INTERIM REPORT 4 -- VRTC-DCD2037 (EA02-034)

Data Analysis of International Truck Corporation Warranty Claims

1.0 INTRODUCTION

This test program was performed at the Vehicle Research and Test Center (VRTC) in response to a request by the Office of Defects Investigation (ODI), National Highway Traffic Safety Administration (NHTSA). The ODI has received complaints alleging brake overheating on the Bosch "Zero-Offset Pin Slide" (ZOPS, aka International Diamondlife) caliper brake system on various vehicles. Many complainants have alleged that these brakes apply normally, and then fail to fully release, resulting in overheated wheel-ends and fires on various vehicles, including school buses. International Truck Corporation was the largest final stage manufacturer who installed the ZOPS calipers and had the most comprehensive warranty database for examination. This warranty data, received as part of an Information Request (IR) by ODI, was reviewed to see how it applied to the alleged complaints. A list of all acronyms used in this report appears in Table A1 (all of the figures and tables for this report are shown in the Appendix A). Additional VRTC reports on the Bosch ZOPS brake calipers are: *Tests of the Bosch Brakes (ZOPS) on a 2001 Monaco Holiday Rambler Ambassador Motorhome, Bench Tests of the Bosch Brake Calipers (ZOPS), Inspections and Bench Tests of Calipers from a 2002 National RV Dolphin LX Motorhome, Monaco Trip Report, and International Truck Corporation Trip Report.*

2.0 BACKGROUND DISCUSSION

The objectives of this portion of the program were to document the types of complaints in the database, tally the number of each type of complaint, compare to the production numbers in order to determine specific complaint rates, and compare these complaint rates to complaint rates for vehicles from other final-stage manufacturers equipped with ZOPS calipers.

3.0 INTERNATIONAL TRUCK CORPORATION WARRANTY DATA

The warranty data was submitted in response to Question 1 of the ODI IR letter of July 11, 2002, referenced as NSA-14sjm / PE02-046f. Question 1, as shown in Figure A1, requested production information (date of manufacture, model, VIN, etc.) as well as problem reports (warranty, goodwill, field reports, etc.). The data submitted were all brake-related claims for International Truck Corporation vehicles, equipped with Bosch ZOPS disc brakes that were repaired under the manufacture's warranty program. This data covered claims for vehicles with

the 12-month standard warranty and 24-month extended warranty (not available for the school buses), as well as repairs for customer satisfaction (goodwill). The database contained warranty information on vehicles built from 29 October 1997 through 19 June 2002. The data was submitted in a Microsoft Excel spreadsheet that consisted of 11,077 records (rows) with 27 data fields (columns) per record. A list of data fields supplied is shown in Table A2.

4.0 WARRANTY DATA REVIEW AND ANALYSIS

4.1 Data Review for Relevance

The warranty data was copied and additional data fields were added. The first new data field was a unique identifier for each record. The second new field was used to indicate the relevance to this investigation. Each record was viewed and a "Yes" or "No" was entered for its relevance to brake drag, overheating, and wheel-end fires.

Relevant records included, but were not limited to, any record that indicated replacement of brake assembly components, missing or broken parts, loose or worn parts, failed or defective parts, frozen or locked brakes, and thermal events. Of the 11,077 records that were reviewed from the first submission, 6,611 (60%) were marked as possibly being relevant to the investigation. Records that were identified as "Not Relevant" included any record that indicated problems with the following: the ABS sensor, light, or wiring (without heat), rotor out-of-round, flaking, or rusting, and/or the vehicle parking brake system. In addition, identified as "Not Relevant" were records related to Recall Campaign No. 02V252000 on heavy duty trucks and buses, equipped with the TRW Model No. 410M Electronic Control Unit (ECU). That recall concerned substandard wheel-speed signals due to rotor corrosion and the inability of the ABS ECU to correctly interpret those signals in some situations.

4.2 Warranty Data Analysis Iterations

4.2.1 First Iteration

For the first iteration of the data analysis, the warranty data was imported into Microsoft Access. Access was used to generate 299 data queries. These queries looked at vehicle model and assembly plant. They also looked for "key words", as described in Table A3, such as fire, burn, smoke, bind, broken, crack, drag, etc to categorize the search results. The results of these queries were tabulated, as shown in Table A4. The yellow highlighted rows indicate records related to

"sticking" and "overheating" brakes. The red highlighted cells in those rows indicate the number of buses involved.

This data mining method proved to be too time consuming with its need to produce a query and a table of results for each combination of criteria when a simple count of the items meeting the criteria was desired. Since warranty data also includes model year, Gross Vehicle Weight Rating (GVWR) range, and front/rear brake codes, to search all the possible combinations would have required over 33,800 query tables be generated.

4.2.2 Second Iteration

A software program, shown in Appendix B, was written in Microsoft Visual Basic for Applications (VBA) to automate the data mining process. This program, which is resident in Microsoft Excel and includes a Graphical User Interface (GUI), as shown on the right side of Figure A2, is used to select various search criteria. The program has the ability to execute a single search or it can process an "Auto Run" of all possible combinations available in the GUI. It has the ability to output data into a tabular format, as shown in Table A5 (this output is from the third iteration search). To show the scope of this search, the entire table of results (for all nonzero queries) is shown in Table A6. This program makes it easier to modify search criteria to focus the search results. Only the most severe case for multiple keyword entrees from the spreadsheet column titled "Complaint Cause Correction" was counted. A revised "key word" search list was also created to better categorize the results. This new list included the entries in the separate categories of "**F**ire", "**B**urn", "**S**moke", "**D**rag", and then "**A**ll" (for all categories, designated as "**FBSD**"), as shown in Figure A3. All keyword hits for the word "**F**ire" were reviewed manually to insure they were referring to an actual fire (and not a firewall, etc).

4.2.3 Third Iteration

The third iteration of the analysis uses the same software interface as the second iteration. This iteration reviewed an updated warranty data set supplied by International Truck Corporation. This data set was also a Microsoft Excel spreadsheet that contained 23,190 records (rows) and 27 data fields (columns). This new file included the warranty information on vehicles built after 29 October 1997 and extended to 19 December 2002. The data file was copied and a unique identifier for each record was added. This expanded data file was compared to the first data file submitted, using a VBA program that compared the contents of both. There were approximately 100 records that appeared in the first data file, but were not in the in the second data file. The reason for this discrepancy is unknown. The new records were reviewed and "Yes" or "No" was entered for

relevance using the same criteria as in the first iteration. The number of unique relevant claims from the updated data sets was 12,125 records. A revised "key word" search list shown in Figure A4 was created to expand the classification of results. This list included the separate severity categories of "**F**ire", "**B**urn", "**S**moke", "**D**rag", "Slide **P**in", "**C**aliper Failure", and "**A**ll" (for **FBSDPC**). The VBA program was run with multiple combinations to generate tables with the number of occurrences or warranty claims in each of the **FSBDPC** categories. It was modified to generate **FSBDPC** tables for the Assembly Plants, Miles to Failure, and Time to Failure. These modifications were made to extract data from fields in the warranty data that were not implemented in the original program code from the second iteration. The combinations for this iteration were selected to generate data that would enable the following analytical methods to be applied:

1) Time to Failure (number and types of claims compared to time in-service before failure)
2) Miles to Failure (number and types of claims compared to miles at failure)
3) Month of Production Trend (number and types of claims compared to month of production)
4) Vehicle GVWR (number and types of claims compared to vehicle weight range)
5) Repair Location (number and types of claims compared to repair location)
6) Owner Location (number and types of claims compared to owner location)
7) Caliper Combinations (number and types of claims compared to caliper size and axle position)
8) Overall Claims Rate (number and types of claims compared to make/model production)

These methods are similar to those of a standard warranty data analysis, as discussed in the editorial ***"Business Applications for Warranty Data"***, by Shawn Herbig for Industrial Fasteners Institute 2002, as shown in Figures A5 and A6.

5.0 RESULTS OF THE THIRD ITERATION OF THE WARRANTY DATA ANALYSIS

A search of the 12,125 relevant warranty records, using the VBA program, found that 7,422 contained warranty claims with key words in the six **FBSDPC** categories. The number of claims in each category was 130 for "**F**ire", 279 for "**B**urn", 425 for "**S**moke", 5,526 for "**D**rag", 696 for "**P**in", and 366 for "**C**aliper". If the keyword search allowed a claim to be placed in multiple categories, it was placed only in the most severe category such as "**F**ire" (most severe) to "**C**aliper" (least severe).

5.1 Time to Failure

From the available data, a “Time to Failure” for each record that was relevant was calculated. This calculation was made by subtracting the numerical value of the “In-Service Date” field from the numerical value of the “Failure Date” field. The resulting number was expressed in days. Of the 12,125 relevant warranty records, 177 records did not list “In-Service Date” data entries, so time to failure could not be calculated.

In a frequency distribution of all relevant data with a bin width of 30 days (the width of a "bar" on a histogram is called the bin width), the maximum number of claims of 761 was found in the bin of days 331 through 360 (last month of the first year) as shown in the graph in Figure A7. In a similar frequency distribution of only the relevant records limited to the key words in the **FBSDPC** categories the maximum number of claims of 502 was found in the same thirty-day bin (last month of the first year) shown in the graph in Figure A8 and the overall trend was the same.

These frequency distributions show that, in the first 360-day period, of the subject vehicles in-service time, there is steady increase in the number of warranty repairs performed. At the end of this period, there is a noticeable decline in warranty repairs. This trend is consistent with the type of information expected to be found in any warranty database. The subject vehicles are covered by a 12-month standard warranty, shown on the manufacturer’s website in Figure A9, with an optional 24-month warranty (not available for school buses), as shown in Figure A10. Warranty data beyond 24-months are repairs covered by the manufacturer as customer satisfaction (goodwill). To illustrate this, a typical graphic representation of any warranty database of all vehicle repairs for any one-month of production is shown in Figure A11. The data collected meets the expected trend with the sharp cutoff after 12 months, the drop off of the goodwill, then the subset of extended warranty, and another drop off of the remaining goodwill claims.

5.2 Miles to Failure

A frequency distribution was also performed for the “Miles to Failure” data. This distribution was for a bin range of 0 to 250,000 miles and a bin width of 1,000 miles. Of the 12,125 relevant warranty records there were 16 records in which the “Miles to Failure” data was greater than 250,000 miles and were not accounted for in this distribution, as shown in Figure A12. In the distribution of all of the relevant data, the maximum number of warranty claims of 634 was found in the bin of 0 through 1,000 miles. There were 2,463 claims with less than 10,000 miles, 9,645 claims between 10,000 and 250,000 miles, and 16 claims over 250,000 miles. Since there was not a sudden increase at a specific point, the following distributions are truncated to 90,000 miles.

In a similar frequency distribution of the relevant records limited to the key words in the **FBSDPC** categories, the maximum number of warranty claims of 386 was in the bin of 0 through 1,000 and shown in Figure A13. There were 1,589 claims with less than 10,000 miles and 5,446 claims between 10,000 and 90,000 miles. There were 636 records in the distribution in which the "Miles to Failure" data was greater than 90,000 miles and they are not included in this figure.

A frequency distribution was also generated for the relevant records limited to the key words in the "**F**ire", "**B**urn", "**S**moke", and "**D**rag" categories were conducted. For these categories the maximum number of warranty claims was 338 in the first bin of 0 through 1,000 and shown in Figure A14. There were 1,403 claims with less than 10,000 miles and 4,670 claims between 10,000 and 90,000 miles. There were 287 records in this distribution in which the "Miles to Failure" data was greater than 90,000 miles.

A frequency distribution for the 130 claims in the "**F**ire" category was created. For this category, the maximum number of warranty claims was 32 in the fist bin of 0 through 1,000 miles, as shown in Figure A15. There were 72 claims with less than 10,000 miles and 55 claims between 10,000 and 90,000 miles. There were three records in this distribution in which the "Miles to Failure" data was greater than 90,000 miles. The average "Miles to Failure" was calculated for the "**F**ire" warranty data from 0 to 90,000 miles. This average was 29,081 miles to a "**F**ire" failure.

5.3 Month of Production Trend

A frequency distribution was calculated for the vehicle "Build Date" data. This distribution was for monthly bins from October 1997 through January 2003. The relevant claims and the **FBSDPC** claims in each bin were overlaid in order to show the proportion of the categorized claims to all relevant claims, as shown in Figure A16. The distribution of occurrences in the "**F**ire" category of warranty claims shows that they are found throughout production of the subject vehicles. The Model Year production numbers are shown across the top of the plot.

The warranty claim rates also were reviewed by model year of production. The production increased from 1998 through 2000, then started to decline, as shown in Figure A17. Meanwhile the warranty claim rate significantly increased in 2000 and then held relatively steady through 2002.

5.4 Vehicle GVWR

A frequency distribution was completed for the vehicle "GVWR Range" data. This distribution was for the bins with the manufacturer's GVWR class ranges of: Class 4 at 14,001 lb to 16,000 lb, Class 5 at 16,001 lb to 19,500 lb, Class 6 at 19,501 lb to 26,000 lb, and Class 7 at 26,001 lb to 33,000 lb. The maximum number of claims (9,226) was in the Class 6 range, where most of the production occurred. The **FBSDPC** and "**O**ther" (all other claims deemed relevant but non-**FBSDPC**) claims in each bin were overlaid in order to show the proportion of the categorized claims to all relevant claims, as shown in Figure A18. Most of the production was in the two heavier weight categories (Class 6 and Class 7), as shown in the production numbers at the bottom of each weight range. The "Other" category includes such complaints as squeal, seal, pull, crack, leak, and lining debond. These claims were then compared to the production numbers to determine the claim rates per 100,000 vehicles in Figure A19. The first two weight ranges (Class 4 and Class 5) contained only 2% of the total production.

5.5 Repair Location

The data from the repair location or "Dealer State" field was collated into the number of claims per state or other location for the relevant warranty claims. This number was entered on a map to check for regional trends for claims, as shown in Figure A20. This same collation was done for the **FBSDPC** claims, as shown in Figure A21, and for the "**F**ire" category, as shown in Figure A22. The states outlined in brown indicate the "rust-belt" states. The same approach was also used to show the states where the owners were located, but the location of the repair was deemed more pertinent and the owner information is not shown in this report.

5.6 Caliper Combinations

In review of the warranty data, it was found that there were three possible brake caliper size combinations on the subject vehicles[1]. They were first the 66-mm calipers on both front and rear axles, second 66-mm calipers on the front axle and 73-mm calipers on the rear axle, and third 73-mm calipers on both front and rear axles. A distribution of the relevant claims and the **FSBDPCO** data were generated for these three combinations, as shown in Figure A23. The production data

[1] The different size calipers use the same castings, but the dual pistons in the calipers come in two different sizes. The piston diameters can be 66-mm or 73-mm and therefore the calipers are referred to as 66-mm or 73-mm calipers.

for caliper combinations was not requested by ODI and therefore it was not possible to determine the claim rates per 100,000 vehicles.

5.7 Overall Claims Rate

The overall claims rate was determined from data extracted from the IR response to Question 1, previously stated in Figure A1, including the "International Warranty Data" and its subsequent update. Data was also used from the IR response to Question 5 ("By make, model, model year, Gross Vehicle Weight Rating (GVWR), and Gross Combined Weight Rating (GCWR), state the total number of subject vehicles sold"), including the "International Vehicle Production Data" and its subsequent update.

Based upon the 12,125 relevant claims for the 128,199 subject vehicles as shown in Table A3, the **FBSDPC** claims data were tallied into six categories. The total claims in these categories selected as pertaining to the Bosch ZOPS brake caliper problems, were 7,422. These six categories were listed as "**F**ire" (130), "**B**urn" (279), "**S**moke" (425), "**D**rag" (5,526), "**P**in" (696), and "**C**aliper" (366).

The **FBSDPC** claims data was combined with the production data to generate a rate per 100,000 vehicles for these six categories from the warranty data. The rate of the six **FBSDPC** categories for each vehicle model is shown in Table A7 for the model years of 1998 through 2003. This table also includes the number of vehicles produced by GVWR Range and the number of warranty claims for each model. The overall "**F**ire" rate is 101/100k, the "**B**urn" is 218/100k, "**S**moke" 332/100k, and "**D**rag" 4,310/100k.

By removing low production models and combining categories of the **FBSDPC** the data was reduced to create Table A8. Vehicle models with unit production of less than 200 for the period of 1998 through 2003 were removed. The categories were grouped for review by severity of "**F**ire-**B**urn-**S**moke", "**D**rag-**P**in-**C**aliper", and "**O**ther". The **FBS** rate was 651/100k, (another possible category **FBSD** had a rate of 4,947/100k), the "**D**rag-**P**in-**C**aliper" rate was 5,122/100k, and the "**O**ther" was 3,661/100k. These rates were very high, and this analysis led to a continuation of the Bosch ZOPS medium-truck brake project to determine the root cause of the thermal events.

6.0 Summary

Based upon the review of the International Truck Corporation warranty database, the following points are noted:

1) The Visual Basic for Applications (VBA), which comes bundled with Microsoft Excel, allowed for a thorough keyword search through an easy to use Graphical User Interface (GUI) dialog box. Searches could be conducted on specific portions (model, year, brake size, etc) of the database, or using the entire database to produce a tabulated output.

2) Keyword searches resulted in counts of incidents for categories of complaints for each model of vehicle produced by International Truck Corporation. Complaints were determined and plotted for the following categories: Time to Failure, Miles to Failure, Month of Production Trend, Vehicle GVWR, Repair Location, Owner Location, Caliper Combinations, and Overall Claims Rate.

3) The warranty data supplied by International Truck Corporation contained 23,190 brake related claims. Claims were removed when they pertained to the following categories: (1) ABS light (2) ABS sensors (without heat) (3) ABS wiring (without heat) (4) glazed brake linings (5) rotors out-of-round, flake, or rust (6) vehicle parking brake system or (7) claims related to Recall Campaign No. 02V252000. This left 12,125 relevant claims. The "**F**ire", "**B**urn", "**S**moke", "**D**rag", "**P**in Slide", "**C**aliper" (**FBSDPC**) claims data was tallied and found to contain 130 "**F**ire", 279 "**B**urn", 425 "**S**moke", 5,526 "**D**rag", 696 "**P**in slide", and 366 "**C**aliper" listings. The total claims in the categories selected as pertaining to the Bosch ZOPS brake caliper problems were 7,422.

4) The rate information was grouped for review by categories of severity of "**F**ire-**B**urn-**S**moke", "**F**ire-**B**urn-**S**moke-**D**rag", as well as "**D**rag-**P**in-**C**aliper". The **FBS** rate was 651/100k, the **FBSD** was 4,947/100k, and the **DPC** was 5,122/100k. These rates were very high, and this analysis led to a continuation of the Bosch ZOPS medium-truck brake project to determine the root cause of the thermal events.

Appendix A

Report Figures and Tables

List of Items in Order of Appearance in the Appendix A

Table A1 – List of Acronyms

Acronym	Meaning
ABS	Antilock Brake System
ECU	Electronic Control Unit
FBSD	Fire, Burn, Smoke, and Drag
FBSDPC	Fire, Burn, Smoke, Drag, Slide Pin, and Caliper Failure
FBSDPCO	Fire, Burn, Smoke, Drag, Slide Pin Problem, Caliper Failure, and Other
GUI	Graphical User Interface
GAWR	Gross Axle Weight Rating
GCWR	Gross Combined Weight Rating
GVW	Gross Vehicle Weight
GVWR	Gross Vehicle Weight Rating
IR	Information Request
NHTSA	The National Highway Traffic Safety Administration
NSA	NHTSA Safety Assurance
NVS	NHTSA Vehicle Safety
ODI	The Office of Defects Investigation
PE	Preliminary Evaluation
RV	Recreational Vehicles
TRW	Thompson-Ramo-Wooldridge
VBA	Visual Basic for Applications
VIN	Vehicle Identification Number
VRTC	The Vehicle Research and Test Center
ZOPS	Zero-Offset Pin Slide *

Note * The "ZOPS" acronym is the trade name of the Bosch medium-duty hydraulic truck brake caliper. The "zero-offset" refers to the design geometry that applies the force vector at the center of brake pad for minimum lining wear. The "pin slide" refers to the caliper design that extends pistons toward the brake rotor on only one side with the caliper housing sliding on two pins to allow a reactionary force to complete the clamping of the brake rotor.

Question 1) Furnish the following information in Excel spreadsheet format. Each report should include the following information for each complaint:

1. Vehicle Model
2. VIN
3. Year of Manufacture
4. Identify which brake system was installed
5. In-Service Date (Year/Month/Day format)
6. Repair Date for "Alleged Defect"
7. Description from Complaint or Warranty Claim
8. Mileage at Occurrence of Complaint
9. Front axle manufacturer and Gross Axle Weight Rating (GAWR)
10. Disposition/resolution
11. Owner name, address and telephone number
12. Repairing dealer's name, address and telephone number

The requested information should include reports from all sources of which International is aware, and which relate, or could relate, to the "alleged defect" in the subject vehicles including,

1. owner/fleet complaints (fleet complaints should indicate qty. of vehicles affected in fleet, not number of fleets reporting an issue) & warranty claims;
2. warranty claims/goodwill;
3. field reports;
4. fires/crash/incident claims;
5. subrogation claims;
6. lawsuits; and
7. third-party arbitration proceedings (where International is a party to the arbitration).

Also provide the total number of vehicle models manufactured by year for each vehicle model listed above.

Figure A1 – Question No. 1 from the International Truck Corporation Information Request NSA-14sjm / PE02-046f

Table A2 – List of Fields from Warranty Data

Field Location (Column)	Field Name
A	VIN
B	Build Year
C	Built Date
D	In Service Date
E	Customer Name
F	Customer Address
G	Customer City
H	Cust State
I	Cust Zip
J	Model Desc
K	Dealer Account
L	Dealer Name
M	Dealer Address
N	Dealer City
O	Dealer State
P	Dealer Zip
Q	VIN
R	GVWR
S	Warranty Claim
T	Complaint Cause Correction
U	Failure Date
V	Failed Mileage
W	Front Brake
X	Rear Brake
Y	Front Axle
Z	Rear Axle
AA	Dealer Phone

Table A3 - Keywords for First Iteration Search

Key Word Search of Relevant Entries
bind, drag, froze, hang, hung, lock, seiz, stick, stuck, OR "not releas"
grind, scrap, squeal, squeel, squeak, squeek, OR nois
seal
pull
heat, hot, odor, OR smell
crack
brok AND bolt
leak
metal (as in metal-to-metal)
uneven OR (prematur AND (wear OR worn))
shake, vibration, pulsat, OR shudder
smok
burn OR fire
separat, seperat, "lining cam off", debond, bebond, OR "pads came apart"
bolts AND (missing OR loos)
"no brakes" OR "not stop"
abs
sensor AND (melt OR burnt)
master cyl
lining AND (missing OR loos)
parking

Table A4 - Results of First Iteration of Microsoft Access Analysis of International Warranty Data

INTERNATIONAL WARRANTY DATA							
	Total Number	Percent of Relevant Entries	Number of Buses	Percent Buses	Number Built In Ohio	Number Built In Arkansas	Number Built In Oklahoma
NUMBER OF RECORDS	11077						
RELEVANT WARRANTY CLAIMS	6611	100%	1488	23%	6081	491	39
Key Word Search of Relevant Entries							
bind, drag, froze, hang, hung, lock, seiz, stick, stuck, OR "not releas"	2525	38%	480	19%	2344	173	8
grind, scrap, squeal, squeel, squeak, squeek, OR nois	1273	19%	170	13%	1154	110	9
seal	903	14%	122	14%	834	61	8
pull	861	13%	89	10%	813	42	6
heat, hot, odor, OR smell	490	7%	145	30%	453	35	2
crack	448	7%	57	13%	436	11	1
brok AND bolt	406	6%	41	10%	392	13	1
leak	419	6%	62	15%	391	27	1
metal (only seen in reference to metal-to-metal)	324	5%	23	7%	292	30	2
uneven OR (prematur AND (wear OR worn))	289	4%	59	20%	250	26	13
smok	261	4%	82	31%	261	0	0
shake, vibration, pulsat, OR shudder	192	3%	31	16%	185	6	1
separat, seperat, "lining came off", debond, OR "pads came apart"	179	3%	85	47%	128	49	2
burn	164	2%	49	30%	150	14	0
bolts AND (missing OR loos)	140	2%	31	22%	131	9	0
fire	69	1%	15	22%	68	1	0
"no brakes" OR "not stop"	59	1%	5	8%	55	3	1
abs	47	1%	18	38%	43	4	0
sensor AND (melt OR burn)	34	1%	20	59%	25	9	0
master cyl	28	0%	9	32%	26	1	1
lining AND (missing OR loos)	10	0%	1	10%	8	2	0

Notes:
Irrelevant entries total approximately 40% and consist of: ABS sensor/light/wiring (without heat), glazed pads, rotor out-of-round/flake/rust, or parking brake problems.
Vehicles listed in the column of "buses" have a model code of: BB, BE, BG, BJ, BK, BM, BR, and BS.
Totals in columns may exceed 100% because some records have multiple entries.

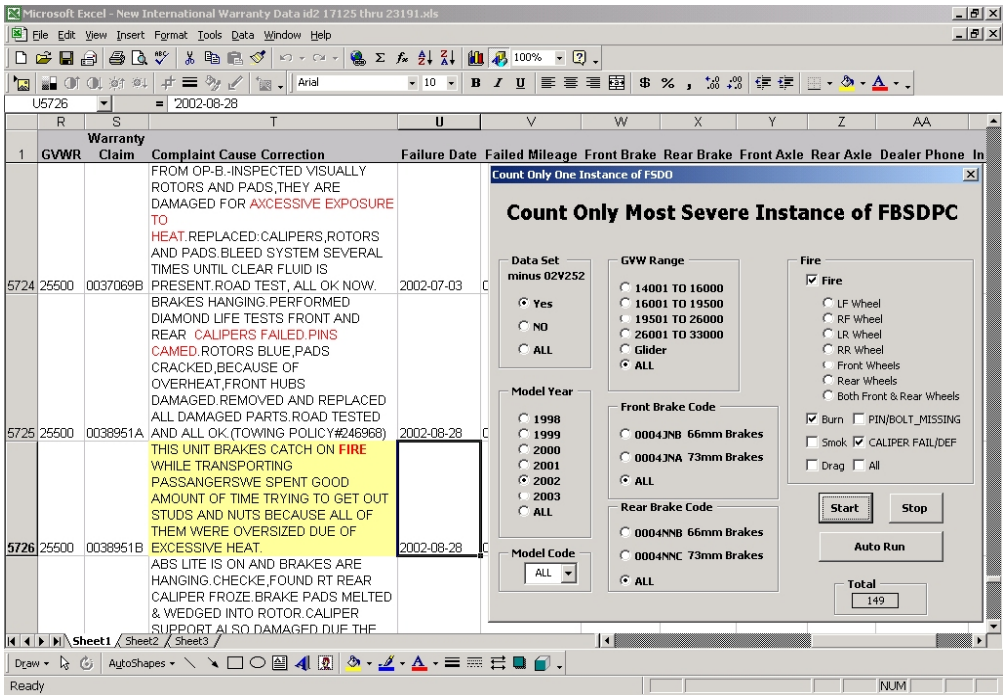

Figure A2 – The Graphical User Interface (on the Right) used for the Second and Third Iteration Searches Using Microsoft Visual Basic for Applications

In the background is shown the International Warranty Database records as provided in Microsoft Excel

Table A5 - Sample Output Table from Microsoft Visual Basic for Applications Program Used For Data Mining

Vehicle Model Designation	Body Code per VIN cositions 4 and 5	GVW Range per VIN Position 8	Front Brake Size	Rear Brake Size	No. of Claims 'Fire'	No. of Claims 'Burn'	No. of Claims 'Smok'	No. of Claims 'Drag'	Total No. of Claims
1998	BB	19501 TO 26000	0004JNB	0004NNB	-	-	-	1	1
1998	BB	19501 TO 26000	0004JNB	0004NNC	-	-	2	5	7
1998	BB	26001 TO 33000	0004JNA	0004NNC	1	-	4	26	31
1998	BD	16001 TO 19500	0004JNB	0004NNB	-	-	1	-	1
1998	BE	19501 TO 26000	0004JNB	0004NNB	-	-	2	1	3
1998	BJ	26001 TO 33000	0004JNA	0004NNC	-	-	-	7	7
1998	SC	19501 TO 26000	0004JNB	0004NNC	1	-	-	3	4
1999	BB	16001 TO 19500	0004JNB	0004NNB	2	-	-	1	3
1999	BB	19501 TO 26000	0004JNB	0004NNB	-	1	1	9	11
1999	BB	19501 TO 26000	0004JNB	0004NNC	-	-	2	13	15
1999	BB	26001 TO 33000	0004JNA	0004NNC	2	4	16	118	140
1999	BE	19501 TO 26000	0004JNB	0004NNB	-	-	1	2	3
1999	BG	26001 TO 33000	0004JNA	0004NNC	-	-	-	1	1
1999	BJ	26001 TO 33000	0004JNA	0004NNC	-	2	7	12	21
1999	BM	26001 TO 33000	0004JNA	0004NNC	-	-	-	1	1
1999	MG	19501 TO 26000	0004JNB	0004NNB	-	1	-	3	4
1999	MG	19501 TO 26000	0004JNB	0004NNC	-	-	-	1	1
1999	MG	26001 TO 33000	0004JNA	0004NNC	-	1	-	-	1
1999	SC	16001 TO 19500	0004JNB	0004NNB	-	1	-	3	4
1999	SC	19501 TO 26000	0004JNB	0004NNB	-	1	3	67	71
1999	SC	19501 TO 26000	0004JNB	0004NNC	6	16	18	162	202
1999	SC	19501 TO 26000	0004JNA	0004NNC	-	-	2	2	4
1999	SC	26001 TO 33000	0004JNA	0004NNC	1	6	4	19	30
1999	SD	19501 TO 26000	0004JNB	0004NNC	-	-	1	5	6
1999	SD	26001 TO 33000	0004JNA	0004NNC	1	1	1	3	6
1999	SL	16001 TO 19500	0004JNB	0004NNB	-	-	-	1	1
1999	SL	19501 TO 26000	0004JNB	0004NNB	-	2	1	8	11
1999	SL	19501 TO 26000	0004JNB	0004NNC	1	-	1	18	20
1999	SM	19501 TO 26000	0004JNB	0004NNB	-	-	-	2	2

Table A6 – The Data Sort Output Table from the Second Iteration Search Using Microsoft Visual Basic for Applications

Showing the Extent of the Results for all Nonzero Queries

Vhecile Model Designation	Body Code per VIN positions 4 and 5	GVW Range per VIN Position 8	Front Brake Size	Rear Brake Size	No. of Claims 'Fire'	No. of Claims 'Burn'	No. of Claims 'Smok'	No. of Claims 'Drag'	No. of Claims 'Pin'	No. of Claims 'Clpr'	Total No. of Claims	No. of Units Produced	Rate per 100,000 for 'Fire'	Rate per 100,000 for 'Burn'	Rate per 100,000 for 'Smok'	Rate per 100,000 for 'Drag'	Rate per 100,000 for 'Pin'	Rate per 100,000 for 'Clpr'
1998	BB	16001 TO 19500	66mm	66mm	-	-	-	1	1	-	2	38	0	0	0	2,632	2,632	0
1998	BB	19501 TO 26000	66mm	66mm	-	-	-	1	-	-	1	1272	0	0	157	550	0	0
1998	BB	19501 TO 26000	66mm	73mm	-	-	-	6	-	-	6							
1998	BB	26001 TO 33000	73mm	73mm	1	1	7	27	7	2	45	4083	24	24	171	661	171	49
1998	BD	16001 TO 19500	66mm	66mm	-	-	1	-	-	-	1	99	0	0	1,010	0	0	0
1998	BE	19501 TO 26000	66mm	66mm	-	-	2	4	-	-	6	244	0	0	820	1,639	0	0
1998	BJ	26001 TO 33000	73mm	73mm	-	-	-	7	5	-	12	490	0	0	0	1,429	1,020	0
1998	SC	19501 TO 26000	66mm	73mm	1	-	-	3	2	-	6	325	308	0	0	923	615	0
1998	SC	26001 TO 33000	73mm	73mm	-	-	-	-	1	-	1	28	0	0	0	0	3,571	0
1999	BB	16001 TO 19500	66mm	66mm	2	-	-	1	-	-	3	27	7,407	0	0	3,704	0	0
1999	BB	19501 TO 26000	66mm	66mm	-	1	1	25	1	1	29	1852	0	108	270	2,592	162	54
1999	BB	19501 TO 26000	66mm	73mm	-	1	4	23	2	-	30							
1999	BB	26001 TO 33000	73mm	73mm	3	4	19	204	13	25	268	6678	45	60	285	3,055	195	374
1999	BE	16001 TO 19500	66mm	66mm	-	-	-	-	-	1	1	121	0	0	0	0	0	826
1999	BE	19501 TO 26000	66mm	66mm	-	-	1	8	1	1	11	451	0	0	222	1,774	222	222
1999	BG	26001 TO 33000	73mm	73mm	-	-	-	1	-	-	1	203	0	0	0	493	0	0
1999	BJ	26001 TO 33000	73mm	73mm	-	2	6	15	4	-	27	742	0	0	270	809	2,022	539
1999	BM	26001 TO 33000	73mm	73mm	-	1	-	3	-	-	4	37	0	2,703	0	8,108	0	0
1999	MG	19501 TO 26000	66mm	66mm	-	1	-	5	-	-	6	254	0	394	0	2,362	0	0
1999	MG	19501 TO 26000	66mm	73mm	-	-	-	1	-	-	1							
1999	MG	26001 TO 33000	73mm	73mm	-	1	-	-	-	-	1	20	0	5,000	0	0	0	0
1999	SC	16001 TO 19500	66mm	66mm	-	1	-	3	-	1	5	187	0	535	0	1,604	0	535
1999	SC	19501 TO 26000	66mm	66mm	-	2	5	104	1	9	121							
1999	SC	19501 TO 26000	66mm	73mm	8	18	23	227	75	16	367	14894	54	134	201	2,249	510	168
1999	SC	19501 TO 26000	73mm	73mm	-	-	2	4	-	-	6							
1999	SC	26001 TO 33000	73mm	73mm	3	7	6	26	5	2	51	1922	156	364	312	1,457	260	104
1999	SD	19501 TO 26000	73mm	73mm	-	-	1	6	13	6	26	440	0	0	227	1,364	2,955	1,591
1999	SD	19501 TO 26000	73mm	73mm	-	-	-	-	-	1	1							
1999	SD	26001 TO 33000	73mm	73mm	1	1	1	5	1	-	9	363	275	275	275	1,377	275	0
1999	SL	16001 TO 19500	66mm	66mm	-	-	-	3	-	-	3	79	0	0	0	3,797	0	0
1999	SL	19501 TO 26000	66mm	66mm	-	4	1	14	1	-	20	1577	63	254	190	3,044	380	127
1999	SL	19501 TO 26000	66mm	73mm	1	-	2	34	5	2	44							
1999	SM	16001 TO 19500	66mm	66mm	-	-	-	-	-	1	1	57	0	0	0	0	0	1,754
1999	SM	19501 TO 26000	66mm	66mm	-	-	-	2	-	1	3	384	0	0	0	521	0	260
2000	BB	16001 TO 19500	66mm	66mm	-	-	-	2	-	-	2	23	0	0	0	8,696	0	0
2000	BB	19501 TO 26000	66mm	66mm	-	1	1	30	-	-	32	1587	63	189	630	5,419	63	63
2000	BB	19501 TO 26000	66mm	73mm	1	2	9	56	1	1	70							
2000	BB	26001 TO 33000	73mm	73mm	15	39	60	386	21	12	533	6194	242	630	969	6,232	339	194
2000	BE	19501 TO 26000	66mm	66mm	1	3	4	13	-	-	21	558	179	538	717	2,330	0	0
2000	BG	26001 TO 33000	73mm	73mm	-	-	-	1	1	-	2	130	0	0	0	769	769	0
2000	BJ	26001 TO 33000	73mm	73mm	-	6	-	25	7	1	39	686	0	872	0	3,634	1,017	145
2000	BM	26001 TO 33000	73mm	73mm	-	-	-	-	-	1	1	15	0	0	0	0	0	6,667
2000	MG	16001 TO 19500	66mm	66mm	-	-	-	-	1	-	1	82	0	0	0	0	1,220	0
2000	MG	19501 TO 26000	66mm	66mm	-	2	2	24	2	1	31	585	0	342	342	4,103	342	171
2000	SC	14001 TO 16000	66mm	66mm	-	-	-	1	-	-	1	6	0	0	0	16,667	0	0
2000	SC	16001 TO 19500	66mm	66mm	-	2	2	17	1	1	23	227	0	881	881	7,489	441	441
2000	SC	19501 TO 26000	66mm	66mm	1	15	26	365	7	24	438							
2000	SC	19501 TO 26000	66mm	73mm	29	40	61	717	116	72	1,035	17736	175	333	507	6,186	727	541
2000	SC	19501 TO 26000	73mm	73mm	1	4	3	15	6	-	29							
2000	SC	26001 TO 33000	73mm	73mm	1	-	1	3	-	-	5	2595	77	231	231	3,545	1,040	193
2000	SC	26001 TO 33000	73mm	73mm	1	6	5	89	27	6	133							
2000	SD	19501 TO 26000	66mm	73mm	-	-	2	20	43	31	96	1349	0	0	148	1,483	3,188	2,298
2000	SD	26001 TO 33000	73mm	73mm	-	1	1	7	4	-	13	301	0	332	332	2,326	1,329	0
2000	SL	16001 TO 19500	66mm	66mm	-	-	1	8	-	-	9	63	0	0	1,587	12,698	0	0
2000	SL	19501 TO 26000	66mm	66mm	4	5	3	51	-	6	69	1478	812	1,015	1,286	9,405	135	1,150
2000	SL	19501 TO 26000	66mm	73mm	8	10	16	88	2	11	135							
2000	SL	26001 TO 33000	66mm	73mm	-	-	-	1	-	-	1	8	0	0	0	25,000	0	0
2000	SL	26001 TO 33000	73mm	73mm	-	-	-	1	-	-	1							
2000	SM	16001 TO 19500	66mm	66mm	-	-	-	3	-	-	3	75	0	0	0	4,000	0	0
2000	SM	19501 TO 26000	66mm	66mm	-	2	-	14	-	-	16	540	0	370	0	2,593	0	0
2001	BB	19501 TO 26000	66mm	66mm	-	-	-	11	-	-	11							
2001	BB	19501 TO 26000	66mm	73mm	-	1	1	20	1	-	23	973	103	103	103	3,392	103	0
2001	BB	19501 TO 26000	73mm	73mm	1	-	-	2	-	-	3							
2001	BB	26001 TO 33000	66mm	73mm	-	-	-	5	-	-	5	3162	32	95	127	2,372	190	63
2001	BB	26001 TO 33000	73mm	73mm	1	3	4	70	6	2	86							
2001	BE	19501 TO 26000	66mm	66mm	-	1	-	14	-	-	15	504	0	198	0	2,778	0	0
2001	BG	26001 TO 33000	73mm	73mm	-	-	-	1	-	-	1	121	0	0	0	826	0	0
2001	BJ	26001 TO 33000	73mm	73mm	-	-	-	1	3	-	4	232	0	0	0	431	1,293	0
2001	BR	16001 TO 19500	66mm	66mm	-	-	-	5	-	-	5	33	0	0	0	15,152	0	0
2001	BR	19501 TO 26000	66mm	66mm	-	-	-	1	-	-	1							
2001	BR	19501 TO 26000	66mm	73mm	-	-	1	8	-	-	9	320	0	0	313	2,813	0	0
2001	BR	26001 TO 33000	73mm	73mm	1	-	1	24	5	-	31	1296	77	0	77	1,049	386	0
2001	MG	16001 TO 19500	66mm	66mm	-	-	-	10	-	1	11	112	0	0	0	8,929	0	893
2001	MG	19501 TO 26000	66mm	66mm	-	5	-	152	5	6	168	1176	0	425	0	12,926	425	510
2001	MG	26001 TO 33000	73mm	73mm	-	1	-	-	-	-	1	6	0	16,667	0	0	0	0
2001	MH	19501 TO 26000	66mm	66mm	-	-	-	2	4	-	6	1380	0	0	0	145	290	0
2001	SC	16001 TO 19500	66mm	66mm	-	-	2	13	-	2	17	208	0	0	962	6,250	0	962
2001	SC	19501 TO 26000	66mm	66mm	-	6	6	161	3	8	184							
2001	SC	19501 TO 26000	66mm	73mm	21	28	45	574	111	34	813	14174	148	240	381	5,277	864	296
2001	SC	19501 TO 26000	73mm	73mm	-	-	3	13	7	-	23							
2001	SC	26001 TO 33000	66mm	73mm	1	-	-	1	-	1	3	1878	266	532	266	2,822	586	160
2001	SC	26001 TO 33000	73mm	73mm	4	10	5	52	11	2	84							
2001	SD	19501 TO 26000	66mm	73mm	-	1	1	3	22	13	39	602	0	0	166	498	3,654	2,159
2001	SD	26001 TO 33000	73mm	73mm	-	1	-	8	5	-	14	377	0	265	0	2,122	1,326	0
2001	SL	14001 TO 16000	66mm	66mm	-	-	-	1	-	-	1	1	0	0	0	100,000	0	0
2001	SL	16001 TO 19500	66mm	66mm	-	-	-	3	-	-	3	51	0	0	0	5,882	0	0
2001	SL	19501 TO 26000	66mm	66mm	-	1	1	30	2	1	35							
2001	SL	19501 TO 26000	66mm	73mm	4	2	1	40	5	4	56	1218	328	246	164	5,747	575	411
2001	SM	16001 TO 19500	66mm	66mm	-	-	2	22	1	-	25	316	0	0	633	6,962	316	0
2001	SM	19501 TO 26000	66mm	66mm	-	-	-	7	1	-	8	261	0	0	0	2,491	766	0
2002	BB	19501 TO 26000	66mm	66mm	-	-	-	5	-	-	5							
2002	BB	19501 TO 26000	66mm	73mm	-	-	1	6	1	-	8	474	0	0	211	2,321	211	0
2002	EB	26001 TO 33000	66mm	73mm	-	-	-	1	-	-	1							
2002	BE	26001 TO 33000	73mm	73mm	-	-	3	36	2	4	45	1411	0	0	213	2,622	142	283
2002	BE	16001 TO 19500	66mm	66mm	-	-	-	-	1	-	1	28	0	0	0	0	3,571	0
2002	BE	19501 TO 26000	66mm	66mm	-	-	-	7	-	-	7	293	0	0	0	2,389	0	0
2002	BJ	26001 TO 33000	73mm	73mm	-	-	-	2	-	-	2	96	0	0	0	2,083	0	0
2002	BR	16001 TO 19500	66mm	66mm	-	-	-	2	-	-	2	15	0	0	0	13,333	0	0
2002	BR	19501 TO 26000	66mm	66mm	-	-	-	10	-	-	10							
2002	BR	19501 TO 26000	66mm	73mm	1	-	-	15	1	-	17	666	150	0	0	3,910	150	0
2002	BR	19501 TO 26000	73mm	73mm	-	-	-	1	-	-	1							
2002	BR	26001 TO 33000	73mm	73mm	-	-	2	25	9	-	36	3016	0	0	66	829	298	0
2002	MG	16001 TO 19500	66mm	66mm	-	-	-	5	-	1	6	56	0	0	0	8,929	0	1,786
2002	MG	19501 TO 26000	66mm	66mm	-	-	-	37	2	3	42	413	0	0	0	8,959	484	726
2002	MG	26001 TO 33000	73mm	73mm	-	-	-	-	1	-	1	18	0	0	0	0	5,556	0
2002	MH	19501 TO 26000	66mm	66mm	-	1	-	4	1	-	6	953	0	105	0	420	105	0
2002	MJ	14001 TO 16000	66mm	66mm	-	-	2	21	-	-	23	156	0	0	1,290	13,548	0	0
2002	MK	19501 TO 26000	66mm	73mm	1	-	1	5	1	-	8							
2002	MP	19501 TO 26000	66mm	66mm	-	-	-	1	-	-	1	148	676	0	676	4,730	676	0
2002	MP	19501 TO 26000	66mm	73mm	-	-	-	1	-	-	1							
2002	MK	26001 TO 33000	73mm	73mm	-	-	-	15	-	1	16							
2002	MR	19501 TO 26000	66mm	66mm	-	-	-	1	-	-	1	121	0	0	826	14,050	826	826
2002	MR	19501 TO 26000	66mm	73mm	-	-	1	1	1	-	3							
2002	MM	16001 TO 19500	66mm	66mm	-	-	-	3	-	-	3	65	0	1,538	0	10,769	0	0
2002	MN	16001 TO 19500	66mm	66mm	-	1	-	4	-	-	6							
2002	MM	19501 TO 26000	66mm	66mm	-	-	1	6	1	-	8							
2002	MM	19501 TO 26000	66mm	73mm	4	20	42	872	38	27	1,003	9073	77	29,811	158	617,157	7	470,215
2002	MM	19501 TO 26000	73mm	73mm	1	-	-	16	2	3	22							
2002	MN	19501 TO 26000	66mm	66mm	2	-	2	21	-	1	26							
2002	MN	19501 TO 26000	66mm	73mm	-	3	2	58	1	1	65							
2002	MM	26001 TO 33000	73mm	73mm	1	2	2	77	6	3	91							
2002	MN	26001 TO 33000	66mm	73mm	-	-	-	1	-	-	1	852	117	235	235	9,155	704	352
2002	SC	16001 TO 19500	66mm	66mm	-	-	-	5	-	-	5	63	0	0	0	7,937	0	0
2002	SC	19501 TO 26000	66mm	66mm	-	1	1	27	-	2	31							
2002	SC	19501 TO 26000	66mm	73mm	1	2	6	70	13	4	96	2709	37	148	258	3,765	480	221
2002	SC	19501 TO 26000	73mm	73mm	-	1	-	5	-	-	6							
2002	SC	26001 TO 33000	73mm	73mm	2	-	-	5	1	-	8	364	549	0	0	1,374	275	0
2002	SD	19501 TO 26000	73mm	73mm	-	-	-	-	1	-	1	13	0	0	0	0	7,692	0
2002	SD	26001 TO 33000	73mm	73mm	-	-	-	2	1	-	3	40	0	0	0	5,000	2,500	0
2002	SL	16001 TO 19500	66mm	66mm	-	-	-	2	-	-	2	23	0	0	0	8,696	0	0
2002	SL	19501 TO 26000	66mm	66mm	2	-	-	44	-	-	46	352	568	0	0	13,352	0	0
2002	SL	19501 TO 26000	66mm	73mm	-	-	-	3	-	-	3							
2002	SM	19501 TO 26000	66mm	66mm	-	1	-	27	-	3	31	308	0	325	0	8,766	0	974
2003	BB	19501 TO 26000	66mm	66mm	-	-	-	1	-	-	1							
2003	BB	19501 TO 26000	66mm	73mm	-	-	-	8	-	-	8							
2003	BB	26001 TO 33000	73mm	73mm	-	-	-	1	2	-	3							
2003	BG	26001 TO 33000	73mm	73mm	-	1	-	-	1	-	2	32	0	3,125	0	0	3,125	0
2003	BR	19501 TO 26000	66mm	66mm	-	-	-	1	-	-	1	251	0	0	0	398	2,390	0
2003	BR	19501 TO 26000	66mm	73mm	-	-	-	-	6	-	6							
2003	BR	26001 TO 33000	73mm	73mm	-	-	-	1	23	-	24	270	0	0	0	370	8,519	0
2003	BT	19501 TO 26000	66mm	66mm	-	-	-	1	-	-	1	19	0	0	0	5,263	0	0
2003	MG	16001 TO 19500	66mm	66mm	-	-	-	1	-	-	1	17	0	0	0	5,882	0	0
2003	MG	19501 TO 26000	66mm	66mm	-	-	-	12	1	-	13	518	0	0	0	2,326	194	0
2003	MK	26001 TO 33000	73mm	73mm	-	-	-	1	-	-	1	42	0	0	0	2,381	0	0
2003	ML	16001 TO 19500	66mm	66mm	-	-	-	1	-	-	1	32	0	0	0	3,125	0	0
2003	MP	19501 TO 26000	66mm	66mm	-	-	-	2	-	-	2							
2003	MP	19501 TO 26000	66mm	73mm	-	-	-	8	1	1	10	748	0	0	0	1,471	134	267
2003	ML	19501 TO 26000	66mm	66mm	-	-	-	1	-	1	2							
2003	MM	19501 TO 26000	66mm	73mm	-	2	4	58	5	1	70							
2003	MM	19501 TO 26000	73mm	73mm	-	-	-	10	-	-	10	2710	0	74	148	2,546	221	74
2003	MN	19501 TO 26000	66mm	66mm	-	-	-	1	1	1	3							
2003	MM	26001 TO 33000	73mm	73mm	-	2	-	1	1	-	3	272	0	735	0	0	368	0
				Totals	130	279	424	5,512	695	366	7,406							

New Keywords for Second Iteration Database Search

FIRE CATEGORY

"fire"

"flame"

BURN CATEGORY

"burn"

(but not the word "burnish")

SMOK CATEGORY

"smok"

"smk"

DRAG CATEGORY

"drag"	"hung"	"stuck"	"lock"
"bind"	"seiz"	"bound"	"glow"
"froz"	"siez"	"hot"	"not_slid"
"hang"	"stick"	"heat"	"not_releas"

Figure A3 – Keyword List for the Second Iteration Search

New Keywords for Third Iteration Database Search

FIRE CATEGORY

"fire"

"flame"

BURN CATEGORY

"burn"

(but not the word "burnish")

SMOK CATEGORY

"smok"

"smk"

DRAG CATEGORY

"drag"	"hung"	"stuck"	"lock"	
"bind"	"seiz"	"bound"	"glow"	
"froz"	"siez"	"hot"	"not_slid"	
"hang"	"stick"	"heat"	"not_releas"	

SLIDE PIN CATEGORY

"torq"	"missing_bolt"	"bolt_loos"	"bolt_brok"	"bolts_gone"
"mtg_bolt"	"missing_caliper"	"bolts_loos"	"bolts_brok"	"caliper_loos"
"bolt_fell"	"bolt_missing"	"pin_loos"	"caliper_fell"	
"bolts_fell	"bolts_missing"	"pins_loos"	"caliper_fall"	

CALIPER FAILURE CATEGORY

"caliper_def"	"caliper_bad"	"clpr_fail"
"defective_caliper"	"bad_caliper"`	"clpr_def"
"caliper_fail"	"clpr_bad"	

Figure A4 – Keyword List for the Third Iteration Search

EDITORIAL

Business Applications for Warranty Data

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Many engineers cringe at the mere mention of warranty. Typically there has been little exposure to warranty information and almost no formal training in the proper use of the data. Many suppliers have come to embrace the statement, *"I don't have a warranty problem unless the OEM tells me I have a warranty problem"*. This attitude is understandable since most companies don't use warranty data unless a special cause warranty problem arises with one of their parts.

Even if your company does get involved with a warranty issue, you are frequently only given a printed list of claims and told to read them. If you have ever gone through this process you are familiar with how it works. An engineer sits down with a stack of claims and a pack of highlighter markers. The logic goes something like this: pink is for claims with a broken bolt, green is a mis-binned claim, yellow is a faulty part that isn't ours and blue is unknown. The engineer spends several days going through the claims and after all of the claims are reviewed the colors are counted. This reading and marking process is highly labor intensive not to mention that it is prone to errors.

After going through this, why would anyone want to embrace warranty data? Well, there are several business reasons for using warranty information including increased sales, problem identification, issue verification and continuous product improvement. The challenge is to understand how to use the information efficiently and effectively.

There are generally two types of information available from the warranty system.

The first type of information is statistical in nature and includes repair counts, repair costs and number of vehicles. These items are combined to provide repair rates and repair cost rates. This information is used for many types of comparison (i.e., plant to plant, month to month, vehicle to vehicle, part to part, etc.). This information is very powerful because it neutralizes the effect of different population sizes and allows a comparison between individual groups.

The second type of information is comment-based. This information comes from the warranty claim turned in by the dealer and can include comments made by the customer and comments made by the technician. This information is used to help identify specific characteristics within a group of repairs.

Considering the large number of claims for a given issue, the only effective method for manipulating the data is to use a computer program. Generally speaking, all of the warranty systems have some ability to export their data to a computer file. These files, called "flat" files, are easily imported into a spreadsheet, database or statistical program. Even comment-based information can and should be imported into a computer program for analysis.

Once the information is in spreadsheet or database there are several ways that it can be analyzed.

continued on page 4

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Figure A5 – Analytical Methods for Warranty Data – (Page 1 of 2)

Warranty Data continued from page 3

1. **Time to Failure Analysis** groups all repairs by the age of the vehicle (typically measured in months) at time of the repair. This is used to isolate infant mortality from latent repairs.
2. **Mileage to Failure Analysis** groups all repairs by the mileage at which the repair occurred. This is useful for determining if a repair is weather/exposure related.
3. **Repair Trend Analysis** looks at the number of repairs by month of vehicle production. This is a great tool for evaluating lot-to-lot quality differences. This is also useful if another company previously produced a part you are now supplying. The trend line will directly compare your parts to theirs. This is also a valuable tool for resolution verification.
4. **Dealer Analysis** provides a breakdown of repairs by the dealer who performed the repair. This is useful if you suspect a single dealer or if you believe all repairs are related to a specific area of the country (i.e., coastal areas).
5. **Geographic Analysis** groups all repairs by the state in which they occurred. This can be presented graphically with different repair intensities represented by different colors for each state.
6. **Part Number Analysis** can be used to identify which parts in the system are having trouble. This can also be useful for comparing your part quality to that of your competitors (when competitive information is available).
7. **Claims Analysis** is very useful looking for specific attributes within a group of repairs. The data-filtering tool available in any spreadsheet or database can be used to drill down to a specific issue so that only those claims need to be read.

The bottom line is that once the information is put into a useable format, it is much easier to use warranty data to effectively analyze a problem. So throw away the markers and start solving problems.

HUMAN RESOURCES

The Skills Gap - A skilled and productive workforce is critical for maintaining U.S. global competitiveness in manufacturing. A recent survey by the National Association of Manufacturers asked 6,000 companies to discuss their general labor situation, recruitment and retention practices, the effects of labor and skills shortages on company operations, their own employee training and education programs, and their views concerning public training and education systems.

Survey respondents represented more than 20 different industries. Results indicate that substantial progress has been made in closing the technology skills gap in some industries. However, more than two-thirds of the firms surveyed said their most serious workforce shortages are in production areas ranging from entry level workers, to operators, machinists and craft workers, including technicians and engineers.

Despite the recession, there are still good production jobs out there looking for workers with the right skills. The survey also showed that some 60 percent of manufacturers are even now having difficulty maintaining production levels necessary to meet demand, and 40 percent say they cannot implement new productivity improvements.

The major areas of concern have shifted from the technology skills back to the fundamental manufacturing, with basic employability attributes cited as the number one deficiency for both current hourly workers and applicants for hourly positions. Poor reading, writing, math and communication skills were also significant concerns. Productivity depends on a skilled workforce, and a highly skilled workforce is exactly what manufacturers say they simply can't find.

continued on page 5

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Figure A6 – Analytical Methods for Warranty Data (Page 2 of 2)

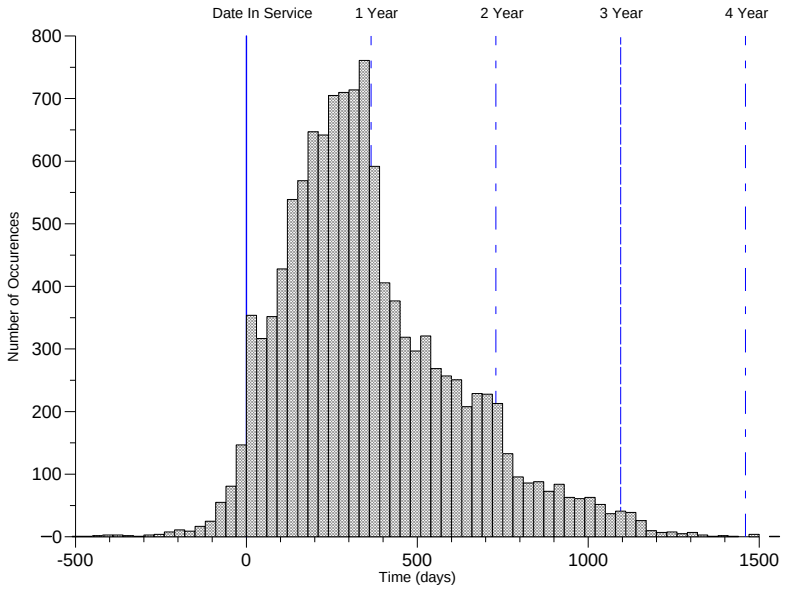

Figure A7 – Time to Failure for the Data Set of 12,125 Relevant Claims

Note: This chart does not include 177 claims where the in-service date was not listed. Some vehicles were repaired prior to the sale or start-of-warranty in-service date.

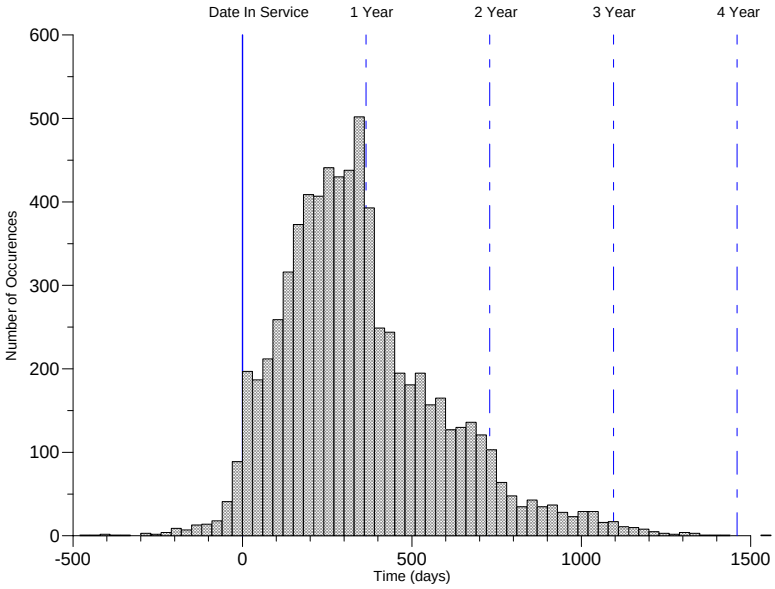

Figure A8 – Time to Failure for the Data Set of 7,164 Relevant Claims in FBSDPC Categories

Note: This chart does not include 55 claims where the in-service date was not listed.

BUSES

International Buses Applications Warranty Search New Truck Inven
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Buses : Warranty : 3800 Model

3800 Model - Standard Warranty (Vehicles Built 11/1/94 and Later)

Basic Vehicle Coverage	Months	Miles/MK	Parts/Labor
Basic Vehicle Warranty	12	Unlimited	100%
Components			
International T 444E Engine*	60	Unlimited	100%
International DT 466(E) Engine*	60	Unlimited	100%
International VT 365 Glow Plugs, Relay, & Harness	36	Unlimited	100%
Frame Side Rails	60	Unlimited	100%
Cab/Cowl Structure	60	Unlimited	100%
International/Spicer Drivetrain			
3 Part Drivetrain (front & rear axles, propshaft, when used with Allison transmission only)	48	50/80	100%
5 Part Drivetrain (front & rear axles, clutch propshaft and transmission)	48	50/80	100%

*In order to identify these engines we have provided the engine code attributes which are found in the 6th and 7th places of the Vehicle Identification Number (VIN). These indicate the specific engine as follows:

AB T 444E
AF VT 365
AA DT 466
AD 530(E)

Example:
A vehicle with VIN # 1HTGH**AF**T4RH597838
is equipped with **DT 466(E)** engine

Figure A9 – International Truck Standard Warranty

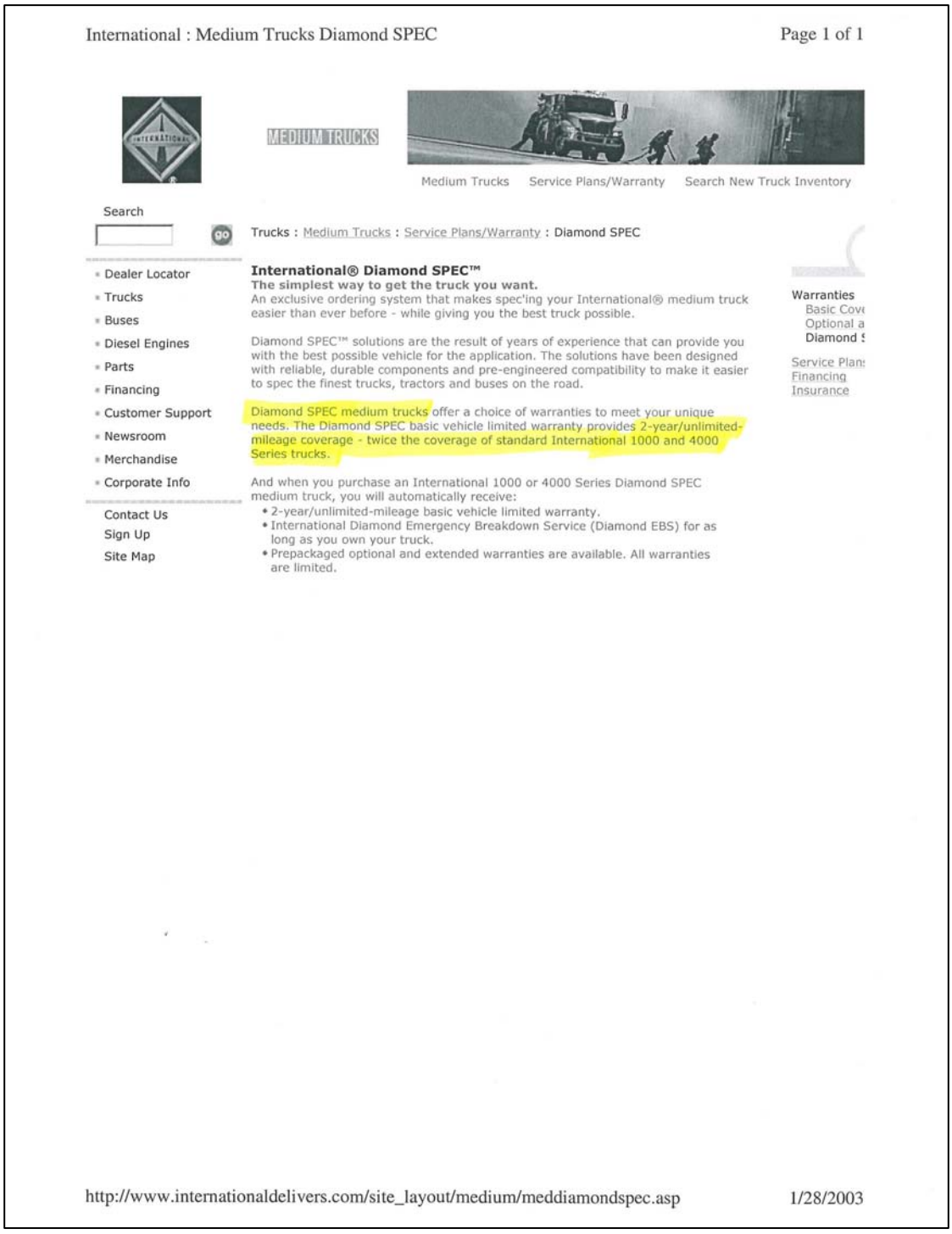

Figure A10 – International Diamond SPEC™ Extended Warranty

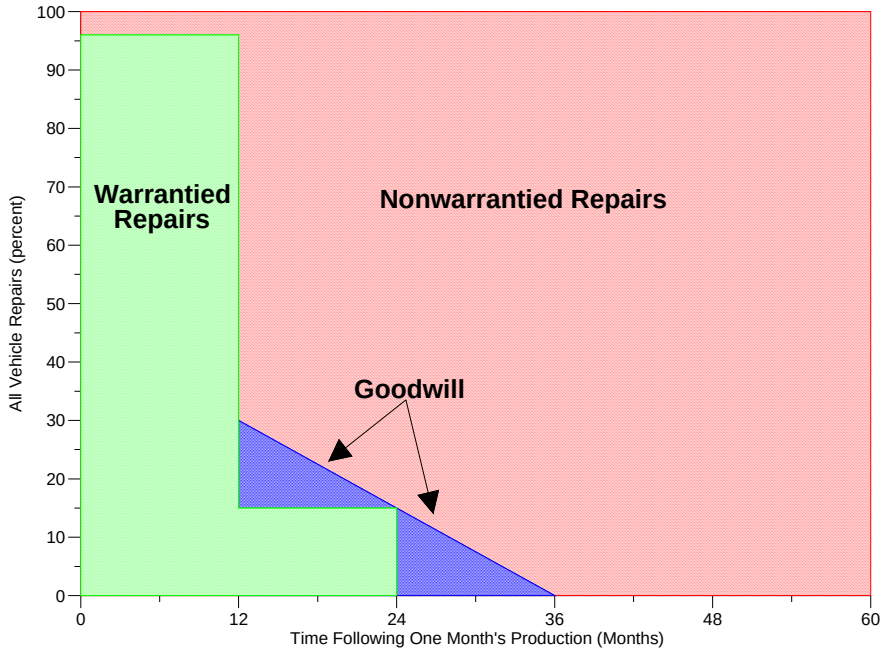

Figure A11 - Graphical Representation of All Vehicle Repairs

This diagram, of typical repairs to a group of vehicles produced in the same month, was created to show the limitations of an analysis of any warranty database. International Truck warranties ended after 12 or 24 months, and then some goodwill was performed. Other repairs are not reported in this database.

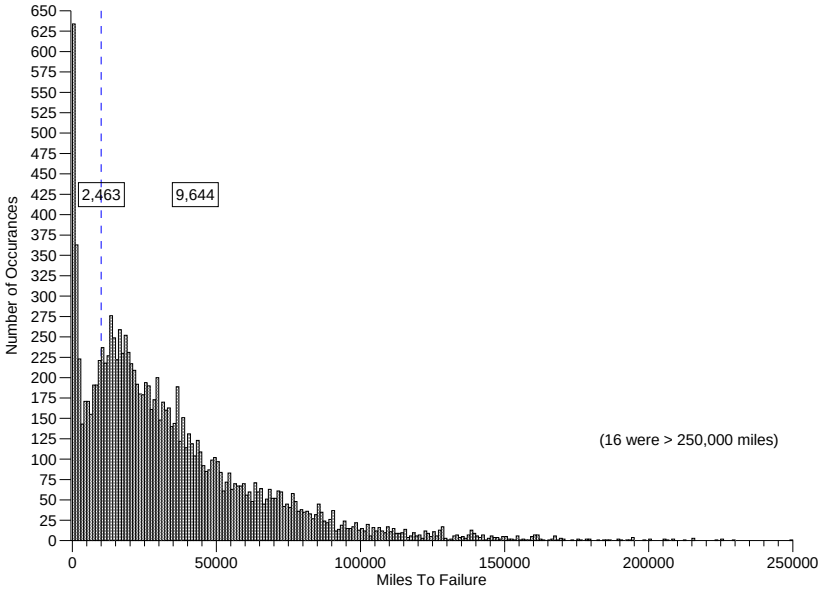

Figure A12 - Miles to Failure of the Data Set of All Relevant (FBSDPCO) Warranty Claims

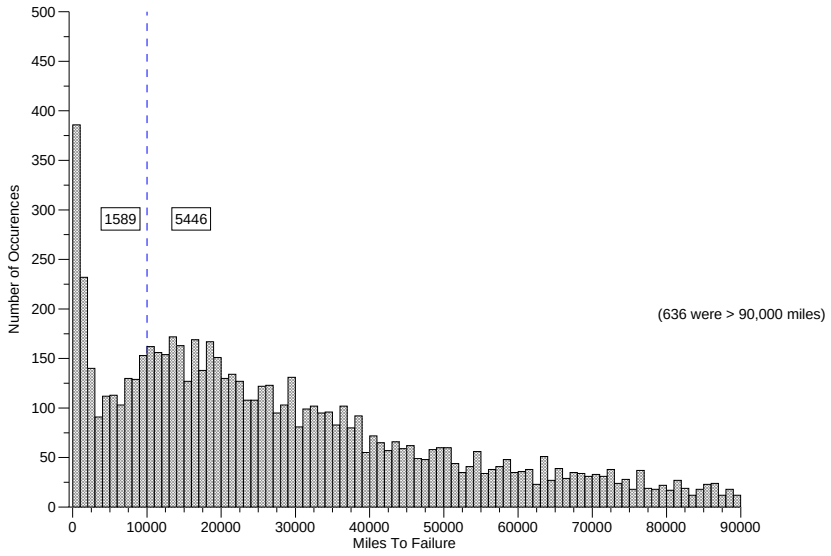

Figure A13 - Miles to Failure of 7,671 Claims in FBSDPC Categories

Note: Graph truncated to 90,000 miles

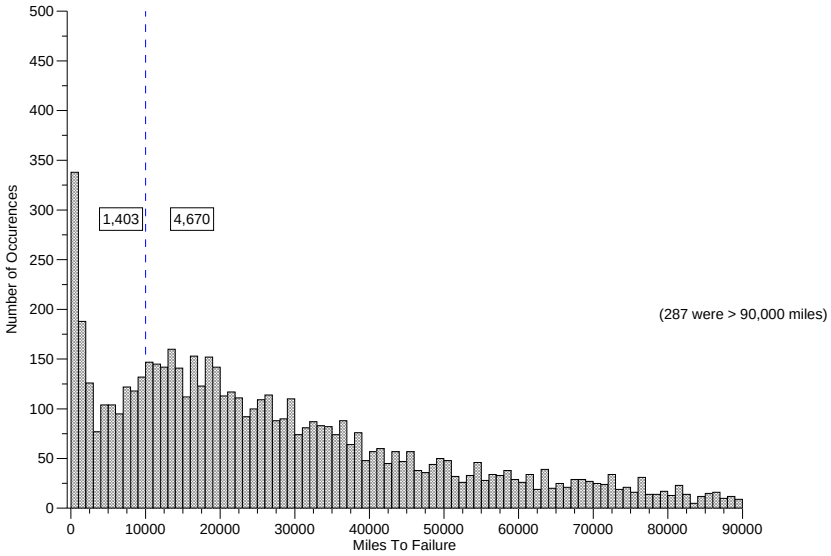

Figure A14 - Miles to Failure of 6,360 Claims in FBSD Categories

Note: Graph truncated to 90,000 miles

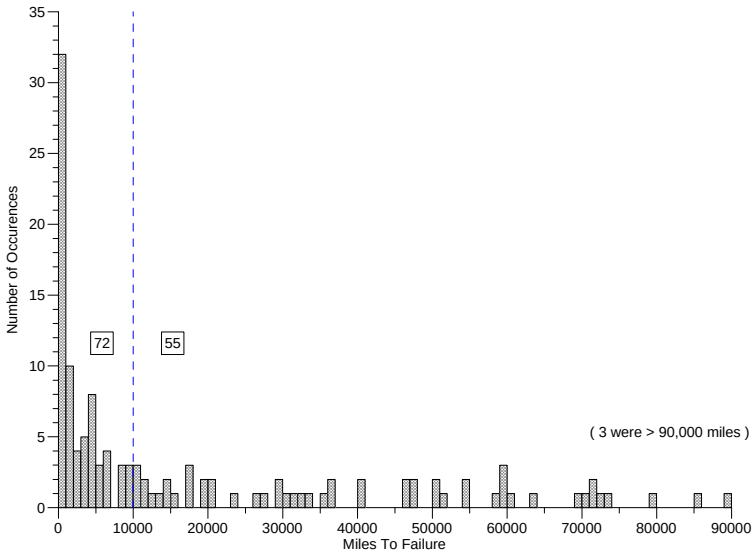

Figure A15 - Miles to Failure of the 130 Claims in the Fire Category

Note: Graph truncated to 90,000 miles

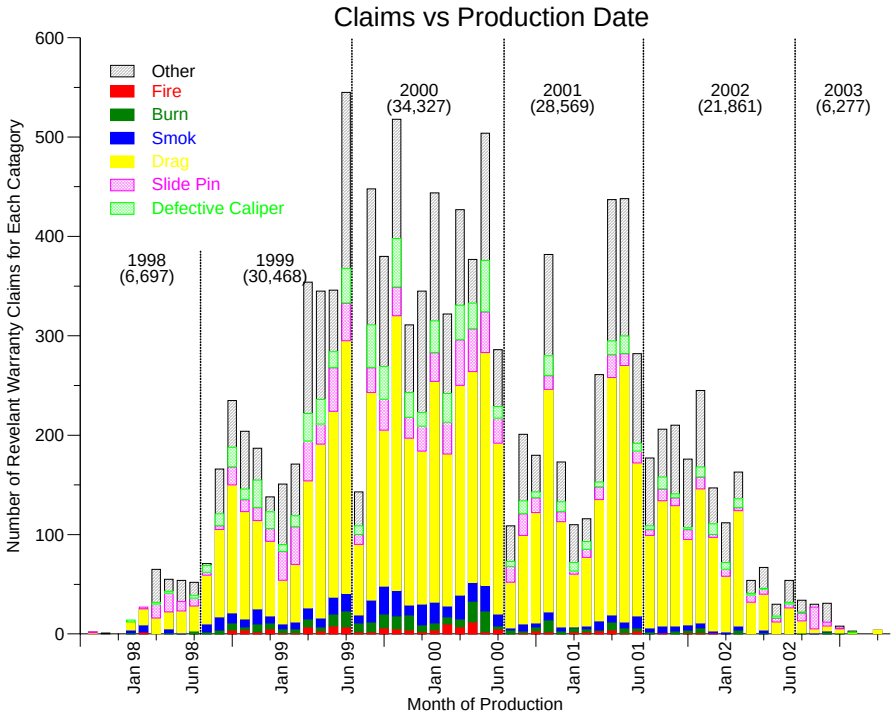

Figure A16 – All Relevant (FBSDPCO) Warranty Claims vs. Month of Production

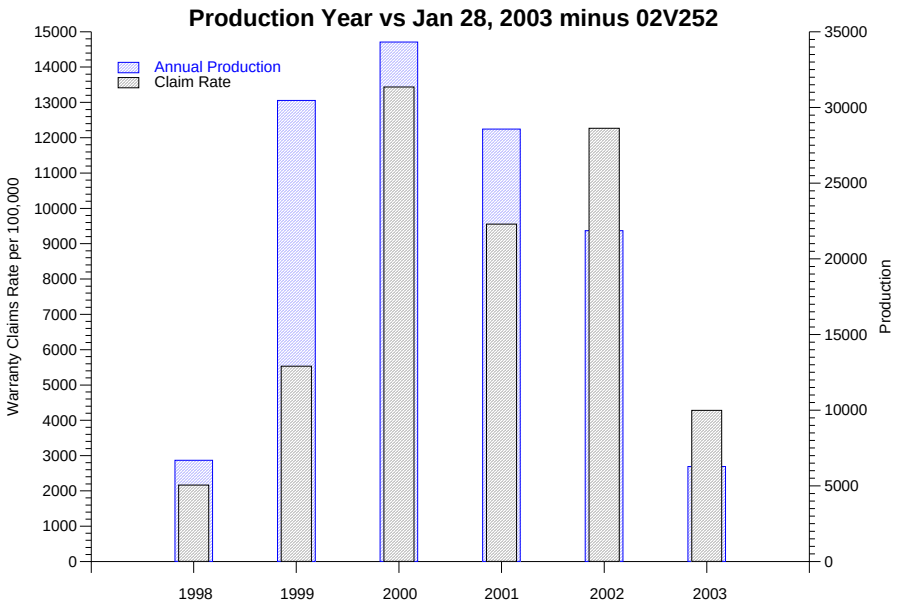

Figure A17 – Annual Production and Relevant Warranty Claim Rate Overlay by Model Year

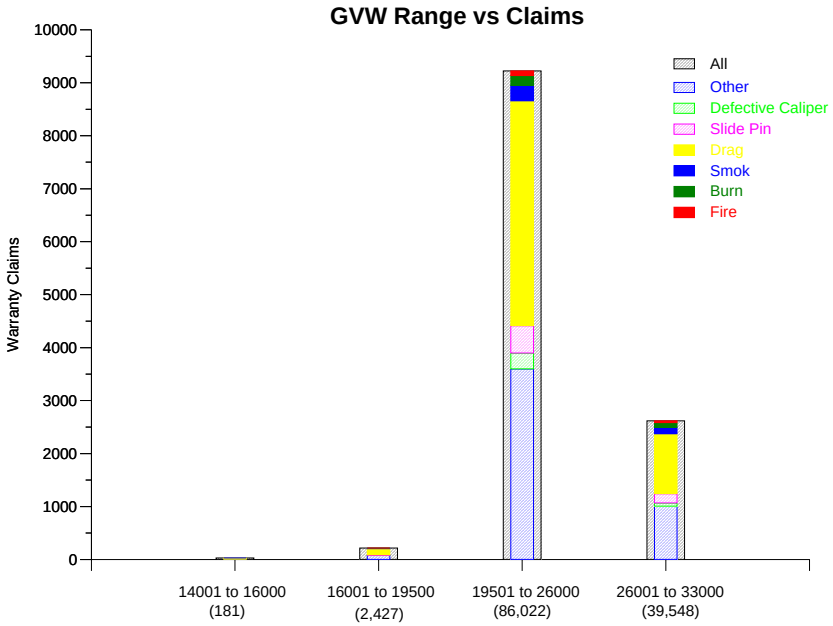

Figure A18 – All Relevant (FBSDPCO) Warranty Claims by GVW Range

Twenty-one vehicles, of the model "Glider", are missing from this plot.

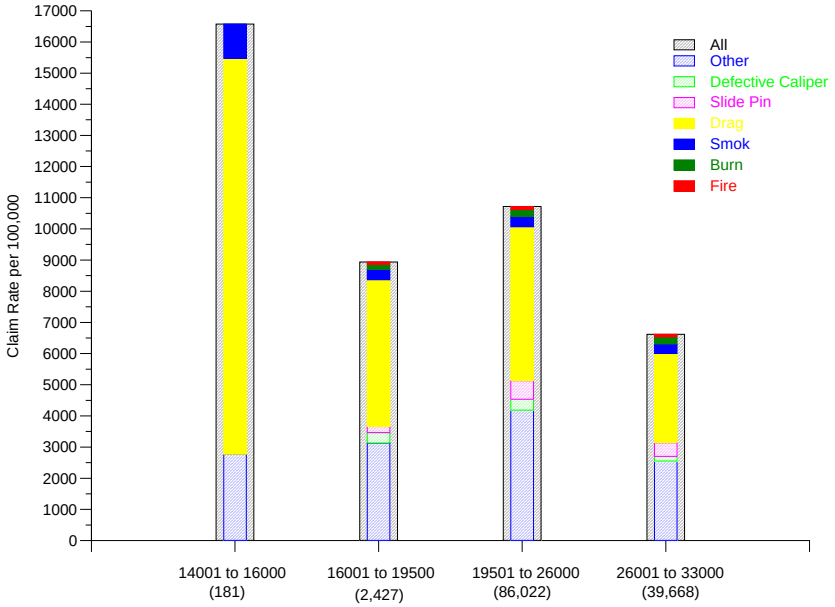

Figure A19 – All Relevant (FBSDPCO) Warranty Claim Rates by Vehicle GVW Range

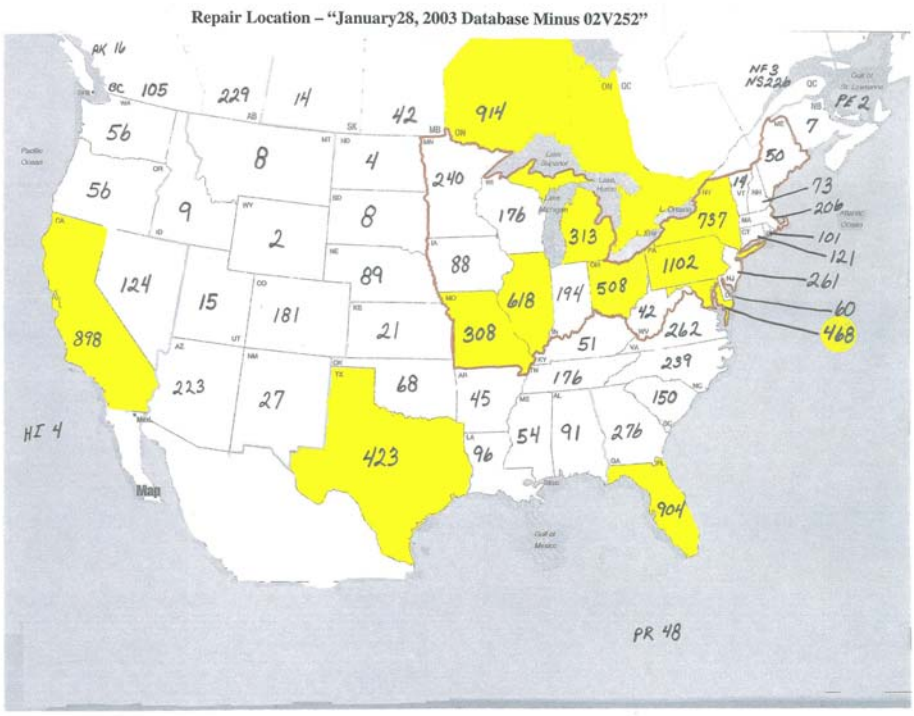

Figure A20 – Number of Warranty Claims per State by Repair Locations for All Relevant Records (highlighted states > 300 claims)

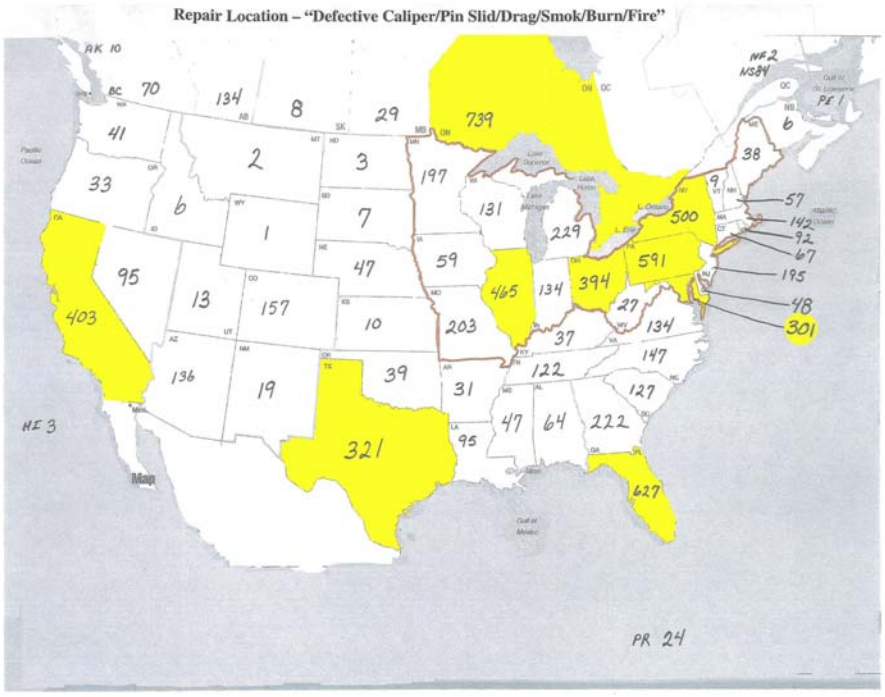

Figure A21 – Number of Warranty Claims per State by Repair Locations for FBSDPC Categories (highlighted states > 300 claims)

Figure A22 – Number of Warranty Claims per State by Repair Locations for the Fire Category (highlighted states > 4 fire claims)

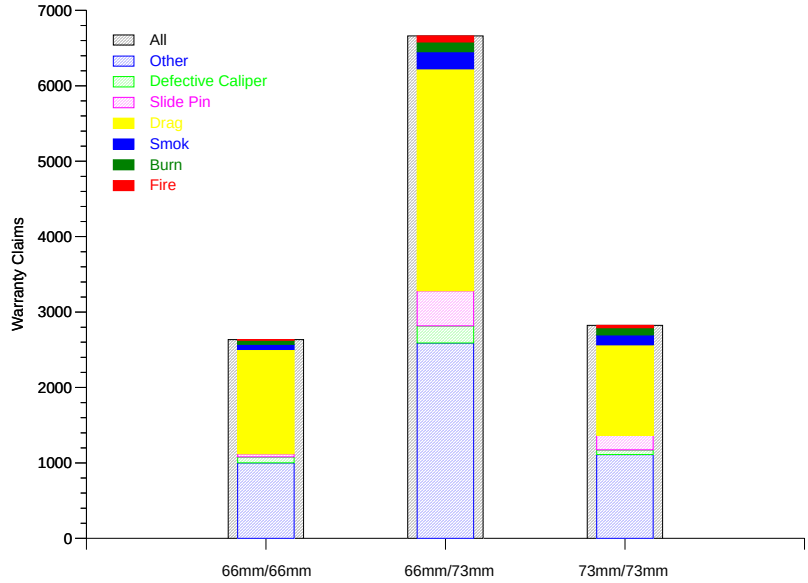

Figure A23 - Relevant and FBSDPC Warranty Claims vs. Front/Rear Wheel Brake Caliper Size Combination

Table A7 – Production Data by Model with Warranty Rate per 100,000 for FBSDPC

1998-2003 MODEL YEARS												Keyword Search from "Complaint Comments" Column											
Vehicle Model Designation	Body Code per VIN Positions 4 and 5	Body Code Comment	GVWR Range per VIN Postion 8					International Production Totals	Percent of Total Production	No. International Warranty Claims	Percent of Production having Warranty Claims	Claims with "Fire"		Claims with "Burn"		Claims with "Smok"		Claims with "Drag"		Claims with "Pin"		Claims with "Clpr"	
			14001 to 16000 lb	16001 to 19500 lb	19501 to 26000 lb	26001 to 33000 lb	Glider					No. of Claims	Rate per 100,000 Vehicles	No. of Claims	Rate per 100,000 Vehicles	No. of Claims	Rate per 100,000 Vehicles	No. of Claims	Rate per 100,000 Vehicles	No. of Claims	Rate per 100,000 Vehicles	No. of Claims	Rate per 100,000 Vehicles
1552 SC	MJ	Stripped Chassis	155	1				156	0.1%	28	17.9%					2	1,282	21	13,462				
1652 SC	MG	Stripped Chassis		306	2,944	53		3,303	2.6%	414	12.5%			10	303	2	61	247	7,478	12	363	12	363
1652 UPS	MH	United Parcel Srv		1	2,334			2,335	1.8%	23	1.0%			1				6	257	5	214		
3000 FE	BL	Bus Chassis				1		1	0.0%		0.0%												
3000 RE	BM	Bus Chassis				52		52	0.0%	7	13.5%							3				1	
3200	BT	Bus Chassis			34			34	0.0%	1	2.9%							1					
3400	BE	Bus Chassis		377	2,050			2,427	1.9%	100	4.1%	1	41	4	165	7	288	46	1,895	2	82	2	82
3600	BD	Bus Chassis		130	105	12		247	0.2%	2	0.8%					1	405						
3800	BB	Bus Chassis		92	6,399	22,786		29,277	22.8%	1,983	6.8%	24	82	53	181	112	383	928	3,170	58	198	47	161
4200 4X2	ML / MP	? Steel Cab		32	766	42		840	0.7%	22	2.6%							14	1,667	1	119	2	238
4300 4X2	MM / MN	? Steel Cab		79	11,783	1,124		12,986	10.1%	2,101	16.2%	8	62	30	231	53	408	1,127	8,679	55	424	37	285
4400 4X2	MK / MR	? Steel Cab			190	153		343	0.3%	41	12.0%	1	292			2	583	23	6,706	2	583	1	292
4700 4X2	SC	? Steel Cab	16	685	49,837	6,757		57,295	44.7%	5,721	10.0%	74	129	143	250	202	353	2,502	4,367	387	675	183	319
4700 GLR	SN	? Steel Cab					21	21	0.0%		0.0%												
4700 LP	SL	? Steel Cab	1	216	4,639	37		4,893	3.8%	675	13.8%	19	388	22	450	25	511	323	6,601	15	307	24	490
4700 LPX	SM / SR	? Steel Cab	9	460	1,513			1,982	1.5%	133	6.7%			3	151	2	101	75	3,784	2	101	5	252
4900 4X2	SD	? Steel Cab			2,404	1,082		3,486	2.7%	435	12.5%	1	29	3	86	6	172	51	1,463	90	2,582	51	1,463
FE BUS	BG	Bus Chassis				614		614	0.5%	12	2.0%			1	163			3	489	3	489		
FE CMRCL	BH	Bus Chassis				5		5	0.0%		0.0%												
IC BUS	BR	Bus Chassis		48	1,004	4,565		5,617	4.4%	222	4.0%	2	36			4	71	93	1,656	44	783		
IC CMRCL	BS	Bus Chassis			20	12		32	0.0%	1	3.1%												
RE BUS	BJ	Bus Chassis				2,252		2,252	1.8%	204	9.1%			9	400	7	311	63	2,798	20	888	1	44
RE CMRCL	BK	Bus Chassis				1		1	0.0%		0.0%												
Grand Total			181	2,427	86,022	39,548	21	128,199	100.0%	12,125	9.5%	130	101	279	218	425	332	5,526	4,310	696	543	366	285

Table A8 – Production Data by Model with Warranty Rate per 100,000 for Combined Categories

1998-2003 MODEL YEARS												Keyword Search from "Complaint Comments" Column					
Vehicle Model Designation	Body Code per VIN Positions 4 and 5	Body Code Comment	GVWR Range per VIN Postion 8					International Production Totals	Percent of Total Production	No. International Warranty Claims	Percent of Production having Warranty Claims	Claims with "Fire/Burn/Smok"		Claims with "Drag/Pin/Clpr"		Claims with "Other"	
			14001 to 16000 lb	16001 to 19500 lb	19501 to 26000 lb	26001 to 33000 lb	Glider					No. of Claims	Rate per 100,000 Vehicles	No. of Claims	Rate per 100,000 Vehicles	No. of Claims	Rate per 100,000 Vehicles
1552 SC	MJ	Stripped Chassis	155	1				156	0.1%	28	17.9%	2	1,282	21	13,462	5	3,205
1652 SC	MG	Stripped Chassis		306	2,944	53		3,303	2.6%	414	12.5%	12	363	271	8,205	131	3,966
1652 UPS	MH	United Parcel Srv		1	2,334			2,335	1.8%	23	1.0%	1	43	11	471	11	471
3400	BE	Bus Chassis		377	2,050			2,427	1.9%	100	4.1%	12	494	50	2,060	38	1,566
3600	BD	Bus Chassis		130	105	12		247	0.2%	2	0.8%	1	405			1	405
3800	BB	Bus Chassis		92	6,399	22,786		29,277	22.8%	1,983	6.8%	189	646	1,033	3,528	761	2,599
4300 4X2	MM / MN	? Steel Cab		79	11,783	1,124		12,986	10.1%	2,101	16.2%	91	701	1,219	9,387	791	6,091
4400 4X2	MK / MR	? Steel Cab			190	153		343	0.3%	41	12.0%	3	875	26	7,580	12	3,499
4700 4X2	SC	? Steel Cab	16	685	49,837	6,757		57,295	44.7%	5,721	10.0%	419	731	3,072	5,362	2,230	3,892
4700 LP	SL	? Steel Cab	1	216	4,639	37		4,893	3.8%	675	13.8%	66	1,349	362	7,398	247	5,048
4700 LPX	SM / SR	? Steel Cab	9	460	1,513			1,982	1.5%	133	6.7%	5	252	82	4,137	46	2,321
4900 4X2	SD	? Steel Cab			2,404	1,082		3,486	2.7%	435	12.5%	10	287	192	5,508	233	6,684
FE BUS	BG	Bus Chassis				614		614	0.5%	12	2.0%	1	163	6	977	5	814
IC BUS	BR	Bus Chassis		48	1,004	4,565		5,617	4.4%	222	4.0%	6	107	137	2,439	79	1,406
RE BUS	BJ	Bus Chassis				2,252		2,252	1.8%	204	9.1%	16	710	84	3,730	104	4,618
Grand Total			181	2,395	85,202	39,435		128,199	99.2%	12,094	9.4%	834	651	6,566	5,122	4,694	3,661

Appendix B

Software Program to Automate Data Mining

```
Option Explicit

Dim Relevant            As String
Dim Model_Year          As String
Dim GVW_Range           As String
Dim Front_Brake_Code    As String
Dim Rear_Brake_Code     As String
Dim Fire_Wheel_Location As String
Dim Running             As Boolean
Dim resultptr           As Long

Private Sub CommandButton1_Click()
  Dim Counter   As Long
  Dim I         As Long
  Dim J         As Long
  Dim st        As String
  Dim cFire     As Long
  Dim cBurn     As Long
  Dim cSmok     As Long
  Dim cDrag     As Long
  Dim cPin      As Long
  Dim cClpr     As Long


  Running = True
  For I = 2 To 23192
   If UCase(Sheet1.Range("AC" & I)) = Relevant Or _
     Relevant = "ALL" Then
    If UCase(Sheet1.Range("C" & I)) = Model_Year Or _
      Model_Year = "ALL" Then
     If UCase(Sheet1.Range("AF" & I)) = Model_Code.Text Or _
       Model_Code = "ALL" Then
      If UCase(Sheet1.Range("AD" & I)) = GVW_Range Or _
        GVW_Range = "ALL" Then
       If UCase(Sheet1.Range("W" & I)) = Front_Brake_Code Or _
         Front_Brake_Code = "ALL" Then
        If UCase(Sheet1.Range("X" & I)) = Rear_Brake_Code Or _
          Rear_Brake_Code = "ALL" Then
         st = UCase(Sheet1.Range("T" & I))
         If CheckBox1.Value = True Then
           For J = 1 To Len(st)
             If Mid(st, J, 4) = "FIRE" Or _
               Mid(st, J, 5) = "FLAME" Then
               Counter = Counter + 1
              cFire = cFire + 1
              J = Len(st)
```

```
            GoTo NextLoop
          End If
        Next J
      End If
      If CheckBox4.Value = True Then
        For J = 1 To Len(st)
          If Mid(st, J, 4) = "BURN" Then
            If Mid(st, J, 7) = "BURNISH" Then
               GoTo EndBurn
            End If
            Counter = Counter + 1
            cBurn = cBurn + 1
            J = Len(st)
            GoTo NextLoop
EndBurn:
          End If
        Next J
      End If
      If CheckBox2.Value = True Then
        For J = 1 To Len(st)
          If Mid(st, J, 4) = "SMOK" Or _
             Mid(st, J, 3) = "SMK" Then
            Counter = Counter + 1
            cSmok = cSmok + 1
            J = Len(st)
            GoTo NextLoop
          End If
        Next J
      End If
      If CheckBox3.Value = True Then
        For J = 1 To Len(st)
          If (Mid(st, J, 3) = "HOT" Or _
              Mid(st, J, 4) = "BIND" Or _
              Mid(st, J, 4) = "DRAG" Or _
              Mid(st, J, 4) = "FROZ" Or _
              Mid(st, J, 4) = "HANG" Or _
              Mid(st, J, 4) = "HUNG" Or _
              Mid(st, J, 4) = "LOCK" Or _
              Mid(st, J, 4) = "SEIZ" Or _
              Mid(st, J, 4) = "SIEZ" Or _
              Mid(st, J, 4) = "HEAT" Or _
              Mid(st, J, 4) = "GLOW" Or _
              Mid(st, J, 5) = "STICK" Or _
              Mid(st, J, 5) = "STUCK" Or _
              Mid(st, J, 5) = "BOUND" Or _
              Mid(st, J, 8) = "NOT SLID" Or _
```

```
      Mid(st, J, 10) = "NOT RELEAS") Then
    Counter = Counter + 1
    cDrag = cDrag + 1
    J = Len(st)
    GoTo NextLoop
   End If
  Next J
End If
If CheckBox6.Value = True Then
  For J = 1 To Len(st)
   If (Mid(st, J, 4) = "TORQ" Or _
      Mid(st, J, 8) = "PIN LOOS" Or _
      Mid(st, J, 8) = "MTG BOLT" Or _
      Mid(st, J, 9) = "BOLT LOOS" Or _
      Mid(st, J, 9) = "PINS LOOS" Or _
      Mid(st, J, 9) = "BOLT FELL" Or _
      Mid(st, J, 9) = "BOLT BROK" Or _
      Mid(st, J, 10) = "BOLTS BROK" Or _
      Mid(st, J, 10) = "BOLTS GONE" Or _
      Mid(st, J, 10) = "BOLTS LOOS" Or _
      Mid(st, J, 10) = "BOLTS FELL" Or _
      Mid(st, J, 12) = "BOLT MISSING" Or _
      Mid(st, J, 12) = "MISSING BOLT" Or _
      Mid(st, J, 12) = "CALIPER LOOS" Or _
      Mid(st, J, 12) = "CALIPER FELL" Or _
      Mid(st, J, 12) = "CALIPER FALL" Or _
      Mid(st, J, 13) = "BOLTS MISSING" Or _
      Mid(st, J, 15) = "MISSING CALIPER") Then
    Counter = Counter + 1
    cPin = cPin + 1
    J = Len(st)
    GoTo NextLoop
   End If
  Next J
End If
If CheckBox7.Value = True Then
  For J = 1 To Len(st)
   If (Mid(st, J, 8) = "CLPR DEF" Or _
      Mid(st, J, 8) = "CLPR BAD" Or _
      Mid(st, J, 9) = "CLPR FAIL" Or _
      Mid(st, J, 11) = "CALIPER BAD" Or _
      Mid(st, J, 11) = "BAD CALIPER" Or _
      Mid(st, J, 11) = "CALIPER DEF" Or _
      Mid(st, J, 12) = "CALIPER FAIL" Or _
      Mid(st, J, 17) = "DEFECTIVE CALIPER") Then
    Counter = Counter + 1
```

```
                cClpr = cClpr + 1
                J = Len(st)
              End If
            Next J
          End If
          If CheckBox5.Value = True Then
              Counter = Counter + 1
          End If
NextLoop:
        End If
      End If
    End If
   End If
  End If
  Label6.Caption = Str(Counter)
  DoEvents
  If Running = False Then Exit Sub
 End If
Next I
If Counter > 0 Then
  Sheet3.Range("A" & resultptr) = Relevant
  Sheet3.Range("B" & resultptr) = Model_Year
  Sheet3.Range("C" & resultptr) = Model_Code
  Sheet3.Range("D" & resultptr) = GVW_Range
  Sheet3.Range("E" & resultptr) = Front_Brake_Code
  Sheet3.Range("F" & resultptr) = Rear_Brake_Code
  Sheet3.Range("G" & resultptr) = cFire
  Sheet3.Range("H" & resultptr) = cBurn
  Sheet3.Range("I" & resultptr) = cSmok
  Sheet3.Range("J" & resultptr) = cDrag
  Sheet3.Range("K" & resultptr) = cPin
  Sheet3.Range("L" & resultptr) = cClpr
  Sheet3.Range("M" & resultptr) = Counter
  resultptr = resultptr + 1
 End If
End Sub
Private Sub CommandButton2_Click()
 Running = False
End Sub
Private Sub CommandButton3_Click()
 Dim pt0 As Long
 Dim pt1 As Long
 Dim pt2 As Long
 Dim pt3 As Long
 Dim pt4 As Long
 Dim pt5 As Long
```

```
Dim pt6 As Long
Dim pt7 As Long

Running = True
Model_Code.ListIndex = 0
CheckBox1.Value = True
CheckBox2.Value = True
CheckBox3.Value = True
CheckBox4.Value = True
CheckBox6.Value = True
CheckBox7.Value = True

Do
  Select Case pt0
     Case 0
        OptionButton27.Value = True
        OptionButton27_Click
     Case 1
        OptionButton28.Value = True
        OptionButton28_Click
  End Select
  Select Case pt1
  Case 0
    OptionButton1.Value = True
    OptionButton1_Click
  Case 1
    OptionButton2.Value = True
    OptionButton2_Click
  Case 2
    OptionButton3.Value = True
    OptionButton3_Click
  Case 3
    OptionButton4.Value = True
    OptionButton4_Click
  Case 4
    OptionButton5.Value = True
    OptionButton5_Click
  Case 5
    OptionButton6.Value = True
    OptionButton6_Click
  End Select
  Select Case pt3
  Case 0
    OptionButton7.Value = True
    OptionButton7_Click
  Case 1
```

```
  OptionButton8.Value = True
  OptionButton8_Click
Case 2
  OptionButton9.Value = True
  OptionButton9_Click
Case 3
  OptionButton10.Value = True
  OptionButton10_Click
Case 4
  OptionButton11.Value = True
  OptionButton11_Click
End Select
Select Case pt4
Case 0
  OptionButton12.Value = True
  OptionButton12_Click
Case 1
  OptionButton13.Value = True
  OptionButton13_Click
End Select
Select Case pt5
Case 0
  OptionButton14.Value = True
  OptionButton14_Click
Case 1
  OptionButton15.Value = True
  OptionButton15_Click
End Select


Call CommandButton1_Click
pt5 = pt5 + 1
If pt5 = 2 Then
  pt5 = 0
  pt4 = pt4 + 1
End If
If pt4 = 2 Then
  pt4 = 0
  pt3 = pt3 + 1
End If
If pt3 = 5 Then
  pt3 = 0
  pt2 = pt2 + 1
End If
If pt2 = 27 Then
  pt2 = 0
```

```
      pt1 = pt1 + 1
    End If
    If pt1 = 6 Then
       pt1 = 0
       pt0 = pt0 + 1
    End If
    If pt0 = 2 Then Running = False
    Model_Code.ListIndex = pt2
    DoEvents
  Loop Until Running = False
End Sub

Private Sub Frame8_Click()

End Sub

Private Sub OptionButton1_Click()
  Model_Year = "1998"
End Sub
Private Sub OptionButton10_Click()
  GVW_Range = "26001 TO 33000"
End Sub
Private Sub OptionButton11_Click()
  GVW_Range = "GLIDER"
End Sub
Private Sub OptionButton12_Click()
  Front_Brake_Code = "04JNB"
End Sub
Private Sub OptionButton13_Click()
  Front_Brake_Code = "04JNA"
End Sub
Private Sub OptionButton14_Click()
  Rear_Brake_Code = "04NNB"
End Sub
Private Sub OptionButton15_Click()
  Rear_Brake_Code = "04NNC"
End Sub
Private Sub OptionButton16_Click()
  Fire_Wheel_Location = "LF"
End Sub
Private Sub OptionButton17_Click()
  Fire_Wheel_Location = "RF"
End Sub
Private Sub OptionButton18_Click()
  Fire_Wheel_Location = "LR"
End Sub
```

```
Private Sub OptionButton19_Click()
  Fire_Wheel_Location = "RR"
End Sub
Private Sub OptionButton2_Click()
  Model_Year = "1999"
End Sub
Private Sub OptionButton20_Click()
  Fire_Wheel_Location = "LF/RF"
End Sub
Private Sub OptionButton21_Click()
  Fire_Wheel_Location = "LR/RR"
End Sub
Private Sub OptionButton22_Click()
  Fire_Wheel_Location = "BOTH"
End Sub
Private Sub OptionButton23_Click()
  Model_Year = "ALL"
End Sub
Private Sub OptionButton24_Click()
  GVW_Range = "ALL"
End Sub
Private Sub OptionButton25_Click()
  Front_Brake_Code = "ALL"
End Sub
Private Sub OptionButton26_Click()
  Rear_Brake_Code = "ALL"
End Sub
Private Sub OptionButton27_Click()
    Relevant = "Y"
End Sub
Private Sub OptionButton28_Click()
    Relevant = "N"
End Sub
Private Sub OptionButton29_Click()
    Relevant = "ALL"
End Sub
Private Sub OptionButton3_Click()
  Model_Year = "2000"
End Sub
Private Sub OptionButton4_Click()
  Model_Year = "2001"
End Sub
Private Sub OptionButton5_Click()
  Model_Year = "2002"
End Sub
Private Sub OptionButton6_Click()
```

```
  Model_Year = "2003"
End Sub
Private Sub OptionButton7_Click()
  GVW_Range = "14001 TO 16000"
End Sub
Private Sub OptionButton8_Click()
  GVW_Range = "16001 TO 19500"
End Sub
Private Sub OptionButton9_Click()
  GVW_Range = "19501 TO 26000"
End Sub
Private Sub UserForm_Initialize()
  Model_Code.AddItem "BB"   ' LISTITEM 0
  Model_Code.AddItem "BD"   ' LISTITEM 1
  Model_Code.AddItem "BE"   ' LISTITEM 2
  Model_Code.AddItem "BG"   ' LISTITEM 3
  Model_Code.AddItem "BH"   ' LISTITEM 4
  Model_Code.AddItem "BJ"   ' LISTITEM 5
  Model_Code.AddItem "BK"   ' LISTITEM 6
  Model_Code.AddItem "BL"   ' LISTITEM 7
  Model_Code.AddItem "BM"   ' LISTITEM 8
  Model_Code.AddItem "BR"   ' LISTITEM 9
  Model_Code.AddItem "BS"   ' LISTITEM 10
  Model_Code.AddItem "BT"   ' LISTITEM 11
  Model_Code.AddItem "MG"   ' LISTITEM 12
  Model_Code.AddItem "MH"   ' LISTITEM 13
  Model_Code.AddItem "MJ"   ' LISTITEM 14
  Model_Code.AddItem "MK"   ' LISTITEM 15
  Model_Code.AddItem "ML"   ' LISTITEM 16
  Model_Code.AddItem "MM"   ' LISTITEM 17
  Model_Code.AddItem "MN"   ' LISTITEM 18
  Model_Code.AddItem "MP"   ' LISTITEM 19
  Model_Code.AddItem "MR"   ' LISTITEM 20
  Model_Code.AddItem "SC"   ' LISTITEM 21
  Model_Code.AddItem "SD"   ' LISTITEM 22
  Model_Code.AddItem "SL"   ' LISTITEM 23
  Model_Code.AddItem "SM"   ' LISTITEM 24
  Model_Code.AddItem "SN"   ' LISTITEM 25
  Model_Code.AddItem "SR"   ' LISTITEM 26
  Model_Code.AddItem "ALL"  ' LISTITEM 27

  Model_Code.ListIndex = 27

  resultptr = 2
End Sub
```

```
Private Sub UserForm_MouseMove(ByVal Button As Integer, ByVal Shift As Integer,
ByVal X As Single, ByVal Y As Single)

End Sub
```