	JETTA WAGON	002.0
29616	18.998	2000	OLDSMOBILE	SILHOUETTE FWD	003.4
29381	19.027	2000	FORD	WINDSTAR 3DR WAGON	003.8
31052	19.041	2002	PONTIAC	GRAND AM	003.4
29985	19.078	2001	FORD	E250 ECONOLINE	005.4
32208	19.096	2004	DODGE	CARAVAN 2WD	003.3
32271	19.100	2004	FORD	FREESTAR CARGO FWD	003.9
29816	19.105	2001	BMW	530I	003.0
31115	19.107	2002	SUZUKI	GRAND VITARA XL7	002.7
1993	19.113	2002	Multiple Mid-Size Van Makes and Models		6 Cylinder Gasoline
30409	19.118	2001	TOYOTA	TUNDRA 2WD	004.7
30014	19.163	2001	FORD	F150 SUPER CAB SHORT	004.6

Appendix C: VLT ID Numbers Most Likely to Fail the OBD II Functional Test

VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
29194	19.206	2000	CHEVROLET	G1500/2500 EXPRESS	004.3
29774	19.224	2001	AUDI	A4 QUATTRO	001.8
50022	19.234	2003	Multiple Heavy Duty Light Truck Makes and Models		8 Cylinder Diesel
31553	19.253	2003	GMC	SIERRA 1500 2WD	004.3
34736	19.273	2000	CHEVROLET	C1500 SUBURBAN 2WD	005.3
29591	19.305	2000	MITSUBISHI	MONTERO SPORT 2WD	003.0
29465	19.310	2000	ISUZU	RODEO 2WD	003.2
31450	19.326	2003	DODGE	STRATUS	002.4
1941	19.327	2001	Multiple Ford Vans and Light Truck Models		006.8
34776	19.343	2003	CHEVROLET	S10 PICKUP 2WD	002.2
1922	19.349	2001	Multiple Full-Size SUV Makes and Models		8 Cylinder Gasoline
30562	19.369	2002	CHEVROLET	CAMARO	005.7
29747	19.379	2000	VOLVO	S40	002.0
30536	19.384	2002	CADILLAC	DEVILLE	004.6
31077	19.396	2002	SAAB	9-5	002.3
31943	19.409	2003	SUBARU	IMPREZA AWD	002.0
30217	19.435	2001	MAZDA	TRIBUTE	003.0
31054	19.437	2002	PONTIAC	GRAND PRIX	003.8
30418	19.443	2001	VOLKSWAGEN	GOLF (Manual)	002.0
29860	19.462	2001	CHEVROLET	CAVALIER	002.2
31551	19.493	2003	FORD	WINDSTAR CARGO VAN	003.8
33376	19.642	2006	CHEVROLET	AVEO	001.6
30423	19.683	2001	VOLKSWAGEN	JETTA (Auto)	002.8
31090	19.698	2002	SATURN	VUE AWD	003.0
30918	19.716	2002	MAZDA	626	002.0
31351	19.745	2003	CHEVROLET	MONTE CARLO	003.4
29974	19.777	2001	FORD	CROWN VICTORIA	004.6
30220	19.788	2001	MERCEDES	C320	003.2
29123	19.846	2000	AUDI	A6 QUATTRO	002.7
30128	19.886	2001	ISUZU	RODEO 4WD	003.2
30587	19.981	2002	CHEVROLET	MONTE CARLO	003.4
30550	20.079	2002	CHEVROLET	BLAZER 4WD	004.3
30593	20.109	2002	CHEVROLET	S10 PICKUP 2WD FFV	002.2
34932	20.118	2002	CHRYSLER	TOWN & COUNTRY 2WD	003.8
31092	20.119	2002	SATURN	VUE FWD	002.2
50034	20.129	2006	Multiple Heavy Duty Light Truck Makes and Models		8 Cylinder Diesel

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
30992	20.145	2002	MITSUBISHI	DIAMANTE SEDAN	003.5
32746	20.246	2005	CHEVROLET	AVEO	001.6
30182	20.273	2001	LINCOLN	TOWN CAR	004.6
29735	20.286	2000	VOLKSWAGEN	PASSAT 4MOTION	002.8
31889	20.289	2003	PONTIAC	GRAND AM	003.4
31991	20.329	2003	TOYOTA	HIGHLANDER 2WD	002.4
29184	20.330	2000	CHEVROLET	C1500 TAHOE 2WD	004.8
34834	20.338	2000	CHEVROLET	SILVERADO 3500 2WD	005.7
34746	20.355	2000	GMC	C1500 YUKON XL 2WD	005.3
29835	20.406	2001	BUICK	LE SABRE	003.8
29836	20.406	2001	BUICK	PARK AVENUE	003.8
30637	20.458	2002	DODGE	CARAVAN 2WD	003.8
31565	20.458	2003	GMC	ENVOY XL 2WD	004.2
30288	20.513	2001	NISSAN	PATHFINDER 4WD	003.5
29179	20.572	2000	CHEVROLET	SILVERADO 1500 2WD	004.3
34941	20.606	2002	FORD	F250 SUPER DUTY	005.4
30417	20.630	2001	VOLKSWAGEN	GOLF (Auto)	002.0
34759	20.651	2002	CHEVROLET	S10 PICKUP 2WD	002.2
31529	20.659	2003	FORD	RANGER 2WD	002.3
1940	20.676	2001	Multiple Full-Size Van Makes and Models		8 Cylinder Gasoline
31767	20.687	2003	MERCEDES	C230 KOMPRESSOR	001.8
31056	20.752	2002	PONTIAC	MONTANA FWD	003.4
29814	20.767	2001	BMW	525I	002.5
31306	20.771	2003	CHEVROLET	BLAZER 2WD	004.3
30008	20.791	2001	FORD	F150 REG CAB SHORT	005.4
32760	20.806	2005	CHEVROLET	COLORADO 2WD	003.5
30089	20.830	2001	GMC	SAFARI 2WD PASSENGER	004.3
1914	20.859	2001	Multiple Light Truck Makes and Models		8 Cylinder Gasoline
29244	20.867	2000	CHRYSLER	SEBRING CONVERTIBLE	002.5
29628	20.896	2000	PONTIAC	FIREBIRD/TRANS AM	003.8
29780	20.904	2001	AUDI	A6 QUATTRO	002.7
31936	20.937	2003	SATURN	VUE FWD (Manual)	002.2
29603	20.973	2000	NISSAN	MAXIMA	003.0
29802	20.974	2001	BMW	325CI	002.5
30121	21.000	2001	INFINITI	QX4 2WD	003.5
31291	21.027	2003	CADILLAC	DEVILLE	004.6

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
30589	21.028	2002	CHEVROLET	PRIZM	001.8
30825	21.053	2002	HYUNDAI	ACCENT	001.5
29804	21.059	2001	BMW	325I	002.5
29306	21.110	2000	FORD	CONTOUR	002.5
30386	21.149	2001	TOYOTA	CELICA	001.8
1977	21.171	2002	FORD	Light Trucks and SUVs	8 Cylinder Gasoline
32292	21.210	2004	GMC	CANYON 2WD	003.5
30256	21.254	2001	MERCURY	VILLAGER	003.3
30870	21.317	2002	JEEP	GRAND CHEROKEE 2WD	004.7
30296	21.365	2001	OLDSMOBILE	ALERO	002.4
32220	21.370	2004	DODGE	INTREPID	002.7
31935	21.475	2003	SATURN	VUE FWD (Auto)	002.2
30427	21.480	2001	VOLKSWAGEN	NEW BEETLE	001.8
1895	21.487	2001	Multiple Full-Size Passenger Car Makes and Models		8 Cylinder Gasoline
31927	21.495	2003	SATURN	L300	003.0
30117	21.522	2001	HYUNDAI	XG 300	003.0
29994	21.566	2001	FORD	EXPEDITION	005.4
31356	21.587	2003	CHEVROLET	S10 PICKUP 2WD	004.3
32388	21.635	2004	KIA	RIO	001.6
34766	21.664	2002	VOLKSWAGEN	JETTA	001.8
30475	21.678	2002	AUDI	A6 QUATTRO	003.0
1913	21.678	2001	Multiple Full-Size Light Truck Makes and Models		8 Cylinder Gasoline
30622	21.736	2002	CHRYSLER	SEBRING SEDAN	002.7
2049	21.738	2003	FORD	Multiple Vans and Light Trucks	006.8
31875	21.767	2003	OLDSMOBILE	ALERO	003.4
29910	21.807	2001	CHRYSLER	PT CRUISER (Manual)	002.4
29844	21.839	2001	CHEVROLET	ASTRO 2WD PASSENGER	004.3
31958	21.854	2003	SUZUKI	AERIO	002.0
30388	21.861	2001	TOYOTA	COROLLA	001.8
30315	21.891	2001	PONTIAC	GRAND AM	002.4
29524	21.909	2000	MAZDA	626	002.0
30573	21.910	2002	CHEVROLET	IMPALA	003.4
34753	21.916	2001	MITSUBISHI	ECLIPSE	003.0
29803	21.947	2001	BMW	325CI CONVERTIBLE	002.5
29733	21.954	2000	VOLKSWAGEN	PASSAT (Auto)	002.8

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
30909	21.957	2002	LINCOLN	LS	003.0
30084	21.967	2001	GMC	K1500 YUKON 4WD	005.3
34908	21.969	2001	JEEP	CHEROKEE 2WD	004.0
29951	21.972	2001	DODGE	RAM 1500 4WD	005.9
30004	22.011	2001	FORD	F150 REG CAB LONG	005.4
30627	22.014	2002	CHRYSLER	VOYAGER	003.3
34889	22.044	2001	FORD	F250 SUPER DUTY	006.8
30149	22.070	2001	JEEP	GRAND CHEROKEE 2WD	004.0
29990	22.095	2001	FORD	ESCAPE	003.0
1892	22.100	2001	Multiple Compact Passenger Car Makes and Models		4 Cylinder Gasoline
34865	22.143	2001	BMW	330CI CONVERTIBLE	003.0
34760	22.164	2002	DODGE	RAM VAN 1500 2WD	005.2
30471	22.195	2002	AUDI	A4 QUATTRO	003.0
29573	22.207	2000	MERCURY	COUGAR	0025
31051	22.246	2002	PONTIAC	GRAND AM	002.2
34894	22.261	2001	FORD	EXCURSION	006.8
33604	22.310	2006	HYUNDAI	TIBURON	002.7
30869	22.314	2002	JEEP	GRAND CHEROKEE 2WD	004.0
1984	22.323	2002	Multiple Mini-Van Makes and Models		6 Cylinder Gasoline
30290	22.329	2001	NISSAN	QUEST	003.3
51859	22.336	2002	CHEVROLET	SILVERADO 2500 DIESEL	006.6
30430	22.337	2001	VOLKSWAGEN	PASSAT	001.8
31837	22.350	2003	MITSUBISHI	LANCER	002.0
35087	22.366	2004	FORD	E350	005.4
33444	22.373	2006	CHRYSLER	PACIFICA 2WD	003.5
30390	22.393	2001	TOYOTA	HIGHLANDER 2WD	002.4
31337	22.431	2003	CHEVROLET	IMPALA	003.8
29546	22.522	2000	MAZDA	PROTEGE	001.8
29634	22.522	2000	PONTIAC	MONTANA FWD	003.4
30254	22.534	2001	MERCURY	SABLE	003.0
30304	22.538	2001	PLYMOUTH	NEON	002.0
31106	22.546	2002	SUZUKI	AERIO	002.0
31397	22.586	2003	CHRYSLER	TOWN & COUNTRY	003.8
29810	22.697	2001	BMW	330CI	003.0
31219	22.706	2003	AUDI	A4 QUATTRO	003.0
29932	22.725	2001	DODGE	DAKOTA 2WD	004.7

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
29657	22.737	2000	SATURN	SC	001.9
29966	22.814	2001	DODGE	STRATUS	003.0
34888	22.817	2001	FORD	F250 SUPER DUTY	005.4
30039	22.825	2001	FORD	RANGER REG CAB SHORT	002.5
29952	22.825	2001	DODGE	RAM 2500 (CA Emission)	005.9
30180	22.873	2001	LINCOLN	LS	003.9
30259	22.881	2001	MITSUBISHI	ECLIPSE	002.4
29931	22.976	2001	DODGE	DAKOTA 2WD	003.9
52255	22.982	2003	VOLKSWAGEN	JETTA TDI	001.9
29299	23.003	2000	DODGE	STRATUS	002.5
30894	23.042	2002	LAND ROVER	RANGE ROVER	004.6
30429	23.077	2001	VOLKSWAGEN	NEW BEETLE (Manual)	002.0
29235	23.135	2000	CHEVROLET	VENTURE FWD	003.4
30542	23.184	2002	CADILLAC	SEVILLE	004.6
29940	23.203	2001	DODGE	DURANGO 4WD	005.9
32258	23.213	2004	FORD	F150 2WD	004.2
32010	23.252	2003	TOYOTA	TUNDRA 2WD	003.4
31430	23.263	2003	DODGE	NEON	002.0
30250	23.321	2001	MERCURY	COUGAR	002.5
29545	23.336	2000	MAZDA	PROTEGE	001.6
30422	23.358	2001	VOLKSWAGEN	JETTA	002.0
30151	23.385	2001	JEEP	GRAND CHEROKEE 4WD	004.0
1894	23.387	2001	Multiple Mid-Size Passenger Car Makes and Models		6 Cylinder Gasoline
31352	23.395	2003	CHEVROLET	MONTE CARLO	003.8
2073	23.453	2004	General Motors Light Trucks		003.5
29854	23.507	2001	CHEVROLET	SILVERADO 1500 2WD	005.3
32041	23.529	2003	VOLVO	S40	001.9
30729	23.550	2002	FORD	FOCUS WAGON	002.0
30181	23.557	2001	LINCOLN	NAVIGATOR	005.4
30832	23.579	2002	HYUNDAI	SONATA	002.7
33015	23.581	2005	KIA	RIO	001.6
32818	23.585	2005	CHRYSLER	SEBRING	002.7
29189	23.607	2000	CHEVROLET	CAMARO	003.8
29992	23.646	2001	FORD	ESCORT 4DR	002.0
30655	23.647	2002	DODGE	NEON	002.0
29857	23.651	2001	CHEVROLET	C1500 TAHOE 2WD	005.3
35080	23.659	2004	FORD	F350 SUPER DUTY	005.4

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
31600	23.664	2003	GMC	SONOMA 2WD	004.3
29450	23.805	2000	HYUNDAI	SONATA	002.5
30721	23.805	2002	FORD	F150 SUPER CAB (Auto)	004.2
31053	23.819	2002	PONTIAC	GRAND PRIX	003.1
31937	23.832	2003	SATURN	VUE FWD	003.0
30715	23.846	2002	FORD	F150 REG CAB SHORT (Auto)	004.2
30431	23.851	2001	VOLKSWAGEN	PASSAT	002.8
30298	23.877	2001	OLDSMOBILE	ALERO	003.4
30063	23.934	2001	GMC	C1500 YUKON 2WD	005.3
29843	23.940	2001	CHEVROLET	ASTRO 2WD CARGO	004.3
29607	23.965	2000	NISSAN	SENTRA	001.8
29839	23.980	2001	CADILLAC	DEVILLE	004.6
30712	24.061	2002	FORD	F150 REG CAB (Manual)	004.2
29165	24.086	2000	CADILLAC	CATERA	003.0
29658	24.094	2000	SATURN	SL	001.9
29250	24.108	2000	DAEWOO	LEGANZA	002.2
30428	24.157	2001	VOLKSWAGEN	NEW BEETLE (Auto)	002.0
30642	24.197	2002	DODGE	DAKOTA 2WD	003.9
29935	24.221	2001	DODGE	DAKOTA 4WD	004.7
29842	24.228	2001	CADILLAC	SEVILLE	004.6
30049	24.229	2001	FORD	TAURUS	003.0
31428	24.264	2003	DODGE	INTREPID	002.7
33202	24.359	2005	SUZUKI	FORENZA	002.0
32340	24.430	2004	HYUNDAI	TIBURON	002.7
30158	24.475	2001	KIA	RIO	001.5
30889	24.507	2002	KIA	SPORTAGE 4WD	002.0
29834	24.508	2001	BUICK	CENTURY	003.1
30709	24.542	2002	FORD	F150 REG CAB LONG	004.2
29503	24.549	2000	LAND ROVER	RANGE ROVER	004.6
34761	24.642	2002	DODGE	RAM VAN 2500 2WD	005.2
32222	24.654	2004	DODGE	NEON	002.0
30119	24.710	2001	INFINITI	I30	003.0
30281	24.718	2001	NISSAN	FRONTIER 2WD (Manual)	002.4
30762	24.783	2002	FORD	WINDSTAR 4DR	003.8
30671	24.801	2002	DODGE	STRATUS 4-DR	002.7
29859	24.842	2001	CHEVROLET	CAMARO	005.7
30893	24.895	2002	LAND ROVER	FREELANDER	002.5

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
30379	24.913	2001	TOYOTA	CAMRY	002.2
30264	24.917	2001	MITSUBISHI	GALANT	003.0
30472	24.941	2002	AUDI	A6	003.0
30148	24.948	2001	JEEP	CHEROKEE 4WD	004.0
30561	25.047	2002	CHEVROLET	CAMARO	003.8
32232	25.056	2004	DODGE	STRATUS	002.4
31501	25.060	2003	FORD	F150 REG CAB LONG	004.2
30653	25.126	2002	DODGE	INTREPID	002.7
30271	25.137	2001	MITSUBISHI	MONTERO SPORT 2WD	003.0
30287	25.188	2001	NISSAN	PATHFINDER 2WD	003.5
31416	25.194	2003	DODGE	DAKOTA 2WD	003.9
32194	25.198	2004	CHRYSLER	SEBRING	002.4
29882	25.228	2001	CHEVROLET	K1500 TAHOE 4WD	005.3
31411	25.233	2003	DODGE	CARAVAN 2WD	003.3
30024	25.292	2001	FORD	MUSTANG CONVERTIBLE	003.8
30412	25.332	2001	VOLKSWAGEN	CABRIO	002.0
29946	25.396	2001	DODGE	NEON	002.0
30266	25.400	2001	MITSUBISHI	MIRAGE	001.8
29499	25.423	2000	LAND ROVER	DISCOVERY SER II	004.0
30610	25.455	2002	CHEVROLET	VENTURE FWD	003.4
31049	25.616	2002	PONTIAC	FIREBIRD	003.8
32923	25.664	2005	GMC	CANYON 2WD	003.5
30345	25.668	2001	SATURN	SC	001.9
30626	25.798	2002	CHRYSLER	VOYAGER	002.4
29878	25.824	2001	CHEVROLET	SILVERADO 1500 4WD	005.3
30113	25.866	2001	HYUNDAI	SONATA	002.4
31336	25.898	2003	CHEVROLET	IMPALA	003.4
29243	25.908	2000	CHRYSLER	SEBRING	002.5
30092	25.958	2001	GMC	SONOMA 2WD	004.3
31690	25.972	2003	JEEP	GRAND CHEROKEE 4WD	004.0
30059	25.999	2001	GMC	SIERRA 1500 2WD	004.8
29939	26.003	2001	DODGE	DURANGO 4WD	004.7
29252	26.040	2000	DAEWOO	NUBIRA	002.0
2038	26.056	2003	Multiple Mini-Van Makes and Models		6 Cylinder Gasoline
30159	26.072	2001	KIA	SEPHIA/SPECTRA	001.8
31401	26.095	2003	CHRYSLER	VOYAGER/TOWN&CTRY	003.3
30446	26.140	2001	VOLVO	V40	001.9

Appendix C: VLT ID Numbers Most Likely to Fail the OBD II Functional Test

VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
29965	26.270	2001	DODGE	STRATUS	002.4
29948	26.302	2001	DODGE	RAM 1500 2WD	005.2
30080	26.312	2001	GMC	SIERRA 1500 4WD	005.3
51985	26.361	2002	GMC	SIERRA 2500 DIESEL	006.6
29993	26.396	2001	FORD	EXPEDITION	004.6
29904	26.427	2001	CHRYSLER	300M	003.5
30722	26.433	2002	FORD	F150 SUPER CAB SHORT (Manual)	004.2
30060	26.528	2001	GMC	SIERRA 1500 2WD	005.3
29837	26.565	2001	BUICK	REGAL	003.8
29848	26.653	2001	CHEVROLET	BLAZER 4WD	004.3
31493	26.658	2003	FORD	F150 2WD	004.2
30763	26.688	2002	FORD	WINDSTAR CARGO VAN	003.8
30421	26.735	2001	VOLKSWAGEN	JETTA	001.8
1910	26.758	2001	Multiple Light Truck Makes and Models		4 Cylinder Gasoline
30213	26.952	2001	MAZDA	PROTEGE/PROTEGE MPS	001.6
31713	26.991	2003	LAND ROVER	FREELANDER	002.5
30635	27.003	2002	DODGE	CARAVAN 2WD	002.4
30104	27.017	2001	HONDA	PASSPORT 2WD	003.2
30668	27.018	2002	DODGE	STRATUS	002.4
30408	27.021	2001	TOYOTA	TUNDRA 2WD	003.4
32568	27.025	2004	SUZUKI	FORENZA	002.0
34748	27.063	2001	AUDI	A4	001.8
30346	27.096	2001	SATURN	SL	001.9
29890	27.114	2001	CHEVROLET	S10 PICKUP 2WD	004.3
32817	27.128	2005	CHRYSLER	SEBRING	002.4
31702	27.183	2003	KIA	RIO	001.6
29991	27.208	2001	FORD	ESCORT	002.0
30440	27.243	2001	VOLVO	S40	001.9
29870	27.283	2001	CHEVROLET	IMPALA	003.4
30280	27.330	2001	NISSAN	FRONTIER 2WD (Auto)	002.4
29888	27.451	2001	CHEVROLET	PRIZM	001.8
30887	27.495	2002	KIA	SPECTRA	001.8
30272	27.592	2001	MITSUBISHI	MONTERO SPORT 2WD	003.5
29968	27.608	2001	DODGE	STRATUS 4-DR	002.7
29912	27.612	2001	CHRYSLER	SEBRING COUPE	003.0
31452	27.612	2003	DODGE	STRATUS 4-DR	002.4

Appendix C: VLT ID Numbers Most Likely to Fail the OBD II Functional Test

VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
1939	27.616	2001	Multiple Full-Size Van Makes and Models		8 Cylinder Gasoline
30636	27.652	2002	DODGE	CARAVAN 2WD	003.3
29853	27.755	2001	CHEVROLET	SILVERADO 1500 2WD	004.8
31000	27.762	2002	MITSUBISHI	LANCER	002.0
34931	27.836	2002	CHRYSLER	TOWN & COUNTRY 2WD	003.3
31711	27.850	2003	LAND ROVER	DISCOVERY	004.6
31890	27.879	2003	PONTIAC	GRAND PRIX	003.1
30263	27.883	2001	MITSUBISHI	GALANT	002.4
29812	28.060	2001	BMW	330I	003.0
30052	28.109	2001	FORD	WINDSTAR 4DR WAGON	003.8
30051	28.132	2001	FORD	WINDSTAR 3DR WAGON	003.8
34878	28.216	2001	CHRYSLER	TOWN & COUNTRY 2WD	003.8
30764	28.220	2002	FORD	WINDSTAR WAGON	003.8
30695	28.274	2002	FORD	ESCORT	002.0
30127	28.310	2001	ISUZU	RODEO 2WD	003.2
32855	28.506	2005	DODGE	STRATUS	002.4
30939	28.554	2002	MAZDA	MPV	003.0
29884	28.670	2001	CHEVROLET	MALIBU	003.1
31511	28.674	2003	FORD	F150 SUPER CAB SHORT	004.2
29632	28.711	2000	PONTIAC	GRAND PRIX	003.1
30028	28.735	2001	FORD	MUSTANG COUPE (Auto)	003.8
29937	28.804	2001	DODGE	DURANGO 2WD	004.7
30260	28.832	2001	MITSUBISHI	ECLIPSE	003.0
29926	28.847	2001	DODGE	CARAVAN 2WD	002.4
31031	28.909	2002	OLDSMOBILE	ALERO	002.2
29847	28.950	2001	CHEVROLET	BLAZER 2WD	004.3
30022	29.059	2001	FORD	MUSTANG	003.8
29915	29.074	2001	CHRYSLER	SEBRING CONVERTIBLE	002.7
30274	29.233	2001	MITSUBISHI	MONTERO SPORT 4WD	003.5
30053	29.428	2001	FORD	WINDSTAR VAN	003.8
30161	29.431	2001	KIA	SPORTAGE 4WD	002.0
31688	29.554	2003	JEEP	GRAND CHEROKEE 2WD	004.0
30382	29.624	2001	TOYOTA	CAMRY SOLARA	002.2
30892	29.696	2002	LAND ROVER	DISCOVERY SER II	004.0
30178	29.716	2001	LINCOLN	LS	003.0
29949	29.790	2001	DODGE	RAM 1500 2WD	005.9
31706	29.811	2003	KIA	SPECTRA	001.8

Appendix C: VLT ID Numbers Most Likely to Fail the OBD II Functional Test

VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
30888	29.893	2002	KIA	SPORTAGE 2WD	002.0
34749	29.908	2001	CHEVROLET	S10 PICKUP 2WD	002.2
29928	29.962	2001	DODGE	CARAVAN 2WD	003.8
29947	30.007	2001	DODGE	RAM 1500 2WD	003.9
30291	30.031	2001	NISSAN	SENTRA	001.8
30265	30.152	2001	MITSUBISHI	MIRAGE	001.5
29543	30.218	2000	MAZDA	MPV	002.5
29871	30.480	2001	CHEVROLET	IMPALA	003.8
31468	30.840	2003	FORD	E150 ECONOLINE	004.2
31552	30.893	2003	FORD	WINDSTAR WAGON	003.8
30317	31.841	2001	PONTIAC	GRAND AM	003.4
29249	32.081	2000	DAEWOO	LANOS	001.6
29883	32.346	2001	CHEVROLET	LUMINA	003.1
30038	32.567	2001	FORD	RANGER REG CAB SHORT	002.3
1930	32.584	2001	Multiple Mini-Van Makes and Models		6 Cylinder Gasoline
30401	32.743	2001	TOYOTA	SIENNA	003.0
30114	32.784	2001	HYUNDAI	SONATA	002.5
29852	32.831	2001	CHEVROLET	SILVERADO 1500 2WD	004.3
30284	32.870	2001	NISSAN	MAXIMA	003.0
29891	32.894	2001	CHEVROLET	S10 PICKUP 2WD FFV	002.2
29886	33.123	2001	CHEVROLET	MONTE CARLO	003.4
32571	33.582	2004	SUZUKI	VERONA	002.5
29776	33.595	2001	AUDI	A6	002.8
30311	33.600	2001	PONTIAC	AZTEK FWD	003.4
30184	33.648	2001	MAZDA	626	002.0
30268	33.916	2001	MITSUBISHI	MONTERO	003.5
30012	33.972	2001	FORD	F150 SUPER CAB (Auto)	004.2
29887	34.010	2001	CHEVROLET	MONTE CARLO	003.8
31762	34.117	2003	MAZDA	MPV	003.0
30160	34.122	2001	KIA	SPORTAGE 2WD	002.0
30005	34.368	2001	FORD	F150 REG CAB SHORT	004.2
30884	34.464	2002	KIA	OPTIMA	002.7
30684	34.520	2002	FORD	E150 ECONOLINE	004.2
30156	34.606	2001	KIA	OPTIMA	002.4
29927	34.666	2001	DODGE	CARAVAN 2WD	003.3
29903	35.058	2001	CHEVROLET	VENTURE FWD	003.4
30258	35.183	2001	MITSUBISHI	DIAMANTE SEDAN	003.5

Appendix C: VLT ID Numbers Most Likely to Fail the OBD II Functional Test

VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
30302	35.378	2001	OLDSMOBILE	INTRIGUE	003.5
29922	35.610	2001	DAEWOO	LEGANZA	002.2
30111	35.804	2001	HYUNDAI	SANTA FE	002.4
31633	35.863	2003	HYUNDAI	TIBURON	002.7
52135	36.005	2003	FORD	EXCURSION DIESEL	006.0
34877	36.346	2001	CHRYSLER	TOWN & COUNTRY 2WD	003.3
30002	36.417	2001	FORD	F150 REG CAB LONG	004.2
29858	36.480	2001	CHEVROLET	CAMARO	003.8
29914	36.501	2001	CHRYSLER	SEBRING SEDAN	002.7
30013	36.526	2001	FORD	F150 SUPER CAB SHORT (Manual)	004.2
30938	36.608	2002	MAZDA	MILLENIA	002.5
30029	36.613	2001	FORD	MUSTANG COUPE (Manual)	003.8
29918	36.666	2001	CHRYSLER	VOYAGER	003.3
29941	37.184	2001	DODGE	INTREPID	002.7
30319	37.807	2001	PONTIAC	GRAND PRIX	003.8
30072	37.998	2001	GMC	JIMMY 2WD	004.3
29921	38.451	2001	DAEWOO	LANOS	001.6
30318	38.909	2001	PONTIAC	GRAND PRIX	003.1
30163	39.043	2001	LAND ROVER	DISCOVERY SER II	004.0
30312	39.576	2001	PONTIAC	BONNEVILLE	003.8
29979	40.481	2001	FORD	E150 ECONOLINE	004.2
30299	40.813	2001	OLDSMOBILE	AURORA	003.5
30320	41.487	2001	PONTIAC	MONTANA FWD	003.4
30211	43.542	2001	MAZDA	MPV	002.5

Appendix D: VLT ID Numbers Demonstrating Zero Failures of the Visual Inspection

VLT ID	Model-Year	Make	Model	Engine Size
2073	2004	General Motors	Light Trucks	003.5
2236	2007	Multiple Mid-Size Light Truck Makes and Models		6 Cylinder Gasoline
2245	2007	Multiple Mid-Size SUV Makes and Models		6 Cylinder Gasoline
2264	2007	Multiple Full-Size Van Makes and Models		8 Cylinder Gasoline
2269	2008	SMART	SMART CAR	001.0
2274	2008	Multiple Luxury Car Makes and Models		10 Cylinder Gas
2281	2008	Multiple Mid-Size Passenger Car Makes and Models		6 Cylinder Gasoline
2318	2008	Multiple Full-Size Van Makes and Models		8 Cylinder Gasoline
2325	2009	Multiple Mid-Size Passenger Car Makes and Models		5 Cylinder Gasoline
2335	2009	Multiple Mid-Size SUV Makes and Models		6 Cylinder Gasoline
2354	2009	Multiple Full-Size SUV Makes and Models		8 Cylinder Gasoline
2372	2009	Multiple Light Truck Makes and Models		8 Cylinder Gasoline
2398	2010	Multiple Compact Light Truck Makes and Models		6 Cylinder Gasoline
2426	2010	Multiple Full-Size Van Makes and Models		8 Cylinder Gasoline
2433	2011	Multiple Mid-Size Passenger Car Makes and Models		5 Cylinder Gasoline
2450	2011	Multiple Compact Light Truck Makes and Models		4 Cylinder Gasoline
2487	2012	Multiple Mid-Size Passenger Car Makes and Models		5 Cylinder Gasoline
2489	2012	Multiple Full-Size Passenger Car Makes and Models		8 Cylinder Gasoline
2513	2012	Multiple Mid-Size SUV Makes and Models		4 Cylinder Gasoline
2516	2012	Multiple Full-Size SUV Makes and Models		8 Cylinder Gasoline
2524	2012	Multiple Mini-Van Makes and Models		6 Cylinder Gasoline
2534	2012	Multiple Full-Size Van Makes and Models		8 Cylinder Gasoline
29568	2000	MERCEDES	SL500	005.0
29575	2000	MERCURY	MOUNTAINEER	004.0
29639	2000	PORSCHE	BOXSTER	002.7
29641	2000	PORSCHE	BOXSTER S	003.2
29776	2001	AUDI	A6	002.8
29817	2001	BMW	540I	004.4
30283	2001	NISSAN	FRONTIER 4WD	003.3
30452	2002	ACURA	3.2CL	003.2
30537	2002	CADILLAC	ELDORADO	004.6
30794	2002	GMC	SIERRA 1500 DENALI AWD	006.0
30889	2002	KIA	SPORTAGE 4WD	002.0
30903	2002	LEXUS	LX 470	004.7
30974	2002	MERCEDES	SL500	005.0
31048	2002	PONTIAC	BONNEVILLE	003.8
31067	2002	PORSCHE	BOXSTER	002.7
31485	2003	FORD	EXPLORER 2WD	004.6

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VLT ID	Model-Year	Make	Model	Engine Size
31565	2003	GMC	ENVOY XL 2WD	004.2
31593	2003	GMC	K1500 YUKON DENALI XL	006.0
31596	2003	GMC	SAFARI 2WD PASSENGER	004.3
31640	2003	INFINITI	I35	003.5
31722	2003	LEXUS	GX 470	004.7
31798	2003	MERCEDES	ML320	003.2
31800	2003	MERCEDES	ML500	005.0
32066	2004	AUDI	A4	003.0
32073	2004	AUDI	A6 QUATTRO	002.7
32094	2004	BMW	5-SERIES	003.0
32109	2004	BUICK	PARK AVENUE	003.8
32244	2004	FORD	E250	004.6
32350	2004	INFINITI	QX56 2WD	005.6
32366	2004	JAGUAR	XJ8	004.2
32403	2004	LEXUS	GS 430	004.3
32406	2004	LEXUS	LX 470	004.7
32413	2004	LINCOLN	LS	003.9
32456	2004	MERCEDES	ML500	005.0
32458	2004	MERCEDES	S500	005.0
32486	2004	MITSUBISHI	MONTERO SPORT	003.5
32499	2004	NISSAN	PATHFINDER 4WD	003.5
32532	2004	PORSCHE	BOXSTER	003.2
32542	2004	SATURN	L300	002.2
32575	2004	TOYOTA	4RUNNER 2WD	004.7
32582	2004	TOYOTA	CAMRY SOLARA	002.4
32624	2004	VOLKSWAGEN	PASSAT	002.8
32640	2004	VOLVO	S40	002.5
32705	2005	BMW	M3	003.2
32707	2005	BMW	X3	003.0
32717	2005	BUICK	LACROSSE	003.8
32739	2005	CADILLAC	STS	003.6
32740	2005	CADILLAC	STS	004.6
32752	2005	CHEVROLET	C1500 SUBURBAN	005.3
32812	2005	CHRYSLER	CROSSFIRE	003.2
32835	2005	DODGE	DURANGO 2WD	004.7
32836	2005	DODGE	DURANGO 2WD	005.7
32884	2005	FORD	EXPLORER SPORT TRAC	004.0
32895	2005	FORD	FIVE HUNDRED	003.0

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VLT ID	Model-Year	Make	Model	Engine Size
32976	2005	INFINITI	FX35 RWD	003.5
33003	2005	JEEP	GRAND CHEROKEE 4WD	003.7
33012	2005	KIA	AMANTI	003.5
33026	2005	LAND ROVER	LR3	004.4
33039	2005	LEXUS	SC 430	004.3
33067	2005	MAZDA	TRIBUTE	003.0
33079	2005	MERCEDES	CLK320	003.2
33080	2005	MERCEDES	CLK500	005.0
33084	2005	MERCEDES	E500	005.0
33089	2005	MERCEDES	ML350	003.7
33095	2005	MERCEDES	SL500	005.0
33133	2005	NISSAN	MURANO AWD	003.5
33158	2005	PONTIAC	VIBE	001.8
33166	2005	PORSCHE	CAYENNE	004.5
33170	2005	SAAB	9-3	002.0
33188	2005	SUBARU	FORESTER AWD	002.5
33209	2005	TOYOTA	4RUNNER 2WD	004.0
33224	2005	TOYOTA	HIGHLANDER 2WD	002.4
33232	2005	TOYOTA	RAV4 2WD	002.4
33233	2005	TOYOTA	RAV4 4WD	002.4
33266	2005	VOLVO	S40	002.4
33321	2006	BMW	3-SERIES	002.5
33324	2006	BMW	5-SERIES	003.0
33339	2006	BMW	Z4 COUPE	003.0
33344	2006	BUICK	LUCERNE	004.6
33360	2006	CADILLAC	DTS	004.6
33367	2006	CADILLAC	STS	003.6
33369	2006	CADILLAC	STS	004.6
33375	2006	CHEVROLET	AVALANCHE 1500 4WD	005.3
33455	2006	CHRYSLER	TOWN & COUNTRY 2WD	003.8
33469	2006	DODGE	DURANGO 2WD	005.7
33494	2006	FORD	E150	005.4
33508	2006	FORD	EXPLORER 4WD	004.0
33529	2006	FORD	FREESTAR WAGON FWD	004.2
33541	2006	FORD	RANGER 4WD	004.0
33601	2006	HYUNDAI	SONATA	002.4
33605	2006	HYUNDAI	TUCSON	002.0
33608	2006	HYUNDAI	TUCSON 4WD	002.7

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VLT ID	Model-Year	Make	Model	Engine Size
33609	2006	INFINITI	FX35	003.5
33610	2006	INFINITI	FX35 AWD	003.5
33624	2006	JAGUAR	S-TYPE	003.0
33657	2006	KIA	OPTIMA	002.4
33665	2006	KIA	SPORTAGE	002.7
33670	2006	LAND ROVER	LR3	004.0
33680	2006	LAND ROVER	SPORT	004.2
33691	2006	LEXUS	LS 430	004.3
33692	2006	LEXUS	LX 470	004.7
33696	2006	LEXUS	SC 430	004.3
33723	2006	MAZDA	TRIBUTE	002.3
33724	2006	MAZDA	TRIBUTE	003.0
33737	2006	MERCEDES	CLK500	005.0
33743	2006	MERCEDES	E500	005.0
33749	2006	MERCEDES	ML500	005.0
33752	2006	MERCEDES	S350	003.7
33763	2006	MERCEDES	SLK350	003.5
33768	2006	MERCURY	MARINER	003.0
33772	2006	MERCURY	MILAN	003.0
33777	2006	MERCURY	MOUNTAINEER 2WD	004.0
33788	2006	MITSUBISHI	ENDEAVOR	003.8
33796	2006	MITSUBISHI	OUTLANDER	002.4
33837	2006	PORSCHE	BOXSTER	002.7
33839	2006	PORSCHE	CAYENNE	003.2
33840	2006	PORSCHE	CAYENNE	004.5
33873	2006	SUBARU	OUTBACK	003.0
33876	2006	SUZUKI	AERIO	002.3
33878	2006	SUZUKI	GRAND VITARA	002.7
33904	2006	TOYOTA	RAV4 2WD	003.5
33905	2006	TOYOTA	RAV4 4WD	002.4
33955	2007	ACURA	MDX	003.7
33956	2007	ACURA	RDX	002.3
33965	2007	AUDI	A4	002.0
34005	2007	BMW	X3	003.0
34025	2007	CADILLAC	DTS	004.6
34027	2007	CADILLAC	ESCALADE AWD	006.2
34044	2007	CHEVROLET	SILVERADO 1500 2WD	004.3
34047	2007	CHEVROLET	C1500 SUBURBAN	005.3

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VLT ID	Model-Year	Make	Model	Engine Size
34053	2007	CHEVROLET	COLORADO 2WD	003.7
34070	2007	CHEVROLET	IMPALA	003.5
34081	2007	CHEVROLET	K1500 SUBURBAN	005.3
34099	2007	CHEVROLET	UPLANDER	003.9
34132	2007	DODGE	CARAVAN 2WD	003.3
34154	2007	DODGE	NITRO	003.7
34168	2007	FORD	EDGE	003.5
34173	2007	FORD	EXPEDITION 2WD	005.4
34174	2007	FORD	EXPLORER 2WD	004.0
34183	2007	FORD	F150 2WD	004.2
34188	2007	FORD	FIVE HUNDRED	003.0
34199	2007	FORD	FUSION	002.3
34211	2007	FORD	TAURUS	003.0
34264	2007	HONDA	ELEMENT	002.4
34351	2007	LAND ROVER	RANGE ROVER	004.4
34359	2007	LEXUS	GS 350	003.5
34374	2007	LINCOLN	NAVIGATOR	005.4
34375	2007	LINCOLN	TOWN CAR	004.6
34399	2007	MERCEDES	C230	002.5
34403	2007	MERCEDES	CLK350	003.5
34413	2007	MERCEDES	GL450	004.6
34414	2007	MERCEDES	ML350	003.5
34420	2007	MERCEDES	S550	005.5
34452	2007	MITSUBISHI	OUTLANDER	003.0
34456	2007	NISSAN	ALTIMA	003.5
34457	2007	NISSAN	ARMADA	005.6
34461	2007	NISSAN	MAXIMA	003.5
34462	2007	NISSAN	MURANO	003.5
34467	2007	NISSAN	TITAN 2WD	005.6
34469	2007	NISSAN	VERSA	001.8
34470	2007	NISSAN	XTERRA 2WD	004.0
34509	2007	SATURN	AURA	003.5
34531	2007	SUBARU	OUTBACK	002.5
34547	2007	TOYOTA	4RUNNER 2WD	004.0
34549	2007	TOYOTA	4RUNNER 4WD	004.0
34560	2007	TOYOTA	FJ CRUISER 4WD	004.0
34571	2007	TOYOTA	RAV4 2WD	003.5
34573	2007	TOYOTA	RAV4 4WD	003.5

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VLT ID	Model-Year	Make	Model	Engine Size
34574	2007	TOYOTA	SEQUOIA 2WD	004.7
34592	2007	VOLKSWAGEN	PASSAT	002.0
34817	2006	CHEVROLET	EXPRESS 2500	006.0
34820	2007	BMW	525I	002.5
34825	2007	CHEVROLET	EXPRESS 2500	004.8
35068	2004	BMW	325I SPORT WAGON	002.5
35168	2005	MINI	MINI COOPER	001.6
35181	2006	BMW	330CI CONVERTIBLE	003.0
35229	2007	BMW	328I COUPE	003.0
35243	2007	CHEVROLET	SILVERADO 2500 2WD	006.0
35257	2007	FORD	E350	005.4
35276	2007	MINI	MINI COOPER	001.6
35277	2007	MINI	MINI COOPER S	001.6
50039	2009	Multiple Mid-Size Passenger Car Makes and Models		Diesel Engine
50041	2010	Multiple Mid-Size Passenger Car Makes and Models		Diesel Engine
50042	2010	Multiple Light Truck Makes and Models		Diesel Engine
50045	2012	Multiple Mid-Size Passenger Car Makes and Models		Diesel Engine
52961	2008	DODGE	SPRINTER 2500 DIESEL	003.0
53016	2009	DODGE	RAM 2500 DIESEL	006.7
53038	2010	FORD	F350 DIESEL	006.4
53069	2005	FORD	F350 SRW SUPER DUTY	006.0

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
50022	1.605	2003	Multiple Domestic Light Truck Makes and Models		6 and 8 Cylinder Diesel
31853	1.627	2003	NISSAN	350Z	003.5
52293	1.647	2004	DODGE	RAM 2500 DIESEL	005.9
29289	1.647	2000	DODGE	NEON	002.0
29349	1.652	2000	FORD	FOCUS ZX3 3DR	002.0
29729	1.659	2000	VOLKSWAGEN	NEW BEETLE (Auto)	002.0
29102	1.660	2000	ACURA	INTEGRA	001.8
29217	1.708	2000	CHEVROLET	MALIBU	003.1
29346	1.722	2000	FORD	FOCUS 4-DR SEDAN	002.0
29631	1.728	2000	PONTIAC	GRAND AM	003.4
30642	1.742	2002	DODGE	DAKOTA 2WD	003.9
34749	1.742	2001	CHEVROLET	S10 PICKUP 2WD	002.2
30109	1.754	2001	HYUNDAI	ACCENT	001.6
30587	1.764	2002	CHEVROLET	MONTE CARLO	003.4
33281	1.771	2005	VOLVO	XC90	002.5
29580	1.771	2000	MERCURY	SABLE	003.0
31095	1.772	2002	SUBARU	IMPREZA AWD	002.0
29731	1.774	2000	VOLKSWAGEN	PASSAT	001.8
30617	1.776	2002	CHRYSLER	PT CRUISER (Auto)	002.4
30730	1.776	2002	FORD	FOCUS ZX3	002.0
29730	1.784	2000	VOLKSWAGEN	NEW BEETLE (Manual)	002.0
29277	1.789	2000	DODGE	DAKOTA 4WD	004.7
31428	1.790	2003	DODGE	INTREPID	002.7
32505	1.794	2004	NISSAN	SENTRA	002.5
30654	1.802	2002	DODGE	INTREPID	003.5
30107	1.813	2001	HONDA	S2000	002.0
29200	1.815	2000	CHEVROLET	IMPALA	003.4
29764	1.815	2001	ACURA	INTEGRA	001.8
30106	1.821	2001	HONDA	PRELUDE	002.2
52265	1.821	2004	CHEVROLET	SILVERADO 2500 DIESEL	006.6
30422	1.825	2001	VOLKSWAGEN	JETTA	002.0
30735	1.826	2002	FORD	MUSTANG CONVERTIBLE (Auto)	004.6
29990	1.827	2001	FORD	ESCAPE	003.0
52341	1.849	2004	FORD	EXCURSION DIESEL	006.0
29299	1.854	2000	DODGE	STRATUS	002.5

Appendix E: VLT ID Numbers Most Likely to Fail the Visual Inspection

VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
30421	1.855	2001	VOLKSWAGEN	JETTA	001.8
32521	1.857	2004	PONTIAC	GRAND AM	003.4
32228	1.858	2004	DODGE	RAM 1500 4WD	004.7
29724	1.865	2000	VOLKSWAGEN	JETTA	001.8
52171	1.868	2003	FORD	F250 DIESEL	006.0
31336	1.868	2003	CHEVROLET	IMPALA	003.4
29322	1.878	2000	FORD	ESCORT	002.0
31522	1.879	2003	FORD	MUSTANG	004.6
52493	1.880	2005	DODGE	RAM 2500 DIESEL	005.9
29323	1.887	2000	FORD	ESCORT 4DR	002.0
31173	1.891	2002	VOLKSWAGEN	NEW BEETLE (Manual)	002.0
29728	1.896	2000	VOLKSWAGEN	NEW BEETLE	001.8
33453	1.896	2006	CHRYSLER	SRT-8	006.1
29727	1.899	2000	VOLKSWAGEN	NEW BEETLE	001.8
30469	1.900	2002	AUDI	A4 QUATTRO (Auto)	001.8
30268	1.919	2001	MITSUBISHI	MONTERO	003.5
29629	1.925	2000	PONTIAC	FIREBIRD/TRANS AM	005.7
29493	1.932	2000	JEEP	WRANGLER 4WD	002.5
29613	1.954	2000	OLDSMOBILE	ALERO	003.4
31434	1.958	2003	DODGE	RAM 1500 2WD	003.7
30217	1.959	2001	MAZDA	TRIBUTE	003.0
30019	1.969	2001	FORD	FOCUS WAGON	002.0
34766	1.973	2002	VOLKSWAGEN	JETTA	001.8
30994	1.977	2002	MITSUBISHI	ECLIPSE	003.0
31889	1.988	2003	PONTIAC	GRAND AM	003.4
30418	1.996	2001	VOLKSWAGEN	GOLF (Manual)	002.0
29632	1.997	2000	PONTIAC	GRAND PRIX	003.1
29584	2.001	2000	MITSUBISHI	ECLIPSE	003.0
52197	2.005	2003	FORD	F350 DIESEL	006.0
29915	2.010	2001	CHRYSLER	SEBRING CONVERTIBLE	002.7
29736	2.014	2000	VOLKSWAGEN	PASSAT WAGON	001.8
29223	2.021	2000	CHEVROLET	S10 PICKUP 2WD FFV	002.2
31205	2.022	2003	ACURA	RSX	002.0
30250	2.027	2001	MERCURY	COUGAR	002.5
29922	2.029	2001	DAEWOO	LEGANZA	002.2
29870	2.035	2001	CHEVROLET	IMPALA	003.4
29269	2.035	2000	DODGE	CARAVAN 2WD	003.3

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
30428	2.036	2001	VOLKSWAGEN	NEW BEETLE (Auto)	002.0
29909	2.038	2001	CHRYSLER	PT CRUISER	002.4
33812	2.044	2006	NISSAN	SENTRA	002.5
30753	2.049	2002	FORD	RANGER SUPER CAB 2DR SH	003.0
29249	2.055	2000	DAEWOO	LANOS	001.6
30618	2.060	2002	CHRYSLER	PT CRUISER (Manual)	002.4
29886	2.064	2001	CHEVROLET	MONTE CARLO	003.4
34839	2.066	2000	CHRYSLER	VOYAGER	003.3
32103	2.066	2004	BMW	X5	004.4
29357	2.068	2000	FORD	MUSTANG COUPE (Auto)	004.6
29442	2.079	2000	HONDA	PRELUDE	002.2
29719	2.080	2000	VOLKSWAGEN	GOLF	002.0
30650	2.084	2002	DODGE	DURANGO 2WD	005.9
51985	2.085	2002	GMC	SIERRA 2500 DIESEL	006.6
30659	2.105	2002	DODGE	RAM 1500 4WD	004.7
29245	2.124	2000	CHRYSLER	TOWN & COUNTRY 2WD	003.3
30417	2.126	2001	VOLKSWAGEN	GOLF (Auto)	002.0
29117	2.132	2000	AUDI	A4 QUATTRO	001.8
29624	2.137	2000	PLYMOUTH	VOYAGER 2WD	003.3
29294	2.141	2000	DODGE	RAM 1500 4WD	005.9
34739	2.162	2000	CHEVROLET	S10 PICKUP 2WD	002.2
30814	2.177	2002	HONDA	CIVIC	002.0
30825	2.186	2002	HYUNDAI	ACCENT	001.5
33462	2.211	2006	DODGE	CHARGER	006.1
31610	2.236	2003	HONDA	CIVIC	002.0
32246	2.262	2004	FORD	ESCAPE	003.0
30030	2.263	2001	FORD	MUSTANG COUPE	004.6
32559	2.263	2004	SUBARU	IMPREZA WRX	002.0
33866	2.267	2006	SUBARU	IMPREZA	002.5
29379	2.284	2000	FORD	TAURUS WAGON	003.0
30260	2.284	2001	MITSUBISHI	ECLIPSE	003.0
29444	2.289	2000	HYUNDAI	ACCENT (Auto)	001.5
33249	2.309	2005	VOLKSWAGEN	JETTA	001.8
29118	2.313	2000	AUDI	A4 QUATTRO	001.8
30148	2.335	2001	JEEP	CHEROKEE 4WD	004.0
52059	2.341	2003	CHEVROLET	SILVERADO 2500 DIESEL	006.6
29725	2.353	2000	VOLKSWAGEN	JETTA	002.0

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
30653	2.362	2002	DODGE	INTREPID	002.7
52063	2.367	2003	CHEVROLET	SILVERADO 3500 DIESEL	006.6
29591	2.370	2000	MITSUBISHI	MONTERO SPORT 2WD	003.0
29966	2.385	2001	DODGE	STRATUS	003.0
32021	2.406	2003	VOLKSWAGEN	JETTA	001.8
30731	2.433	2002	FORD	FOCUS ZX3	002.0
29910	2.459	2001	CHRYSLER	PT CRUISER (Manual)	002.4
34764	2.466	2002	FORD	RANGER SUPER CAB 4DR	003.0
51859	2.475	2002	CHEVROLET	SILVERADO 2500 DIESEL	006.6
29219	2.489	2000	CHEVROLET	METRO	001.3
30419	2.494	2001	VOLKSWAGEN	GTI	001.8
30668	2.494	2002	DODGE	STRATUS	002.4
32436	2.500	2004	MAZDA	TRIBUTE	003.0
29921	2.515	2001	DAEWOO	LANOS	001.6
31027	2.535	2002	NISSAN	SENTRA (Manual)	002.5
30729	2.545	2002	FORD	FOCUS WAGON	002.0
29586	2.566	2000	MITSUBISHI	GALANT	003.0
30108	2.584	2001	HYUNDAI	ACCENT	001.5
31695	2.590	2003	JEEP	LIBERTY 4WD	003.7
29445	2.639	2000	HYUNDAI	ACCENT (Manual)	001.5
30739	2.662	2002	FORD	MUSTANG COUPE	004.6
29593	2.697	2000	MITSUBISHI	MONTERO SPORT 4WD	003.0
52087	2.700	2003	DODGE	RAM 2500 DIESEL	005.9
29358	2.707	2000	FORD	MUSTANG COUPE (Manual)	004.7
31452	2.712	2003	DODGE	STRATUS 4-DR	002.4
30736	2.714	2002	FORD	MUSTANG CONVERTIBLE (Manual)	004.6
29286	2.734	2000	DODGE	INTREPID	002.7
33794	2.746	2006	MITSUBISHI	LANCER EVOLUTION	002.0
29965	2.768	2001	DODGE	STRATUS	002.4
33193	2.783	2005	SUBARU	IMPREZA STI	002.5
52209	2.831	2003	GMC	SIERRA 2500 DIESEL	006.6
29941	2.867	2001	DODGE	INTREPID	002.7
29968	2.908	2001	DODGE	STRATUS 4-DR	002.7
31943	2.943	2003	SUBARU	IMPREZA AWD	002.0
31528	2.950	2003	FORD	MUSTANG COUPE	004.6
29714	2.958	2000	VOLKSWAGEN	CABRIO	002.0
29298	3.044	2000	DODGE	STRATUS	002.4

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VLT ID	Odds Ratio	Model Year	Make	Model (Transmission Type)	Engine Size
29885	3.082	2001	CHEVROLET	METRO	001.3
31163	3.100	2002	VOLKSWAGEN	GTI	001.8
32614	3.116	2004	VOLKSWAGEN	GTI	001.8
52095	3.175	2003	DODGE	RAM 3500 DIESEL	005.9
29239	3.394	2000	CHRYSLER	CONCORDE	002.7
32019	3.439	2003	VOLKSWAGEN	GTI	001.8
30412	3.706	2001	VOLKSWAGEN	CABRIO	002.0
31158	4.331	2002	VOLKSWAGEN	CABRIO	002.0

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