GENERAL MOTORS NORTH AMERICA
Structure & Safety Integration

March 28, 2003

Kathleen C. DeMeter, Director
Office of Defects Investigation
NHTSA Enforcement
Room #5326
400 Seventh Street, S.W.
Washington, D.C. 20590

GM-022B
NVS213
EA02-031

Dear Ms. DeMeter:

This letter is General Motors (GM) response to your information request (IR), dated January 22, 2003, regarding alleged lockup of the steering column in 1997–2001 model year (MY) Chevrolet Corvette vehicles.

Your questions and our corresponding replies are as follows:

1. **State by model year the number of subject vehicles GM has manufactured for sale or lease in the United States. Separately, for each subject vehicle manufactured to date by GM, state the following:**
   a. **Vehicle identification number (VIN);**
   b. **Model Year;**
   c. **Transmission Type;**
   d. **Date of manufacture;**
   e. **Date warranty coverage commenced; and**
   f. **The State in the United States where the vehicle was originally sold or leased (or delivered for sale or lease).**

   Provide the table in Microsoft Access 2000, or a compatible format, entitled "PRODUCTION DATA." See Enclosure 2, EA02-031 Data Collection Disc, for a pre-formatted table which provides further details regarding this submission.

   The total number of subject vehicles GM has manufactured for sale or lease in the United States is shown in Table Q1. An electronic summary of the production data is provided on the CD in Attachment 1; refer to the Microsoft Access 2000 file in the folder labeled "Response for Q1." This data was collected from GM Vehicle Profile System on March 17, 2003.

TABLE Q1

CHEVROLET CORVETTES	1997 MY	1998 MY	1999 MY	2000 MY	2001 MY	TOTAL
With Man. Transmission	2,662	6,565	12,618	12,469	14,953	49,467
With Auto. Transmission	6,386	22,126	17,026	18,721	18,255	82,514
Total	9,048	28,691	29,644	31,190	33,208	131,981

2. **State the number of each of the following, received by GM, or of which GM is otherwise aware, which relate to, or may relate to, the alleged defect in the subject vehicles:**
   a. **Consumer complaints, including those from fleet operators;**
   b. **Field reports, including dealer field reports;**

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Mail Code: 480-106-304 • 30600 Mound Road • Warren, MI 48090-9055
Phone: (586) 986-8029 • Fax (586) 947-2318

c. Reports involving a crash, injury, or fatality, based on claims against the manufacturer involving a death or injury, notices received by the manufacturer alleging or proving that a death or injury was caused by a possible defect in a subject vehicle, property damage claims, consumer complaints, or field reports;
d. Property damage claims; and,
e. Third-party arbitration proceedings where GM is or was a party to the arbitration; and,
f. Lawsuits, both pending and closed, in which GM is or was a defendant or codefendant.

For subparts "a" through "f ," state the total number of each item (e.g., consumer complaints, field reports, etc.) separately. Multiple incidents involving the same vehicle are to be counted separately. Multiple reports of the same incident are also to be counted separately (i.e., a consumer complaint and a field report involving the same incident in which a crash occurred are to be counted as a crash report, a field report and a consumer complaint).

In addition, for items "c" through "f," provide a summary description of the alleged problem and causal and contributing factors and GM's assessment of the problem, with a summary of the significant underlying facts and evidence. For items e and f, identify the parties to the action, as well as the caption, court, docket number, and date on which the complaint or other document initiating the action was filed.

Table Q2 summarizes the reports to GM that could relate to the subject condition. These reports are in addition to the reports provided in GM's September 13, 2002 response.

TABLE Q2

REPORT TYPE	COUNT (INCLUDING DUPLICATES)	UNIQUE GM REPORTS	GM REPORTS CORRESPONDING TO NHTSA VOQs	ATTACHMENT CONTAINING REPORTS	NUMBER OF CRASH INCIDENT REPORTS	NUMBER OF REPORTED INJURIES*
Owner Reports, speed ≥ 20 MPH	0	0	0	N/A	0	0
Owner Reports, speed < 20 MPH	1	1	0	2a	0	0
Owner Reports, speed unknown	1	1	0	2a	0	0
Field Reports, speed ≥ 20 MPH	3	3	0	2b	3	2
Field Reports, speed < 20 MPH	4	4	0	2b	1	0
Field Reports, speed unknown	0	0	0	N/A	0	0
Notice/Suit Claims (any speed)	0	0	0	N/A	0	0
Lawsuits (any speed)	0	0	0	N/A	0	0
Subrogation Claims (any speed)	0	0	0	N/A	0	0
3rd Party Arbitration (any speed)	0	0	0	N/A	0	0
Total (Including Duplicates)	9	9	0	N/A	4	2
Total (Excluding Duplicates)	9	9	0	N/A	4	2

* GM is not aware of any fatalities related to the subject condition.
** N/A – not applicable

GM's response to Item 2 does not include warranty claim data. Refer to question 5 for all warranty claim data. GM has searched the following sources to collect the data for this response: Corporate Central File, Customer Assistance Center, Technical Assistance Center, ESIS, Field Information Network Database, Company Vehicle Evaluation Program, Early Quality Feedback, 24 Hour Concern Detection Process, and Legal. The collection of the reports was completed on March 5, 2003.

3. **Separately, for each item (complaint, report, claim, notice, or matter) within the scope of your response to Request No. 2, state the following information:**
   a. **GM's file number or other identifier used;**
   b. **The category of the item, as identified in Request No. 2 (i.e., consumer complaint, field report, etc.);**
   c. **Vehicle owner or fleet name (and fleet contact person), address, and telephone number;**
   d. **Vehicle's model year;**
   e. **Vehicle's VIN;**
   f. **Incident date;**
   g. **Report or claim date;**
   h. **Vehicle's mileage at time of incident;**
   i. **Vehicle's speed at time of incident;**
   j. **Whether a crash is alleged;**
   k. **Number of alleged injuries, if any;**
   l. **Number of alleged fatalities, if any;**
   m. **System/component codes; and**
   n. **Summary of the complaint/report.**

   Provide this information in Microsoft Access 2000, or a compatible format, entitled "REQUEST NUMBER TWO DATA." See Enclosure 2, EA02-031 Data Collection Disc, for a pre-formatted table which provides further details regarding this submission.

   An electronic summary of the records included in Item 2 is provided on the CD in Attachment 1; refer to the Microsoft Access 2000 file in the folder labeled "Response for Q3." GM has organized this summary by GM file number within each attachment.

4. **Produce copies of all documents related to each item within the scope of Request No 2 excluding those submitted in GM's September 13, 2002 response to PE02-054. Organize the documents separately by category (i.e., consumer complaints, field reports, etc.) and describe the method GM used for organizing the documents.**

   Copies of the records identified in Item 2 are provided in the attachments listed in Table Q2. GM has organized the records by the GM file number within each attachment.

5. **State, by model year, a total count for all of the following categories of claims, collectively, that have been paid by GM to date that relate to, or may relate to, the alleged defect in the subject vehicles: warranty claims; extended warranty claims; claims for good will services that were provided; field, zone, or similar adjustments and reimbursements; and warranty claims or repairs made in accordance with a procedure specified in a technical service bulletin or customer satisfaction campaign. Separately, for each such claim, state the following information:**
   a. **GM's claim number;**
   b. **Vehicle owner or fleet name (and fleet contact person) and telephone number;**
   c. **VIN;**
   d. **Repair date;**
   e. **Vehicle mileage at time of repair;**
   f. **Repairing dealer's or facility's name, telephone number, city and state or ZIP code;**
   g. **Labor operation number;**
   h. **Problem code;**
   i. **Replacement part number(s) and description(s);**

j. Concern stated by customer; and
k. Comment, if any, by dealer/technician relating to claim and/or repair.

Provide this information in Microsoft Access 2000, or a compatible format, entitled "WARRANTY DATA." See Enclosure 2, EA02-031 Data Collection Disc, for a pre-formatted table which provides further details regarding this submission.

A summary of warranty claims that may relate to the subject condition on vehicles for sale or lease in the U.S. is provided on the CD in Attachment 1; refer to the Microsoft Access 2000 file in the folder labeled "Response for Q5." The summary includes claims provided in GM's previous submissions on September 13, 2002 and October 23, 2002. GM searched its Claims Analysis Retrieval Database (warranty database) on February 14, 2003.

GM's warranty database does not contain the following information: vehicle owner's name or telephone number, replacement part number description, or customer concern statement. GM is providing fields labeled "Customer Code", "Customer Code Description" and "Verbatim Text" in response to request 5j and 5k. The verbatim text is an optional field, not required to be completed for every warranty claim. It is for the dealer to enter any additional comments that may be applicable to the warranty claim.

The warranty data provided has limited analytical value in analyzing the field performance of a motor vehicle component. The warranty records do not contain sufficient information to establish the condition of the part at the time of the warranty correction; and service personnel may not consistently use the appropriate labor and trouble codes. Warranty numbers represent claims by our dealers for reimbursement for parts and labor costs incurred in performing warranty service for our customers.

6. **Describe in detail the search criteria used by GM to identify the claims identified in response to Request No. 5, including the labor operations, problem codes, part numbers and any other pertinent parameters used. Provide a list of all labor operations, labor operation descriptions, problem codes, and problem code descriptions applicable to the alleged defect in the subject vehicles.**

The warranty data was collected by searching for the labor codes listed in Table Q6. A list of warranty trouble codes and trouble code descriptions associated with the labor operations are provided on the CD in Attachment 1; refer to the Microsoft Excel 2000 file in the folder labeled "Response for Q6." Some of these trouble codes do not seem appropriate for a description of the alleged defect. Labor code E7501 is used for the replacement of the steering column locking parts for any reason.

TABLE Q6

LABOR CODE	DESCRIPTION
E7501	Locking Parts, Steering Column – Replace
V0743*	ECL Relay Harness Replace

* Labor code dedicated to performing product campaigns 01044 and 01044A.

The warranty data provided has limited analytical value in analyzing the field performance of a motor vehicle component. The warranty records do not contain sufficient information to establish the condition of the part at the time of the warranty correction, and service personnel do not consistently use the appropriate labor and trouble codes. Warranty numbers represent claims by our dealers for reimbursement for parts and labor costs incurred in performing warranty service for our customers.

7. **State, by model year, the terms of the new vehicle warranty coverage offered by GM on the subject vehicles (i.e., the number of months and mileage for which coverage is provided and the vehicle systems that are covered). Describe any extended warranty coverage option(s) related to the alleged defect that GM offered for the subject vehicles and state by option and model year, the number of vehicles that are covered under each such extended warranty.**

   The subject vehicles are covered by a bumper-to-bumper new vehicle warranty for three years or 36,000 miles, whichever occurs first. Many extended warranty options are available through GM dealerships. They are offered at different prices and for varying lengths of time, based on customer's preference, up to 7 years from the date of purchase or up to a total of 100,000 vehicle miles. The GM warranty system does not contain information on the number of vehicles that have extended warranty coverage

8. **Provide a chart showing electronic column lock warranty incidents per thousand vehicles by build month and by time in service. Provide all charts in full color, or in an electronic format that contains full color.**

   The requested charts are provided on the CD in Attachment 1; refer to the Microsoft Excel 2000 file in the folder labeled "Response for Q8." These charts were completed on March 24, 2003 by GM Product Investigations Department using the information provided for Item 1 and Item 5 of this response.

9. **Produce copies of all service, warranty, and other documents that relate to, or may relate to, the alleged defect in the subject vehicles, that GM has issued to any vehicle owners, dealers, regional or zone offices, field offices, fleet purchasers, or other entities, other than those identified in GM's September 13, 2002 response to PE02-054. This includes, but is not limited to, bulletins, advisories, informational documents, training documents, or other documents or communications, with the exception of standard shop manuals. Also include the latest draft copy of any communication that GM is planning to issue within the next 120 days.**

   GM supplied communications to the dealers related to the subject investigation as part of its September 13, 2002 response. Attachment 9 contains a copy of the communication to the dealers related to the subject investigation since September 13, 2003. This data was supplied by GM Service and Parts Operation on March 21, 2003

   General Motors is not planning to issue any additional service, warranty or other technical document or communication to its dealers, regional offices, zone offices or other entities regarding the subject condition.

10. **Describe all assessments, analyses, tests, test results, studies, surveys, simulations, investigations, inquiries and/or evaluations (collectively, "actions") that relate to, or may relate to, the alleged defect in the subject vehicles that have been conducted, are being conducted, are planned, or are being planned by, or for, GM, other than those identified in GM's September 13, 2002 response to PE02-054. For each such action, provide the following information:**
    a. **Action title or identifier;**
    b. **The actual or planned start date;**

c. The actual or expected end date;

d. Brief summary of the subject and objective of the action;

e. Engineering group(s)/supplier(s) responsible for designing and for conducting the action; and,

f. A brief summary of the findings and/or conclusions resulting from the action.

For each action identified, provide copies of all documents related to the action, regardless of whether the documents are in interim, draft, or final form. Organize the documents chronologically by action and for each document provided, state the source of the document and the date the action was or will be completed.

The Table Q10-A summarizes the actions conducted by or on behalf of GM. The documents are provided on the CD in Attachment 1; refer to the Microsoft Excel 2000 and Microsoft Word 2000 files in the folder labeled "Response for Q10."

TABLE Q10-A

IDENTIFIER	START	END	SUMMARY OF TEST	GROUP	RESULT SUMMARY
C-6 ECL Actuator Rebound Evaluation Over Life Cycle	3/31/03	4/17/03 (estimate)	The objective is to determine if the lock pin can ever protrude, due to rebound, and contact the lock ring, while the micro switch continues to indicate an unlocked column. It is planned to run the test to 50,000 cycles (durability requirement of ignition switch).	Warren Electrical Test Development & Validation	To Be Determined
Analysis of Warranty Claims	1/07/03	On going, no set end date	Review recent warranty claims to determine if any may have happened while driving & identify vehicles that may exhibit alleged condition for further review.	GM Service & Parts Operation	Only one claim was identified that may exhibit condition – VIN 1G1YY22G0W5123464. Vehicle analyzed (see analysis below).
Evaluation of Customer Vehicle –VIN: 1G1YY22G0W5123464	3/13/03	4/15/03 (estimate)	Review vehicle to determine validity of complaint & likely cause. Vehicle was reviewed in MD. Column was removed for further analysis by Delphi & Honeywell	GM Engineering – Electrical, Steering Column Representatives, Delphi Automotive, Honeywell.	No cause identified that could result in column locking while vehicle is driven. Complaint does not appear to be valid. Further investigation is being done on the column.

In addition to the above documents, Delphi Automotive (Delphi) has provided information relating to the testing listed in Table Q10-B and analysis of the returned warranty parts. This information is provided in "Attachment-Delphi."

TABLE Q10-B

IDENTIFIER	START	END	SUMMARY OF TEST	GROUP	RESULT SUMMARY
Rebound Test	9/27/02	9/30/02	Evaluation of 26050980 & 26089807 w/o dynamic braking	Fasco/Invensys/ Honeywell	See Report Provided in Attachment-Delphi
Evaluation of Original 1997.2 MY System	4/03 (estimate)	5/03 (estimate)	Evaluation of Dynamic Braking	Honeywell & Delphi	To Be Determined

The preceding information was collected from GM Engineering, GM Service and Parts Operation, and Delphi Automotive. The data collection was completed on March 27, 2003.

11. State by model year and transmission type all modification(s), component(s), or kit(s) that would be required to retrofit the MY 2001 ECL assembly onto MY 1997-2000 subject vehicles, including all modifications required in the Passenger Zone Module (PZM). For each component or kit required, state the part number(s), the component or kit application, and the modifications made to the component or kit from the earlier vehicle. State whether any new or additional service or maintenance processes are required to retrofit or maintain the component(s) or kit(s) on earlier vehicles.

Table Q11 indicates the changes that would likely be necessary to retrofit MY 1997-2000 subject vehicles to make them similar to 2001 MY vehicles. GM cannot currently retrofit the 1997-2000 MY vehicles to make them the same as 2001 MY vehicles because production of the 2001 ECL has ceased.

Table Q11

VEHICLE – TRANSMISSION TYPE	1997 MY	EARLY 1998 MY	LATE 1998 MY	1999 MY	2000 MY
Automatic *Option 1*	1. New '97 PZM 2. New wiring kit to add SPDT ECL relay. 3. Latest ECL p/n 26089807*. 4. Steering wheel nut p/n 26056108.	1. New '98 PZM 2. New wiring kit to add SPDT ECL relay. 3. Latest ECL p/n 26089807*. 4. Steering wheel nut p/n 26056108.	1. Service Kit 88952428. 2. Latest ECL p/n 26089807*. 3. Steering wheel nut p/n 26056108.	1. Service Kit 88952428. 2. Latest ECL p/n 26089807*. 3. Steering wheel nut p/n 26056108.	1. Service Kit 88952428. 2. Latest ECL p/n 26089807*. 3. Steering wheel nut p/n 26056108.
Automatic Option 2	1. Service Kit 88952427 to disable ECL using procedure in Customer Satisfaction Campaign #01044A. 2. Steering wheel nut p/n 26056108.	1. Service Kit 88952427 to disable ECL using procedure in Customer Satisfaction Campaign #01044A. 2. Steering wheel nut p/n 26056108.	1. Service Kit 88952427 to disable ECL using procedure in Customer Satisfaction Campaign #01044A. 2. Steering wheel nut p/n 26056108.	1. Service Kit 88952427 to disable ECL using procedure in Customer Satisfaction Campaign #01044A. 2. Steering wheel nut p/n 26056108.	1. Service Kit 88952427 to disable ECL using procedure in Customer Satisfaction Campaign #01044A. 2. Steering wheel nut p/n 26056108.
Manual	1. New '97 PZM 2. New wiring kit to add SPDT ECL relay. 3. Latest ECL p/n 26089807*. 4. Steering wheel nut p/n 26056108.	1. New '98 PZM 2. New wiring kit to add SPDT ECL relay. 3. Latest ECL p/n 26089807*. 4. Steering wheel nut p/n 26056108.	1. Service Kit 88952428. 2. Latest ECL p/n 26089807*. 3. Steering wheel nut p/n 26056108.	1. Service Kit 88952428. 2. Latest ECL p/n 26089807*. 3. Steering wheel nut p/n 26056108.	1. Service Kit 88952428. 2. Latest ECL p/n 26089807*. 3. Steering wheel nut p/n 26056108.

* ECL part number 26089807 has supercaded ECL part number 26050960 used in MY 2001 vehicles.

Please note that some of these changes have not been validated and other changes may be necessary. In addition the following are likely:

Automatic Option 1 and Manual Notes

- New Passenger Zone Modules are required to add the software to control the external Electric Column Lock Relay, using an existing spare low side driver. The software changes would drive new GM part numbers. The new Passenger Zone Modules would be used by both auto and manual transmission vehicles for a given model year.

- New wiring kit would be needed for 1997 to Early 1998 model year vehicles to add SPDT relay to ECL subsystem.

- The latest ECL part number 26089807 would be needed to update the steering column. It could be released with the new wiring kit in item 2 above.

- Service Kit 88952428 converts an existing SPST ECL relay to a SPDT ECL relay. The kit contains a new SPDT ECL relay and a wiring jumper. In addition, the latest ECL p/n 26089807 and steering wheel nut p/n 2606608 are needed.

Automatic Option 2 Notes

- Service Kit 88952427 is used to disable the ECL using procedure provided in Customer Satisfaction Campaign #01044A. The steering column lock/cam orientation plate is replaced with a new cam orientation plate. A new jumper wire and relay harness (from the kit) is used to replicate the function of the ECL. The ECL actuator remains operational to counteract oxide growth on the ECL relays in the Passenger Zone Module. The ECL lock bolt will no longer lock the column because the steering column lock/cam orientation plate has been replaced with a new cam orientation plate.

12. **Provide a chronological description of all modifications or changes, other than those identified in GM's September 13, 2002 response to PE02-054, made by, or on behalf of, GM in the design, material composition, manufacture, quality control, supply, or installation of the subject component, from the start of production to date, which relate to, or may relate to, the alleged defect in the subject vehicles. For each such modification or change, provide the following information:**
    a. **The date or approximate date on which the modification or change was incorporated into vehicle production;**
    b. **A detailed description of the modification or change;**
    c. **The reason(s) for the modification or change;**
    d. **The part numbers (service and engineering) of the original component;**
    e. **The part number (service and engineering) of the modified component;**
    f. **Whether the original unmodified component was withdrawn from production and/or sale, and if so, when;**
    g. **Disposition of unused pre-modified parts;**
    h. **When the modified component was made available as a service component; and,**
    i. **Whether the modified component can be interchanged with earlier production components.**

Also, provide the above information for any modification or change that GM is aware of which may be incorporated into vehicle production within the next 120 days.

GM is not aware of any changes made to the subject component that were not provided in its previous response. There is a planned change to change the Positive Temperature Coefficient (PTC - thermal circuit breaker Part number 26089807) in June of 2003 because the manufacturer (Raychem) is incorporating a material change that will obsolete the current PTC. There should be

no effect on the performance of the Electric Column Lock (ECL). The new PTC (part number has not been determined) is planned to be interchangeable with the current part number. It is intended that current stock will be used. The date the new part will be available in service has not been determined.

13. Furnish each of the following:

a. Field return samples of the subject component exhibiting each subject failure mode GM has identified, including subject components exhibiting the following:

I. Failure of actuator;
II. Short circuiting of ECL;
III. Binding of worm/worm gear;
IV. Excessive lock bolt rebound; and
V. Any other failure mode.

b. One assembled steering column (without steering wheel) per Enclosure 3, General Motor's 1998 Chevrolet Corvette Service Manual - Steering Column – Disassembled View; and

c. Two exemplar samples of the Shaft Lock Shield Assembly.

To respond to 13a, GM requested parts returned to its Warranty Return Center. As of March 21, GM had not identified any parts responsive to 13a. If any parts are returned that are responsive to 13a, GM will forward them to NHTSA.

Delphi Automotive will supply the parts requested in 13b and 13c. Delphi will send them to VRTC as NHTSA requested in the e-mail note from Ms. Cheryl Tuosto dated March 14, 2003.

14. Produce GM's design specifications and testing requirements for the subject component used on the subject vehicle, including:

a. The original GM specification;
b. A chronological listing of all specification modifications or additions, including the date the change was incorporated into the production of the subject vehicle and the reason for the change;
c. The original testing requirements and a description of how each testing process was conducted, including the name and description of each type of testing and measurement equipment;
d. The test results used to validate how the subject component met the design specifications for each testing requirement;
e. A chronological listing of any testing requirement modification or addition, including a description of the modified or additional testing procedure, if applicable, the date the change was incorporated into the production of the subject vehicle, and the reason the change was made; and
f. The test results used to validate how the subject component met the design specifications for each modified testing requirement.;

a. Attachment 14 contains the GM specification, 26087216 - revision 001. GM is seeking confidentiality on this information. The Delphi specification is 26052016 - revision 025. Delphi is seeking confidentiality on this specification. The Delphi specification and the request for confidentiality are provided in Attachment-Delphi.

b. The specification change history is included as the last page of each specification. There have been no changes to the GM specification since its release.

c. The testing requirements are listed in the specifications. A description of the testing process is contained in the specification instructions.

d. Test results are provided in the Attachment-Delphi, Appendix A.

e. No changes or additions were made to the testing requirements.

f. Not applicable. There were no modified testing requirements.

15. The following questions refer to the summary table provided on Bates pages GM622 Att. 10 16 through 18 in Attachment "10" of GM's September 13, 2002 response to PE02-054.

a. State the source and date of the document.

b. Produce copies of all reference documents cited, including:

I. Reference Document B-2;
II. Reference Document C-1;
III. Reference Document D-1;
IV. Reference Document E-4;
V. Chart: Appendix S;
VI. Reference Documents J-1, J-3, and J-4;
VII. Reference Document N; and
VIII. Reference Document K-1.

c. Explain the terminology "PPAP", "Interim A", "Interim D", and "engineering permit", as it applies to the subject component.

d. Explain the PPAP approval process and requirement specifications for the steering column as it relates to the subject component in the subject vehicle.

e. Explain the requirements and testing procedures necessary to validate the ECL actuator and provide the test results used to substantiate its validation prior to the start of production of the subject vehicles.

f. Explain the ECL durability requirements and the specific durability requirements referenced in the 12/19/96 modification description, which Fasco (Invensus) could not meet.

g. Explain each action that Fasco (Invensus) has taken to meet the specific durability requirements that it could not meet in question 14f.

h. Describe failure mode referenced in the 04/1998 modification description and the vehicle mechanism GM changed to address this failure mode.

i. Describe the purpose and requirement specifications of the relay referenced in the 04/1998-12/1999 modification description, which GM added in April 1998.

j. Produce all documents and drawings that relate to, or may relate to, the relay referenced in question 14i.

k. Provide GM's detailed opinion of how and why the relay referenced in question 14h adversely affected the performance of the ECL.

l. Describe the "out of print" condition experienced with the stainless steel actuator referenced in the 12/16/98 modification description and the procedure used to rectify this issue in the subject vehicles containing the subject component.

a. Delphi Automotive provided the chart on pages 16-18 of Attachment 10 in GM's previous response. Delphi has not been able to confirm the author or date of the chart. There are some inaccuracies in the chart. For example, the chart indicates that GM identified early warranty concerns in the fall of 1996; however, the 1997 MY was a late introduction and was not introduced to commerce until early 1997 calendar year. Therefore, there could not be any

warranty in the fall of 1996. It is more likely that the chart refers to a concern that surfaced during validation or durability testing.

b. The referenced documents are provided by Delphi in Attachment-Delphi.

c. The following terms: "PPAP", "Interim A", "Interim D", and "engineering permit" are explained in the PPAP process booklet provided in Attachment-Delphi.

d. The PPAP approval process is defined in the PPAP process booklet provided in Attachment-Delphi.

e. This is explained in Attachment-Delphi, response to 15.

f. This is explained in Attachment-Delphi, response to 15.

g. This is explained in Attachment-Delphi, response to 15.

h. This question was answered in GM's September 13, 2002 response to PE02-054. Please the response to question 17c.

i. The purpose of the SPST relay was described in GM's September 13, 2002 response 17c to PE02-054.

j. The requested drawings are provided on the CD in Attachment 1; refer to the files in the folder labeled "Response for Q15i."

k. Prior to the addition of the relay, the ECL actuator, when commanded to unlock, had an inadvertent 350,000 ohms resistive load across the ECL motor when the circuit was de-energized. This resistive load may cause some dynamic braking of the ECL motor, and may help the ECL motor to slow. The addition of the relay eliminates the resistive load.

GM does not believe that the 350,000 ohm resistive load contributes any significant dynamic braking of the ECL motor. The analysis, found in Attachment 1, Response to Q15k, indicates that the load resistance needs to be less than 13 ohm for dynamic braking to occur. Therefore, the addition of the relay does not adversely affect the ECL function. GM and Delphi intend to conduct testing to provide additional information on this issue, refer to the planned testing listed in response to item 10.

l. This is explained in Attachment-Delphi, response to 15.

This response was prepared from data supplied by GM Engineering, GM Supplier Quality and Delphi on March 21, 2003.

16. Provide the following product validation and quality assurance (SQA) data relating to the subject component in the subject vehicles:
a. All Invensus product validation data;
b. All Delphi product validation data;
c. All GM product validation data;
d. All Invensus quality assurance (SQA) data;
e. All Delphi quality assurance (SQA) data; and
f. All GM quality assurance data.

Include all documents relating to this data. For each document provided, state the source of the document, identify any testing performed, the entity that performed the tests, and the date each test was performed, state the testing procedure for each test, and state the results of the tests. Identify any problems, non-conformance to technical requirements, or other exceptions contained within this data and describe the corrective action taken.

a. The Invensys product validation data available at Delphi is provided in Attachment-Delphi, Appendix A.

b. Delphi product validation data is provided in Attachment-Delphi, Appendix A.

c. GM does not validate the column assembly as a system. It relies on the component testing conducted by the suppliers

d. GM does not have this information. Honeywell Corporation has indicated that this data will be submitted as part of its response to the IR that it received.

e. The Delphi quality assurance data is provided in Attachment-Delphi, Appendix D

f. GM does not conduct SQA testing on the ECL system. As part of the a general system check at the end of the assembly line the key is removed to verify the column properly locks; however, there are no records kept of this check. If a vehicle were to fail this check, it would be repaired prior to leaving the assembly plant.

This data was supplied by Delphi on March 21, 2003.

17. **Provide copies of all communications between GM and the first and second tier suppliers relating to the subject component. If any communications were oral or were conducted electronically, provide a written transcript or summary of each such communication, and include a statement that identifies the participants and the date of the communication.**

As part of this response and its September 13, 2003, GM supplied testing data and reports that it received from Delphi Automotive. Additional documents that GM has found responsive to this request are provided on the CD in Attachment 1; refer to the Microsoft Access 2000 file in the folder labeled "Response for Q5. Delphi has also supplied document that is has found. They are provided in Attachment-Delphi, Appendix E.

The GM information was supplied on March 25, 2003. The Delphi information was supplied on March 28, 2003.

18. **Identify, by make, model and model year, all other vehicles manufactured by GM which contain the subject component used in the subject vehicles. For each vehicle, state the following:**
    a. **Make;**
    b. **Model;**
    c. **Model year;**
    d. **The GM part number of the subject component;**
    e. **The manufacturer part number of the subject component;**
    f. **The number of vehicles sold; and**
    g. **The electrical schematic and/or wiring diagram detailing the ECL circuit in the vehicle.**

There are no other GM products that use the ECL system found on the subject vehicles.

19. Furnish GM's assessment of the alleged defect in the subject vehicle, including:

a. The causal or contributory factor(s);
b. The failure mechanism(s);
c. The failure mode(s);
d. The risk to motor vehicle safety that it poses;
e. What warnings, if any, the operator and the other persons both inside and outside the vehicle would have that the alleged defect was occurring or subject component was malfunctioning; and
f. The reports included with this inquiry.

GM has continued to monitor the alleged condition in the field and has not been able to substantiate any factor that could lead to a column locking while a vehicle is driving down the road. Most of the known reports of locked steering columns are consistent with a single point failure that results in a failure of the column to unlock. In that circumstance, the vehicle can be started and put in gear, but the column does not unlock. If the customer attempts to move the vehicle, the engine will stop when the vehicle reaches approximately 1 MPH. GM does not believe that this poses a safety risk. Specific responses to Question 19 follow:

a. GM has not been able to substantiate any factors that causes a steering column to lock while the vehicle is in motion.

b. GM has not been able to substantiate any failure mechanism that causes a steering column to lock while the vehicle is in motion. In January 2003, GM requested dealers and technicians call whenever there is an alleged complaint of a vehicle locking while in motion. GM has received several calls (see chart provided in Attachment 10) and has followed-up on each. In every case the complaint is consistent with a failure to unlock; and does not appear to have happened while the vehicle was in motion.

c. GM has not been able to substantiate any failure mode that causes a steering column to lock while the vehicle is in motion.

d. GM will continue to monitor this situation. However, for the following reasons GM believes that there is not a safety defect:

- GM has not found any evidence of a failure in the field that could cause the steering column to lock while the vehicle is being driven down the road.
- GM only received 9 new reports since its September 13 response, and most of these are consistent with a failure to unlock. This suggests that the rate of field complaints for the alleged condition is declining.
- There are a low number of reports (20) that indicate the customer was driving at speeds above 20 MPH. As indicated in GM's previous response Attachment 8A, GM has investigated many of these allegations, but in none of the cases did GM find any failures that could lead to a column locking while driving down the road.
- There are a low number of crashes (10 above 20 MPH).
- There are a low number of injuries (10, all minor).

- There are no fatalities.
- The Customer Satisfaction Campaigns appear to be addressing the customer's concerns.

e. Not applicable. GM cannot verify any warning related to the alleged condition.

f. Ninety-four percent of the 161 reports that NHTSA provided indicate the involved vehicle was not in motion; no speed was reported; or the speed was below 10 MPH. This is consistent with the steering column failing to unlock. In that circumstance, it would be possible for the vehicle to be moved a small amount, until a speed of 1 MPH is reached; at which time the engine is stopped. GM does not believe that this poses a safety risk.

* * *

General Motors requests that the document stamped "GM Confidential" included in Attachment 14 afforded confidential treatment by the NHTSA. This information is not customarily made public by General Motors and contains trade secrets and commercial information which is privileged or confidential under 5 U.S.C. Section 552(b)(4), 49 CFR Part 512 and 49 U.S.C. Section 30167(a).

Attachment 14 contains an engineering Subsystem Technical Specifications. These specifications have commercial value that can only be obtained independently at considerable cost. This information can be used by competitors to identify quality and performance requirements, thereby enabling them to improve their own products, without the expenditures associated with the development of these specifications, all at the expense of General Motors. Attachment 14 contains commercial information the disclosure of which would likely result in substantial competitive harm.

General Motors treats the above material as confidential proprietary information available only to authorized General Motors or supplier personnel, and not otherwise available to the public. The document is maintained under a record-keeping system which is intended to control dissemination of this material within General Motors, and to assure that it is not disseminated outside the Corporation, except as described in the attached certification made pursuant to 49 CFR Part 512.4(e).

To the best of our knowledge, no prior determinations of the confidentiality of this document has been made by the NHTSA, other Federal Agencies, or the Federal Courts. Document such as the one contained in Attachment 14, however, have, to the best of our knowledge, normally been granted confidential treatment by the NHTSA in the past. The document in Attachment 14 is of a type for which a class determination of confidentiality has been made under 49 CFR Part 512, Appendix B.

The document subject to this request for confidentiality has been clearly stamped "GM CONFIDENTIAL". If a request for disclosure of any or all of this information is received by the NHTSA, General Motors requests notification of receipt of each such request and, if necessary, an opportunity to further explain the reasons why such material is trade secret and commercial information which should not be disclosed under the applicable statutes and regulations.

This response is based on searches of General Motors Corporation (GM) locations where documents determined to be responsive to your request would ordinarily be found. As a result, the scope of this search did not include, nor could it reasonably include, "all of its divisions, subsidiaries (whether or not incorporated) and affiliated enterprises and all of their headquarters, regional, zone and other offices and their employees, and all agents, contractors, consultants, attorneys and law firms and other persons engaged directly or indirectly (e.g., employee of a consultant) by or under the control of GM (including all

business units and persons previously referred to), who are or, in or after January 1, 1994, were involved in any way with any of the following related to the alleged defect in the subject vehicles:

a. Design, engineering, analysis, modification or production (e.g. quality control);
b. Testing, assessment or evaluation;
c. Consideration, or recognition of potential or actual defects, reporting, record-keeping and information management, (e.g., complaints, field reports, warranty information, part sales), analysis, claims, or lawsuits; or
d. Communication to, from or intended for zone representatives, fleets, dealers, or other field locations, including but not limited to people who have the capacity to obtain information from dealers.

This response was compiled and prepared by this office upon review of the documents produced by various GM locations, and does not include documents generated or received at those GM locations subsequent to their searches.

Please contact me if you require further information about this response or the nature or scope of our searches.

Sincerely,

Lyndon R. Lie
Director
Product Investigations

attachments

CERTIFICATE IN SUPPORT OF REQUEST FOR CONFIDENTIALITY

I, Lyndon R. Lie, pursuant to the provisions of 49 CFR Part 512 state as follows:

(1) I am the Director of Product Investigations, and I am authorized by General Motors Corporation (GM) to execute documents on its behalf;

(2) The information stamped "GM Confidential" contained in Attachment 14 to this document is confidential and proprietary data and is being submitted with the claim that it is entitled to confidential treatment of 5 USC s552(b)(4), 49 U.S.C. Section 30167(a) and implemented in 49 CFR Part 512;

(3) I, or members of my staff, have personally inquired of the responsible GM personnel who have authority in the normal course of business to release the information for which a claim of confidentiality has been made to ascertain whether such information has ever been released outside GM;

(4) Based upon such inquiries to the best of my knowledge, information and belief, the information for which GM has claimed confidential treatment has never been released or become available outside GM or authorized supplier personnel, except as hereinafter specified: None.

(5) I make no representations beyond those contained in this certificate and in particular, I make no representations as to whether this information may become available outside GM because of unauthorized or inadvertent disclosure except as stated in Paragraph 4; and,

(6) I certify under penalty of perjury that the foregoing is true and correct. Executed on this the 28 day of March 2003.

Lyndon R. Lie
Director
Product Investigations

GENERAL MOTORS NORTH AMERICA
Structure & Safety Integration

OFFICE OF LYNDON R. LIE								01-28-03
✓ COPY		■ ASSIGNED				✖ FAX		
✓	BLUST	■	PLOTZKE	✖	LANGE	✓	DEACON	✖	FOLEY-GARDNER
✓	CZAJKOWSKI	✓	SCHULTZ	✖	CONNELLY	✖	EWING	✖	FOX
✓	DEBOTELL	✖	SIM	✖	COONEY	✖	GRAHAM	✖	SKAAR
✓	HOTCHKISS	✖		✖	GEHRING	✖	WACHTEL	✖	NIKOLOFF
✓	JANIK	✖	ARNETT	✖	PREMBELER	✖		✖	WILTSE
✓	KARDELL	✓	CRUMPTON	✖	SCHELL	✖	HALL	✖	ELLISON
✓	KREMER	✖	ROBINSON	✖		✖	RUSK	✖	BARREN
✓	LINENGER	✓	SILVERMAN	✖		✖	TONSOK	✖	

NHTSA LOG

DATE: November 15, 2002

GM IR #: GM-622B

FR: NHTSA OFFICE OF DEFECTS INVESTIGATIONS

TO: LYNDON R. LIE

UPGRADED: PE02-054

NOW: EA02-031

NHTSA HAS UPGRADED ITS DEFECT INVESTIGATION ON:

1997-01 CORVETTE

STEERING COLUMN LOCKUP

THE NHTSA OFFICE OF DEFECTS INVESTIGATION RESUME IS ATTACHED

WILL BE RECEIVING AN INFORMATION REQUEST? ☒ YES ☐ NO

Product Investigations
Mail Code: 480-106-304 • 30600 Mound Road • Warren, MI 48090-9055
Phone: (810) 986-8025 • Fax: (810) 947-2318

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Lyndon R. Lie, Director
Product Investigations
General Motors Corporation
Mail code 480-106-304
30500 Mound Road
Warren, MI 48090-9055

NVS-213
EA02-031

Dear Mr. Lie:

As you are aware, on November 15, 2002, the Office of Defects Investigation (ODI) of the National Highway Traffic Safety Administration (NHTSA) upgraded Preliminary Evaluation PE02-054 of alleged steering column lockup in model year (MY) 1997-2001 Chevrolet Corvette vehicles to Engineering Analysis EA02-031. As part of this investigation, this letter requests additional information from General Motors Corporation (GM).

The basis for upgrading this investigation is 344 consumer complaints submitted to ODI and GM, including 25 crashes and 10 injuries, and over 24,000 warranty claims. The warranty claims cited here are all claims submitted outside of the GM's Customer Service Campaign (CSC) 1044. A copy of 161 ODI reports, which do not include any of the reports previously provided in PE02-054, are enclosed for your information (Enclosure 1).

Unless otherwise stated in the text, the following definitions apply to these information requests:

- **Subject vehicles:** all MY 1997-2001 Chevrolet Corvette vehicles manufactured for sale or lease in the United States.
- **Subject component:** all electronic column lock (ECL) assemblies manufactured for use on the subject vehicles.
- **GM:** General Motors, all of its past and present officers and employees, whether assigned to its principal offices or any of its field or other locations, including all of its divisions, subsidiaries (whether or not incorporated) and affiliated enterprises and all of their headquarters, regional, zone and other offices and their employees, and all agents,

contractors, consultants, attorneys and law firms and other persons engaged directly or indirectly (e.g., employee of a consultant) by or under the control of GM (including all business units and persons previously referred to), who are or, in or after January 1, 1994, were involved in any way with any of the following related to the alleged defect in the subject vehicles:

a. Design, engineering, analysis, modification or production (e.g. quality control);
b. Testing, assessment or evaluation;
c. Consideration, or recognition of potential or actual defects, reporting, record-keeping and information management, (e.g., complaints, field reports, warranty information, part sales), analysis, claims, or lawsuits; or
d. Communication to, from or intended for zone representatives, fleets, dealers, or other field locations, including but not limited to people who have the capacity to obtain information from dealers.

- **Alleged defect**: the lockup of the steering column while the vehicle is in motion (regardless of cause).

- **Document**: "Document(s)" is used in the broadest sense of the word and shall mean all original written, printed, typed, recorded, or graphic matter whatsoever, however produced or reproduced, of every kind, nature, and description, and all non-identical copies of both sides thereof, including, but not limited to, papers, letters, memoranda, correspondence, communications, electronic mail (e-mail) messages (existing in hard copy and/or in electronic storage), faxes, mailgrams, telegrams, cables, telex messages, notes, annotations, working papers, drafts, minutes, records, audio and video recordings, data, databases, other information bases, summaries, charts, tables, graphics, other visual displays, photographs, statements, interviews, opinions, reports, newspaper articles, studies, analyses, evaluations, interpretations, contracts, agreements, jottings, agendas, bulletins, notices, announcements, instructions, blueprints, drawings, as-builts, changes, manuals, publications, work schedules, journals, statistical data, desk, portable and computer calendars, appointment books, diaries, travel reports, lists, tabulations, computer printouts, data processing program libraries, data processing inputs and outputs, microfilms, microfiches, statements for services, resolutions, financial statements, governmental records, business records, personnel records, work orders, pleadings, discovery in any form, affidavits, motions, responses to discovery, all transcripts, administrative filings and all mechanical, magnetic, photographic and electronic records or recordings of any kind, including any storage media associated with computers, including, but not limited to, information on hard drives, floppy disks, backup tapes, and zip drives, electronic communications, including but not limited to, the Internet and shall include any drafts or revisions pertaining to any of the foregoing, all other things similar to any of the foregoing, however denominated by GM, any other data compilations from which information can be obtained, translated if necessary, into a usable form and any other documents. For purposes of this request, any document which contains any note, comment, addition, deletion, insertion, annotation, or otherwise comprises a non-identical copy of another document shall be treated as a separate document subject to production. In all cases where original and any non-identical copies are not available, "document(s)"also means any identical copies of the original and all non-identical copies

thereof. Any document, record, graph, chart, film or photograph originally produced in color must be provided in color. Furnish all documents whether verified by the manufacturer or not. If a document is not in the English language, provide both the original document and an English translation of the document.

- **Other Terms:** To the extent that they are used in these information requests, the terms "claim," "consumer complaint," "dealer field report," "field report," "fire," "fleet," "good will," "make," "model," "model year," "notice," "property damage," "property damage claim," "rollover," "type," "warranty," "warranty adjustment," and "warranty claim," whether used in singular or in plural form, have the same meaning as found in 49 CFR 579.4.

In order for my staff to evaluate the alleged defect, certain information is required. Pursuant to 49 U.S.C. § 30166, please provide numbered responses to the following information requests. Insofar as GM has previously provided a document to ODI, GM may produce it again or identify the document, the document submission to ODI in which it was included and the precise location in that submission where the document is located. When documents are produced, the documents shall be produced in an identified, organized manner that corresponds with the organization of this information request letter (including all individual requests and subparts). When documents are produced and the documents would not, standing alone, be self-explanatory, the production of documents shall be supplemented and accompanied by explanation.

Please repeat the applicable request verbatim above each response. After GM's response to each request, identify the source of the information and indicate the last date the information was gathered.

1. State by model year the number of subject vehicles GM has manufactured for sale or lease in the United States. Separately, for each subject vehicle manufactured to date by GM, state the following:
   a. Vehicle identification number (VIN);
   b. Model Year;
   c. Transmission Type;
   d. Date of manufacture;
   e. Date warranty coverage commenced; and
   f. The State in the United States where the vehicle was originally sold or leased (or delivered for sale or lease).

   Provide the table in Microsoft Access 2000, or a compatible format, entitled "PRODUCTION DATA." See Enclosure 2, EA02-031 Data Collection Disc, for a pre-formatted table which provides further details regarding this submission.

2. State the number of each of the following, received by GM, or of which GM is otherwise aware, which relate to, or may relate to, the alleged defect in the subject vehicles:
   a. Consumer complaints, including those from fleet operators;
   b. Field reports, including dealer field reports;

c. Reports involving a crash, injury, or fatality, based on claims against the manufacturer involving a death or injury, notices received by the manufacturer alleging or proving that a death or injury was caused by a possible defect in a subject vehicle, property damage claims, consumer complaints, or field reports;
d. Property damage claims; and,
e. Third-party arbitration proceedings where GM is or was a party to the arbitration; and,
f. Lawsuits, both pending and closed, in which GM is or was a defendant or codefendant.

For subparts "a" through "f, " state the total number of each item (e.g., consumer complaints, field reports, etc.) separately. Multiple incidents involving the same vehicle are to be counted separately. Multiple reports of the same incident are also to be counted separately (i.e., a consumer complaint and a field report involving the same incident in which a crash occurred are to be counted as a crash report, a field report and a consumer complaint).

In addition, for items "c" through "f," provide a summary description of the alleged problem and causal and contributing factors and GM's assessment of the problem, with a summary of the significant underlying facts and evidence. For items e and f, identify the parties to the action, as well as the caption, court, docket number, and date on which the complaint or other document initiating the action was filed.

3. Separately, for each item (complaint, report, claim, notice, or matter) within the scope of your response to Request No. 2, state the following information:
   a. GM's file number or other identifier used;
   b. The category of the item, as identified in Request No. 2 (i.e., consumer complaint, field report, etc.);
   c. Vehicle owner or fleet name (and fleet contact person), address, and telephone number;
   d. Vehicle's model year;
   e. Vehicle's VIN;
   f. Incident date;
   g. Report or claim date;
   h. Vehicle's mileage at time of incident;
   i. Vehicle's speed at time of incident;
   j. Whether a crash is alleged;
   k. Number of alleged injuries, if any;
   l. Number of alleged fatalities, if any;
   m. System/component codes; and
   n. Summary of the complaint/report.

   Provide this information in Microsoft Access 2000, or a compatible format, entitled "REQUEST NUMBER TWO DATA." See Enclosure 2, EA02-031 Data Collection Disc, for a pre-formatted table which provides further details regarding this submission.

4. Produce copies of all documents related to each item within the scope of Request No 2 excluding those submitted in GM's September 13, 2002 response to PE02-054. Organize the documents separately by category (i.e., consumer complaints, field reports, etc.) and describe the method GM used for organizing the documents.

5. State, by model year, a total count for all of the following categories of claims, collectively, that have been paid by GM to date that relate to, or may relate to, the alleged defect in the subject vehicles: warranty claims; extended warranty claims; claims for good will services that were provided; field, zone, or similar adjustments and reimbursements; and warranty claims or repairs made in accordance with a procedure specified in a technical service bulletin or customer satisfaction campaign. Separately, for each such claim, state the following information:
   a. GM's claim number;
   b. Vehicle owner or fleet name (and fleet contact person) and telephone number;
   c. VIN;
   d. Repair date;
   e. Vehicle mileage at time of repair;
   f. Repairing dealer's or facility's name, telephone number, city and state or ZIP code;
   g. Labor operation number;
   h. Problem code;
   i. Replacement part number(s) and description(s);
   j. Concern stated by customer; and
   k. Comment, if any, by dealer/technician relating to claim and/or repair.

   Provide this information in Microsoft Access 2000, or a compatible format, entitled "WARRANTY DATA." See Enclosure 2, EA02-031 Data Collection Disc, for a pre-formatted table which provides further details regarding this submission.

6. Describe in detail the search criteria used by GM to identify the claims identified in response to Request No. 5, including the labor operations, problem codes, part numbers and any other pertinent parameters used. Provide a list of all labor operations, labor operation descriptions, problem codes, and problem code descriptions applicable to the alleged defect in the subject vehicles.

7. State, by model year, the terms of the new vehicle warranty coverage offered by GM on the subject vehicles (i.e., the number of months and mileage for which coverage is provided and the vehicle systems that are covered). Describe any extended warranty coverage option(s) related to the alleged defect that GM offered for the subject vehicles and state by option and model year, the number of vehicles that are covered under each such extended warranty.

8. Provide a chart showing electronic column lock warranty incidents per thousand vehicles by build month and by time in service. Provide all charts in full color, or in an electronic format that contains full color.

9. Produce copies of all service, warranty, and other documents that relate to, or may relate to, the alleged defect in the subject vehicles, that GM has issued to any vehicle owners, dealers, regional or zone offices, field offices, fleet purchasers, or other entities, other than those identified in GM's September 13, 2002 response to PE02-054. This includes, but is not

limited to, bulletins, advisories, informational documents, training documents, or other documents or communications, with the exception of standard shop manuals. Also include the latest draft copy of any communication that GM is planning to issue within the next 120 days.

10. Describe all assessments, analyses, tests, test results, studies, surveys, simulations, investigations, inquiries and/or evaluations (collectively, "actions") that relate to, or may relate to, the alleged defect in the subject vehicles that have been conducted, are being conducted, are planned, or are being planned by, or for, GM, other than those identified in GM's September 13, 2002 response to PE02-054. For each such action, provide the following information:
    a. Action title or identifier;
    b. The actual or planned start date;
    c. The actual or expected end date;
    d. Brief summary of the subject and objective of the action;
    e. Engineering group(s)/supplier(s) responsible for designing and for conducting the action; and,
    f. A brief summary of the findings and/or conclusions resulting from the action.

    For each action identified, provide copies of all documents related to the action, regardless of whether the documents are in interim, draft, or final form. Organize the documents chronologically by action and for each document provided, state the source of the document and the date the action was or will be completed.

11. State by model year and transmission type all modification(s), component(s), or kit(s) that would be required to retrofit the MY 2001 ECL assembly onto MY 1997-2000 subject vehicles, including all modifications required in the Passenger Zone Module (PZM). For each component or kit required, state the part number(s), the component or kit application, and the modifications made to the component or kit from the earlier vehicle. State whether any new or additional service or maintenance processes are required to retrofit or maintain the component(s) or kit(s) on earlier vehicles.

12. Provide a chronological description of all modifications or changes, other than those identified in GM's September 13, 2002 response to PE02-054, made by, or on behalf of, GM in the design, material composition, manufacture, quality control, supply, or installation of the subject component, from the start of production to date, which relate to, or may relate to, the alleged defect in the subject vehicles. For each such modification or change, provide the following information:
    a. The date or approximate date on which the modification or change was incorporated into vehicle production;
    b. A detailed description of the modification or change;
    c. The reason(s) for the modification or change;
    d. The part numbers (service and engineering) of the original component;
    e. The part number (service and engineering) of the modified component;
    f. Whether the original unmodified component was withdrawn from production and/or sale, and if so, when;

g. Disposition of unused pre-modified parts;
h. When the modified component was made available as a service component; and,
i. Whether the modified component can be interchanged with earlier production components.

Also, provide the above information for any modification or change that GM is aware of which may be incorporated into vehicle production within the next 120 days.

13. Furnish each of the following:
    a. Field return samples of the subject component exhibiting each subject failure mode GM has identified, including subject components exhibiting the following:
        i. Failure of actuator;
        ii. Short circuiting of ECL;
        iii. Binding of worm/worm gear;
        iv. Excessive lock bolt rebound; and
        v. Any other failure mode.
    b. One assembled steering column (without steering wheel) per Enclosure 3, General Motor's 1998 Chevrolet Corvette Service Manual - Steering Column – Disassembled View; and
    c. Two exemplar samples of the Shaft Lock Shield Assembly.

14. Produce GM's design specifications and testing requirements for the subject component used on the subject vehicle, including:
    a. The original GM specification;
    b. A chronological listing of all specification modifications or additions, including the date the change was incorporated into the production of the subject vehicle and the reason for the change;
    c. The original testing requirements and a description of how each testing process was conducted, including the name and description of each type of testing and measurement equipment;
    d. The test results used to validate how the subject component met the design specifications for each testing requirement;
    e. A chronological listing of any testing requirement modification or addition, including a description of the modified or additional testing procedure, if applicable, the date the change was incorporated into the production of the subject vehicle, and the reason the change was made; and
    f. The test results used to validate how the subject component met the design specifications for each modified testing requirement.

15. The following questions refer to the summary table provided on Bates pages GM622 Att. 10 16 through 18 in Attachment "10" of GM's September 13, 2002 response to PE02-054.
    a. State the source and date of the document.
    b. Produce copies of all reference documents cited, including:
        i. Reference Document B-2;
        ii. Reference Document C-1;
        iii. Reference Document D-1;

iv. Reference Document E-4;
v. Chart: Appendix S;
vi. Reference Documents J-1, J-3, and J-4;
vii. Reference Document N; and
viii. Reference Document K-1.

c. Explain the terminology "PPAP", "Interim A", "Interim D", and "engineering permit", as it applies to the subject component.
d. Explain the PPAP approval process and requirement specifications for the steering column as it relates to the subject component in the subject vehicle.
e. Explain the requirements and testing procedures necessary to validate the ECL actuator and provide the test results used to substantiate its validation prior to the start of production of the subject vehicles.
f. Explain the ECL durability requirements and the specific durability requirements referenced in the 12/19/96 modification description, which Fasco (Invensus) could not meet.
g. Explain each action that Fasco (Invensus) has taken to meet the specific durability requirements that it could not meet in question 14f.
h. Describe failure mode referenced in the 04/1998 modification description and the vehicle mechanism GM changed to address this failure mode.
i. Describe the purpose and requirement specifications of the relay referenced in the 04/1998-12/1999 modification description, which GM added in April 1998.
j. Produce all documents and drawings that relate to, or may relate to, the relay referenced in question 14i.
k. Provide GM's detailed opinion of how and why the relay referenced in question 14h adversely affected the performance of the ECL.
l. Describe the "out of print" condition experienced with the stainless steel actuator referenced in the 12/16/98 modification description and the procedure used to rectify this issue in the subject vehicles containing the subject component.

16. Provide the following product validation and quality assurance (SQA) data relating to the subject component in the subject vehicles:
    a. All Invensus product validation data;
    b. All Delphi product validation data;
    c. All GM product validation data;
    d. All Invensus quality assurance (SQA) data;
    e. All Delphi quality assurance (SQA) data; and
    f. All GM quality assurance data.

    Include all documents relating to this data. For each document provided, state the source of the document, identify any testing performed, the entity that performed the tests, and the date each test was performed, state the testing procedure for each test, and state the results of the tests. Identify any problems, non-conformance to technical requirements, or other exceptions contained within this data and describe the corrective action taken.

17. Provide copies of all communications between GM and the first and second tier suppliers relating to the subject component. If any communications were oral or were conducted

electronically, provide a written transcript or summary of each such communication, and include a statement that identifies the participants and the date of the communication.

18. Identify, by make, model and model year, all other vehicles manufactured by GM which contain the subject component used in the subject vehicles. For each vehicle, state the following:
    a. Make;
    b. Model;
    c. Model year;
    d. The GM part number of the subject component;
    e. The manufacturer part number of the subject component;
    f. The number of vehicles sold; and
    g. The electrical schematic and/or wiring diagram detailing the ECL circuit in the vehicle.

19. Furnish GM's assessment of the alleged defect in the subject vehicle, including:
    a. The causal or contributory factor(s);
    b. The failure mechanism(s);
    c. The failure mode(s);
    d. The risk to motor vehicle safety that it poses;
    e. What warnings, if any, the operator and the other persons both inside and outside the vehicle would have that the alleged defect was occurring or subject component was malfunctioning; and
    f. The reports included with this inquiry.

This letter is being sent to GM pursuant to 49 U.S.C. § 30166, which authorizes NHTSA to conduct any investigation that may be necessary to enforce Chapter 301 of Title 49 and to request reports and the production of things. It constitutes a new request for information. GM's failure to respond promptly and fully to this letter could subject GM to civil penalties pursuant to 49 U.S.C. § 30165 or lead to an action for injunctive relief pursuant to 49 U.S.C. § 30163. (Other remedies and sanctions are available as well.) Please note that maximum civil penalties under 49 U.S.C. § 30165 have increased as a result of the recent enactment of the Transportation Recall Enhancement, Accountability, and Documentation (TREAD) Act, Public Law No. 106-414 (signed November 1, 2000). Section 5(a) of the TREAD Act, codified at 49 U.S.C. § 30165(b), provides for civil penalties of up to $5,000 per day, with a maximum of $15 million for a related series of violations, for failing or refusing to perform an act required under 49 U.S.C. § 30166. This includes failing to respond to ODI information requests.

If GM cannot respond to any specific request or subpart(s) thereof, please state the reason why it is unable to do so. If on the basis of attorney-client, attorney work product, or other privilege, GM does not submit one or more requested documents or items of information in response to this information request, GM must provide a privilege log identifying each document or item withheld, and stating the date, subject or title, the name and position of the person(s) from, and the person(s) to whom it was sent, and the name and position of any other recipient (to include all carbon copies or blind carbon copies), the nature of that information or material, and the basis for the claim of privilege and why that privilege applies.

GM's response to this letter, in duplicate, together with a copy of any confidentiality request, must be submitted to this office by **March 28, 2003**. Please refer to EA02-031 in GM's response to this letter. If GM finds that it is unable to provide all of the information requested within the time allotted, GM must request an extension from Jeffrey Quandt at (202) 366-5207 no later than five business days before the response due date. If GM is unable to provide all of the information requested by the original deadline, it must submit a partial response by the original deadline with whatever information GM then has available, even if an extension has been granted.

If GM claims that any of the information or documents provided in response to this information request constitute confidential commercial material within the meaning of 5 U.S.C. § 552(b)(4), or are protected from disclosure pursuant to 18 U.S.C. § 1905, GM must submit supporting information together with the materials that are the subject of the confidentiality request, in accordance with 49 CFR Part 512, to the Office of Chief Counsel (NCC-113), National Highway Traffic Safety Administration, Room 5219, 400 Seventh Street, S.W., Washington, D.C. 20590. GM is required to submit two copies of the documents containing allegedly confidential information (except only one copy of blueprints) and one copy of the documents from which information claimed to be confidential has been deleted.

If you have any technical questions concerning this matter, please call Cheryl Tuosto of my staff at (202) 366-1869.

Sincerely,

Kathleen C. Demeter, Office Director
Office of Defects Investigation
Vehicle Safety

Enclosure 1, 161 Consumer Complaints
Enclosure 2, one CD ROM titled EA02-031 Data Collection Disc containing three files
Enclosure 3, General Motor's 1998 Chevrolet Corvette Service Manual - Steering Column – Disassembled View

VOQ NOs: 847524, 847624, 709793, 709813, 710195, 710722, 852313, 549439, 713331, 853726, 857996, 867996, 715251, 858648, 858648, 859668, 859668, 721517, 860561, 860561, 722429, 723199, 723232, 863460, 863460, 864067, 864071, 723465, 723487, 724018, 724044, 724118, 724686, 865069, 865398, 724902, 725200, 725220, 726259, 726451, 867662, 727760, 728502, 728388, 728986, 725500, 725512,725701, 725734, 726549, 726767, 724473, 870914, 731324, 854362, 864515, 730803, 733150, 873815, 873815, 735912, 737020, 737602, 737643, 737981, 857121, 887121, 744646, 887597, 887849, 733801, 766170, 751902, 864222, 8016605, 749356, 724910, 854299, 896851,726887, 726293, 730256, 730883, 730908, 745008, 745415, 745537, 746207, 889736, 890467, 746440, 746504, 746734, 747022, 747501, 747575, 747855, 892620, 748030, 748538, 750908, 751049, 751137, 752107, 896528, 752599, 754094, 8004509, 761799, 8011895, 763098, 8012737, 8012856, 763749, 763965, 8013711, 8012712, 764029, 764556, 764677, 8014637, 8014673, 8014969, 8015002, 8015104, 8015565, 8015756, 8015789, 765280, 765393, 8019441, 8016123, 8016294, 8016713, 766104, 766348, 766375, 766568, 766825, 8018468, 766963, 767082, 8018734, 767191, 8018921, 567472, 8020423, 767699, 767987, 768499, 8022625, 837079, 842279, 710830, 710830, 717135, 726075, 721513, 723568, 724240, 892872, 749921, 726360, 553532, 733598, 731928, 731947, 882036, 745653, 746202

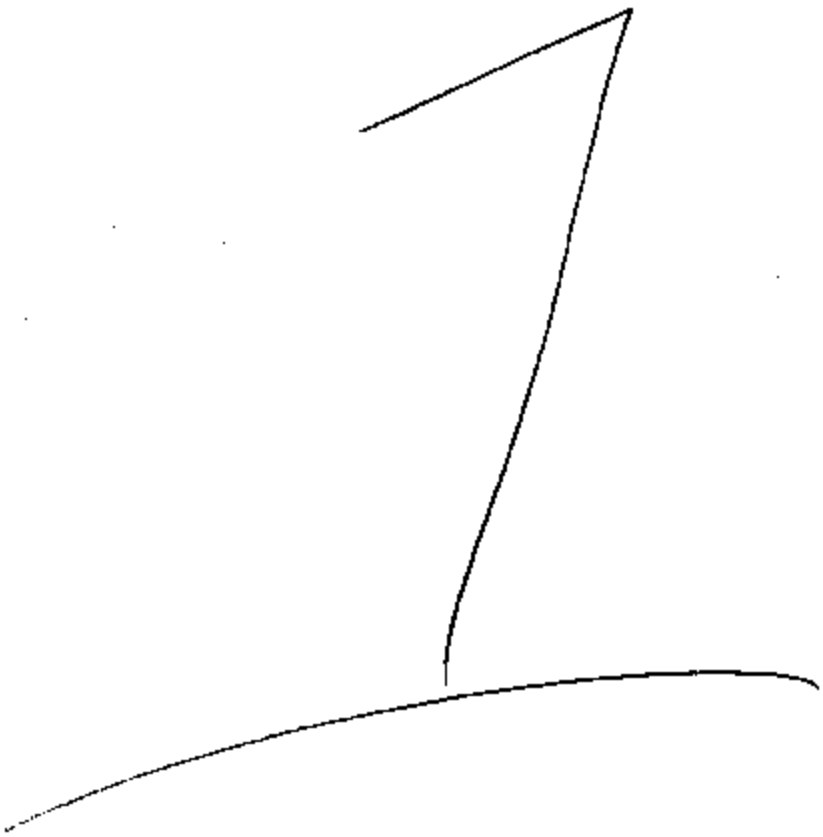
NHTSA:NVS:ODI

NVS-*121\TUOTSO:vrj:*

Cc:
NVS-200 Chron
NVS-213 *Johnson* Chron
Document:*\121:EA02-_031_Steering Column Lock_GMIR_0121*

Mr. Lyndon R. Lie, Director
Product Investigations
General Motors Corporation
Mail code 480-106-304
30500 Mound Road
Warren, MI 48090-9055

NVS-213
EA02-031



GM622B
EA02-031

ATTACHMENT "1"

GM622B
EA02-031

ATTACHMENT "2A"

GENERAL MOTORS CORPORATION
CHEVROLET DIVISION
GM RESTRICTED

CUSTOMER: [redacted]
ADDRESS:
HOME PHONE:

San Jose , CA 95120

CASE NUMBER:	1-21986008	VIN:	1G1YY22G9W5100846
		MODEL YEAR:	1998
DATE OPENED:	2002-08-05	SERIES:	Corvette
DATE CLOSED:	2002-09-11	MILEAGE:	42203.0000000
SOURCE:	Phone	DELIVERY DATE:	
BRC TYPE:	N/AYes	DEALER NAME:	Carl Chevrolet, Inc.
BRC PARENT:		DEALER ADDRESS:	905 W Capitol Expy Automall,San Jose,CA,95136-1197,USA

**********GENERAL CASE INFORMATION**********

M01 General
0 REPAIR ATTEMPT(S) Inoperative

**********WORK HISTORY**********

steering locked up; ; 2002-08-05
02-08-05

spoke with a woman in service; ; 2002-08-05
2002-08-05

1-21986008 call dlr to speak with Phil about cust concern; ; 2002-08-05
2002-08-05

calling cust to advise of gw offer; ; 2002-08-05
2002-08-19

1-21986008 - call to follow up on repair and documents; ; 2002-08-19

1-21986008 - CALL CUST TO F/U ON DOCS; ; 2002-08-29
2002-08-28

REQ DOCS; ; 2002-08-28
2002-08-28

REQ DOCS; ; 2002-08-29
2002-08-28

REQUEST FOR ASSISTANCE Scanned: 2002-08-26-22.39.48.000000, MSXDocNum: 0223800637; ; 2002-08-29
2002-08-29

OKE WITH SVC DEPT; ; 2002-08-29

1-21986008 - CALL DRL TO VERIFY PAYMENT AND AMOUNT; ; 2002-08-30

1-21986008 - CALL CUST TO VERIFY AMOUNT AND ADDRESS FOR REIM; ; 2002-08-30

2002-08-30

CAPITAL; ; 2002-08-30
2002-08-30

1-21986008 - CALL CUST TO VERIFY AMOUNT AND ADDRESS; ; 2002-08-30

1-21986008 - CALL CUST TO VERIFY AMOUNT AND ADDRESS; ; 2002-09-04
2002-09-04

creating reim; ; 2002-09-04
2002-09-04

Created:CAC_RS0005. SR#1-21986008; ; 2002-09-04
2002-09-04

REIMBURSEMENT FOR 219.00 TO GL FOR REVIEW AND SUBMISSION; ; 2002-09-05
2002-09-05

Reimbursement $219.00 to approver for final approval; ; 2002-09-05
2002-09-05

Goodwill Status has been changed from: Not Initiated to Pending SITEL; ; 2002-09-05
2002-09-05

Reimbursement in the amount of $219.00 was final approved.; ; 2002-09-05
2002-09-05

odwill Status has been changed from: PreAprv - Check to Pending SITEL; ; 2002-09-05
002-09-05

Goodwill Status has been changed from: PreAprv - Check to Approved; ; 2002-09-05
2002-09-05

Service Request has been Closed Satisfied.; ; 2002-09-05
2002-09-11

CHECK MAILED; ; 2002-09-11
2002-09-11

Service Request has been Closed Satisfied.; ; 2002-09-11

**********PAR INFORMATION**********

INCIDENT DATE:
INCIDENT TIME:
INCIDENT LOCATION:

DRIVER NAME:
DRIVER AGE:
DRIVER DISABILITY:

OWNER DESCRIPTION:

ALLEGED DEFECTIVE COMPONENT:

CIDENT RESULT:
POLICE REPORT:
ROAD CONDITION:
ROAD SURFACE:
NUMBER OF PEOPLE:
BODY INJURY:
INJURIES:

WAS ANOTHER VEHICLE INVOLVED:

NUMBER OF VEHICLES: 0

[redacted]OPERTY DAMAGE:

WAS VEHICLE INSURED:
INSURANCE COMPANY NAME:
INSURANCE COMPANY ADDRESS:
AGENT NAME:
AGENT PHONE NUMBER:

MORE INFORMATION:
MAINTENANCE LOCATION:
CURRENT LOCATION OF VEHICLE:
NOTIFY NAME:

WAS VEHICLE INSPECTED:
INSPECTORS NAME:. INSPECTION DATE:
MILEAGE AT INSPECTION:
WHERE WAS INSPECTION DONE:

WAS VEHICLE ROAD TESTED:
ROAD TEST DESCRIPTION:
ROAD TEST RESULT:
COMP INSPECTED:
INVESTIGATIVE SUMMARY:
PAR STATUS:

**********PAR INFORMATION**********

SOURCE:
TRANSACTION:
REQUEST TYPE:
REPURCHASE REASON:

[redacted]ALER BAC:
[redacted]EALER NAME:
DEALER ADDRESS: , ,
CONTACT: ,
PHONE NUMBER:
FAX NUMBER:
PRODUCT CODE:
BODY TYPE:
TRIM:
ENGINE TYPE:
TRANSMISSION:
VEHICLE DRIVEABLE:
MILEAGE @ BUY-BACK: 0
BRC WARRANTY DATE:
MSRP:
NADA: 0
SALES TAX:

DEPRECIATION:
UPGRADE:
AFTERMARKET:
LEASE TERM:
DAMAGE:
OTHER:
BRANCH:
NAME:
ACCOUNT NUMBER:
INTEREST RATE:
INTEREST PAID:
DEALER BUYOUT:

ACCOUNT BALANCE:
LEGAL:
LEGAL TYPE:
LEMON LAW:
DEALER ADMINISTRATION:
VEHICLE DESTINATION:
RELEASE:
LIEN PAYOFF:
TITLE BRAND:

[redacted]PLACEMENT VIN:

**********BODILY INJURY**********

NUMBER OF INJURIES: 0
COMMENTS:

NAME: LOCATION:
ADDRESS: ,
CITY/STATE: ,
PHONE NUMBER:
SEATING POSITION: RESTRAINT:
TYPE OF INJURY:
TREATED: IF SO, WHERE:

**********ADR INFORMATION**********

EXTERNAL CASE NUMBER: DATE:
TITLE NAMES:
BUSINESS: % BUSINESS: 0
ACCIDENT: DATE OF ACCIDENT:
DESCRIPTION OF DAMAGE:
PURCHASE/LEASE: 0 DATE OF PURCHASE/LEASE:
MILEAGE AT PURCHASE: 0 PURCHASE/LEASE AS:
DOES OWNER HAVE POSESSION OF VEHICLE:
RESOLUTION SOUGHT:

**********BRC CONTACT INFORMATION**********

NAME: CONTACT NUMBER: 1
COMPANY: CONTACT TYPE:
CONTACT PHONE:

ADDRESS:

March 27, 2003

[redacted]

Service Request: S1-21986008

Dear Mr. Deornellas:

We sincerely regret that you experienced a concern with your 1998 Chevrolet Corvette, which resulted in an unexpected repair expense to you.

We value you as a Chevrolet owner and your satisfaction with our products is a high priority. As we discussed over the phone, we believe you are entitled to a reimbursement. We have enclosed a check in the amount of $ 219.00. We hope this goodwill adjustment will offset, to some degree, the inconvenience that this repair may have caused you.

We look forward to keeping you in our Chevrolet family. If you have any future questions, please feel free to contact our Chevrolet Customer Assistance Center at 1-800-222-1020 Monday through Friday between 8:00 a.m. and 11:00 p.m., Eastern Time. Please refer to your service request number above and any of our Customer Relationship Managers will be happy to assist you.

Sincerely,

Dana Saier
Customer Relationship Manager

RS0005-T/pdm

North American Operations
General Motors Corporation
Disbursements (2613)
PO Box 62530
Phoenix, AZ 85062-2530

CHECK No. 900504938

DATE 09/09/02

**************219 DOLLARS ****00 CENTS

AMOUNT **************219.00

PAY TO THE ORDER OF [redacted]

North American Operations
General Motors Corporation
Disbursement Account

[redacted]

SEP 09 2002

The Chase Manhattan Bank, N.A.
Syracuse, New York

AUDIT

⑈900504938⑈ ⑆021309379⑆ 601⑈2⑈62520⑈

North American Operations
General Motors Corporation
Disbursements (2613)
PO Box 62530
Phoenix, AZ 85062-2530

DETACH BEFORE DEPOSITING CHECK

VENDOR UNIT NO. 33 000000005 1

CHECK NO. 900504938

VENDOR NAME HARRY DESRNELLAS

PAYMENT DATE 09/09/02

INVOICE NO. DESCRIPTION	INVOICE DATE	DOC. REFERENCE NUMBER	% DISC.	INVOICE AMOUNT	DISC. AMOUNT	NET AMOUNT
101TY2209NE100	09/04/02 44.1-21904400	VM 1-I0C01 .1-I0C01	00.0000	219.00	.00	219.00
TOTAL				219.00	.00	219.

ACCEPTANCE OF THIS CHECK CONSTITUTES FULL RESOLUTION FOR REIMBURSEMENT. ON QUESTIONS CALL 800-462-8782

NISSAN

ALAND NISSAN INC.
P.O. Box [illegible]
[illegible] El Camino Real
Millbrae, CA 94030-0[illegible]

CHEVROLET
P.O. BOX 33170
DETROIT, MI.
48232

AUG 26 2002

ATTN: DANA SAIER
RE: E1-2198-6008

48232+5170

DANA - PAYMENT TO → THANKS

WS100846

250871

[redacted]

INVOICE

PAGE 1

CARL CHEVROLET

905 CAPITOL EXPRESSWAY AUTOMALL
SAN JOSE, CA 95136

(408) 266-4000

BAR# AA-002879 EPA# CAD982013860

SERVICE ADVISOR: 854 PHILIP KLADKO

COLOR	YEAR	MAKE/MODEL	VIN	LICENSE	MILEAGE IN / OUT	TAG
SILVER	98	CHEVROLET CORVETTE	1G1YY22G9W5100846	XL884FN	42203/42204	T6360

DEL. DATE	PROD. DATE	WARR. EXP.	PROMISED	PO NO.	RATE	PAYMENT	INV. DATE
22AUG1997		22AUG2000	17:00			CASH	05AUG2002

R.O. OPENED	READY	OPTIONS
02AUG02	05AUG02	ENG:5.7L,V-8 TRN:AUTO. AXL:RWD. 1)MELODY'S BUS.#224-0588

LINE OPCODE TECH TYPE HOURS	LIST	NET	TOTAL

A TOWED IN, CUSTOMER REPORTS THE STEERING COLUMN LOCKS UP AT TIMES,
LOCKED UP ONCE AS SHE WAS BACKING OUT OF HER DRIVEWAY OWNER
CARRIES ... (CHECK/REPORT) REPAIRS $100.00 ...
CAUSE: VERIFIED LOCK ACT
RC REPAIRS COMPLETED ...
979 CPC 209.00 209.00
... 114.04 114.04
08/06/02 RANDY AT GM CAP $313.45 TOTAL $113.45 AFTER $200.00 DE DUCT
#A0208... OWNER TO BE PAID BY ... CHECK REPLACED LOCK ACTUATOR
ASBLY
...
OWNER PAY'S FULL AMOUNT SHOWN
R/LOWER CORNER, P ER LINE "A"
AUTH, OWNER WILL RECIEVE
MONIES FROM GM CAP.....OWNERS
BALANCE AFTER MONIES $219.0

ORIGINAL

PAID
AUG 07 2002
BY

STATEMENT OF DISCLAIMER	NOTICE TO CUSTOMER	DESCRIPTION	TOTALS
The factory warranty constitutes all of the warranties with respect to the sale of this item/items. The Seller hereby expressly disclaims all warranties either express or implied, including any implied warranty of merchantability or fitness for a particular purpose. Seller neither assumes nor authorizes any other person to assume for it any liability in connection with the sale of this vehicle.	I acknowledge notice and oral approval of any additional customer or warranty work performed and/or increase in the original estimate price. I also acknowledge and approve all repairs as itemized and/or receipt of vehicle. Subject to terms and conditions on reverse side.	LABOR AMOUNT	209.00
		PARTS AMOUNT	114.04
		GAS, OIL, LUBE	0.00
		SUBLET AMOUNT	0.00
	ORIGINAL ESTIMATE $ 70 ω	MISC. CHARGES	0.00
	AUTHORIZED REVISED ESTIMATE $ 361-	TOTAL CHARGES	323.04
		LESS INSURANCE	0.00
		SALES TAX	9.41
	[redacted] EIPT OF A COPY HEREOF	PLEASE PAY THIS AMOUNT	[illegible]

CUSTOMER COPY

[redacted]

REGISTRATION CARD VALID FROM: 04/02/2002 TO: 04/02/2003

MAKE	YR MODEL	YR 1ST SOLD	VLF CLASS	*YR	TYPE VEH	TYPE LIC	LICENSE NUMBER
CHEV	1998	0000	JF	2001	170	69	XLR84FN

BODY TYPE MODEL			VEHICLE ID NUMBER
CP	G	NB	1G1YY22G9W5100846

TYPE VEHICLE USE	DATE ISSUED	CC/ALCO	DI FEE RECVD	PEC	STICKER ISSUED
AUTOMOBILE	04/02/02	43	04/02/02	8	84030705

PR EXP DATE: 04/02/2002

AMOUNT PAID
$ 249.00

[redacted]

AMOUNT DUE	AMOUNT RECVD	
$ 249.00	CASH :	
	CHCK :	249.00
	CRDT :	

SAN DIEGO
CA 2101

I05 B57 5G 0024900 0009 CS I05 040202 69 XLR84FN B46

G E N E R A L M O T O R S C O R P O R A T I O N
C H E V R O L E T D I V I S I O N
G M R E S T R I C T E D

CUSTOMER:
ADDRESS: [redacted] Madison Heights ,
MI 48071-2152

HOME PHONE:

CASE NUMBER:	1-27269777	VIN:	1G1YY22G7X5122894
		MODEL YEAR:	1999
DATE OPENED:	2002-08-23	SERIES:	Corvette
DATE CLOSED:	2002-09-06	MILEAGE:	16000.0000000
SOURCE:	White Mail	DELIVERY DATE:	
BRC TYPE:	N/AYes	DEALER NAME:	
BRC PARENT:		DEALER ADDRESS:	

**********GENERAL CASE INFORMATION**********

M41 Column / Ignition Lock / Parts
0 REPAIR ATTEMPT(S) Excessive Effort

**********WORK HISTORY**********

Inbound White Mail; ; 2002-08-23
2002-08-23

1st Call Attempt; ; 2002-08-23
2002-08-23

SAFETY Scanned: 2002-08-21-17.30.54.000000, MSXDocNum: 0223300150; ; 2002-08-28
2002-08-28

1-27269777 2nd call attempt; ; 2002-08-28
2002-08-30

Customer Unavailable/Contact Cac; ; 2002-08-30
2002-08-30

Created:CAC_RS0006. SR#1-27269777; ; 2002-08-30
2002-08-30

Customer Unavailable/Contact Cac; ; 2002-08-30
2002-08-30

Cust called; ; 2002-08-30
2002-08-30

Correspondence Rejected; ; 2002-08-30
2002-08-30

Cust called in; ; 2002-08-30
2002-08-30

Service Request has been Closed Satisfied.; ; 2002-08-30
2002-09-06

Service Request has been Closed Satisfied.; ; 2002-09-06

**********PAR INFORMATION**********

INCIDENT DATE: INCIDENT TIME:
INCIDENT LOCATION:

DRIVER NAME: DRIVER AGE:
DRIVER DISABILITY:

OWNER DESCRIPTION:

ALLEGED DEFECTIVE COMPONENT:

INCIDENT RESULT:
POLICE REPORT: ROAD CONDITION: ROAD SURFACE:
NUMBER OF PEOPLE: BODY INJURY:
INJURIES:

WAS ANOTHER VEHICLE INVOLVED:
NUMBER OF VEHICLES: 0

PROPERTY DAMAGE:

WAS VEHICLE INSURED: INSURANCE COMPANY NAME:
INSURANCE COMPANY ADDRESS:
AGENT NAME:
AGENT PHONE NUMBER:

MORE INFORMATION:
MAINTENANCE LOCATION:
CURRENT LOCATION OF VEHICLE:
NOTIFY NAME:

WAS VEHICLE INSPECTED: INSPECTORS NAME: INSPECTION DATE:
MILEAGE AT INSPECTION:
WHERE WAS INSPECTION DONE:

WAS VEHICLE ROAD TESTED:
ROAD TEST DESCRIPTION:
ROAD TEST RESULT:
COMP INSPECTED:
INVESTIGATIVE SUMMARY:
PAR STATUS:

**********PAR INFORMATION**********

SOURCE: TRANSACTION:
REQUEST TYPE:
REPURCHASE REASON:

DEALER BAC:
DEALER NAME:
DEALER ADDRESS: , ,
CONTACT: ,
PHONE NUMBER: FAX NUMBER:
PRODUCT CODE: BODY TYPE:
TRIM:
ENGINE TYPE: TRANSMISSION:
VEHICLE DRIVEABLE:
MILEAGE @ BUY-BACK: 0 BRC WARRANTY DATE:
MSRP: NADA: 0
SALES TAX:

DEPRECIATION:
UPGRADE:

AFTERMARKET:
LEASE TERM:
MAGE:
THER:
BRANCH: NAME:
ACCOUNT NUMBER:
INTEREST RATE: INTEREST PAID:
DEALER BUYOUT:
ACCOUNT BALANCE:
LEGAL: LEGAL TYPE:
LEMON LAW:
DEALER ADMINISTRATION: VEHICLE DESTINATION:
RELEASE: LIEN PAYOFF:
TITLE BRAND:
REPLACEMENT VIN:

**********BODILY INJURY**********

NUMBER OF INJURIES: 0
COMMENTS:

NAME: LOCATION:
ADDRESS: ,
CITY/STATE: ,
PHONE NUMBER:
SEATING POSITION: RESTRAINT:
TYPE OF INJURY:
TREATED: IF SO, WHERE:

**********ADR INFORMATION**********

EXTERNAL CASE NUMBER: DATE:
TITLE NAMES:
BUSINESS: % BUSINESS: 0
ACCIDENT: DATE OF ACCIDENT:
DESCRIPTION OF DAMAGE:
PURCHASE/LEASE: 0 DATE OF PURCHASE/LEASE:
MILEAGE AT PURCHASE: 0 PURCHASE/LEASE AS:
DOES OWNER HAVE POSESSION OF VEHICLE:
RESOLUTION SOUGHT:

**********BRC CONTACT INFORMATION**********

NAME: CONTACT NUMBER: 1
COMPANY: CONTACT TYPE:
CONTACT PHONE:

ADDRESS:

[redacted]

CHEVROLET CUSTOMER ASSISTANCE CTR
P O BOX 33170
DETROIT MI 48232-5170

AUG 21 2002

[redacted]

Recall information
Processing Center
Box 8056
Royal Oak, Mi
48068-9864

[redacted]

To whom it may concern!

Maybe you can help me—

I don't have a clue if this was taken care of I have had this car in shop 3 times and each time they said is was fixed. Until I drove it and column locked up on me, while driving—

Please find this out for me—

I am done dealing with Hamilton Chev.

[redacted]

CHEVROLET

CAMPAIGN INFORMATION PROCESSING CENTER
PO BOX 8058, ROYAL OAK, MI 48068-8058

IMPORTANT RECALL NOTICE

Recall Service Must Be Performed On A Vehicle Owned By:

[redacted]

CHEVROLET

RECALL NOTICE
Recall service performed at no charge to owner.

ATTENTION: Completion of the recall listed to the right is required. If these corrections have not been made, contact your dealer/retailer immediately for an appointment. If the corrections have been made, or you no longer own this vehicle for any of the reasons listed on the attached Owner Reply Card, please update the card and drop it into any mailbox.

ACCORDING TO OUR RECORDS AS OF MAY 1, 2002, THE FOLLOWING RECALL(S) HAVE NOT BEEN COMPLETED ON YOUR CHEVROLET
VEHICLE IDENTIFICATION NUMBER 1G1YY22G7X5122894

00034 LAP BELT WEBBING TWISTED
01044 CORVETTE ELECTRONIC COLUMN LOCK

DEALER:
HAMILTON CHEVROLET, INC.
5800 14 MILE RD
WARREN MI 48092
(586) 264-1400

1G1YY22G7X5122894

[redacted]

GM622B
EA02-031

ATTACHMENT "2B"

405671

GM RESTRICTED

[redacted] NUMBER: 1-6121998

DATE	06/05/02	VIN:	1G1YY22GXW5130535
DATE	06/13/02	MODEL	1998
SOURCE:	PARYES	SERIES	CORVETTE
CUSTOMER:	[redacted]	MILEAGE	51000.
ADDRESS:			
HOME PHONE:		STATE:	MO
BUS. PHONE:			

GENERAL MOTORS CORPORATION
CHEVROLET DIVISION
GM RESTRICTED

CUSTOMER: [redacted]
ADDRESS: Hollister , MO 65672-5247
HOME PHONE:

CASE NUMBER:	1-6121998	VIN:	1G1YY22GXW5130535
		MODEL YEAR:	98
DATE OPENED:	2002-06-05	SERIES:	Corvette
DATE CLOSED:	2002-06-13	MILEAGE:	51000.0000000
[redacted]RCE:	Phone	DELIVERY DATE:	
[redacted] TYPE:	PARYes	DEALER NAME:	Pinegar Chevrolet-Oldsmobile, Inc.
BRC PARENT:		DEALER ADDRESS:	181 Adair Rd.,Branson,MO,65616,

**********GENERAL CASE INFORMATION**********

M41 Column / Ignition Lock / Parts
0 REPAIR ATTEMPT(S) Sticks

**********WORK HISTORY**********

ASSIGNED PAR CASE TO KRYSTEL DAVIS-GRANT/58130; ; 2002-06-07
2002-06-07

INITIAL-BROCK ROESCH; ; 2002-06-12
2002-06-07

initial; ; 2002-06-11
2002-06-07

initial; ; 2002-06-11
2002-06-07

Service Request Ownership has changed FROM: LOPEZROM TO: KDAVIS; ; 2002-06-07
[redacted]2-06-07

Cust seeks update; ; 2002-06-07

GM RESTRICTED

2002-06-07

[redacted]Cust seeks call; ; 2002-06-13
2002-06-10

Cust called; ; 2002-06-10
2002-06-11

CRM LEFT MESSAGE @ 417-339-2368.; ; 2002-06-11
2002-06-12

ESIS; ; 2002-06-12
2002-06-13

ESIS; ; 2002-06-13
2002-06-13

ESIS; ; 2002-06-13
2002-06-13

FORWARDING TO ESIS DUE TO INJURY; ; 2002-06-13
2002-06-13

FORWARDING TO ESIS FOR FURTHER HANDLING DUE TO INJURIES; ; 2002-06-13
2002-06-13

FORWARDING TO ESIS.; ; 2002-06-13
2002-06-13

[redacted]EFT MESSAGE; ; 2002-06-13
2002-06-13

Service Request has been Closed Satisfied.; ; 2002-06-13
2002-06-13

CUST CALLED; ; 2002-06-13
2002-06-13

Service Request has been Closed Satisfied.; ; 2002-06-13
2002-06-05

Corvette Steering Column Lockup; ; 2002-06-11
2002-06-05

Cust was on line long distance; ; 2002-06-05
2002-06-05

Product Allegation; ; 2002-06-06
Brock Roesch

**********PAR INFORMATION**********

INCIDENT DATE: 2002-06-05 INCIDENT TIME: 14:47:00.000000
INCIDENT LOCATION: V Highway, 100 yards south of Acacia Rd. Hollister, Mo. 65672

[redacted]VER NAME: DRIVER AGE:
DRIVER DISABILITY: none

G M R E S T R I C T E D

[redacted]ER DESCRIPTION: Owners son driving veh @50-60mph when the steering wheel locked. Veh left a convert and gouged the asphalt. Son attempted unlocking steering column by hitting it. Son broke hand and hit the top T-Top glass.

ALLEGED DEFECTIVE COMPONENT: Steering Column Seatbelt

INCIDENT RESULT:
POLICE REPORT: Y
NUMBER OF PEOPLE: 1
INJURIES:

ROAD CONDITION: Dry
BODY INJURY: Y

ROAD SURFACE: Asphalt

WAS ANOTHER VEHICLE INVOLVED:
NUMBER OF VEHICLES: 0

PROPERTY DAMAGE:

WAS VEHICLE INSURED:

INSURANCE COMPANY NAME:
INSURANCE COMPANY ADDRESS:
AGENT NAME:
AGENT PHONE NUMBER:

MORE INFORMATION: none
MAINTENANCE LOCATION: Pinegar Chevrolet
CURRENT LOCATION OF VEHICLE: All Time Towing, 88 Highway, Hollister, MO 417-334-4302
Contact: Ron Kellett
NOTIFY NAME: Owner

[redacted] VEHICLE INSPECTED:
MILEAGE AT INSPECTION:
WHERE WAS INSPECTION DONE:

INSPECTORS NAME:
INSPECTION DATE:

WAS VEHICLE ROAD TESTED:
ROAD TEST DESCRIPTION:
ROAD TEST RESULT:
COMP INSPECTED:
INVESTIGATIVE SUMMARY:
PAR STATUS:

**********PAR INFORMATION**********

SOURCE:
REQUEST TYPE:
REPURCHASE REASON:

TRANSACTION:

DEALER BAC:
DEALER NAME:
DEALER ADDRESS: , ,
CONTACT: ,
PHONE NUMBER:
PRODUCT CODE:

ENGINE TYPE:

MILEAGE @ BUY-BACK: 0
MSRP:
[redacted]PRECIATION:

FAX NUMBER:
BODY TYPE:
TRIM:
TRANSMISSION:
VEHICLE DRIVEABLE:
BRC WARRANTY DATE:
NADA: 0
SALES TAX:

GM RESTRICTED

UPGRADE:
[redacted]ERMARKET:
LEASE TERM:
DAMAGE:
OTHER:
BRANCH: NAME:
ACCOUNT NUMBER:
INTEREST RATE: INTEREST PAID:
DEALER BUYOUT:

ACCOUNT BALANCE:
LEGAL: LEGAL TYPE:
LEMON LAW:
DEALER ADMINISTRATION: VEHICLE DESTINATION:
RELEASE: LIEN PAYOFF:
TITLE BRAND:

REPLACEMENT VIN:

**********BODILY INJURY**********

NUMBER OF INJURIES: 0
COMMENTS:

LOCATION:

NAME: [redacted]
ADDRE
CITY/
PHONE
SEATING POSITION: Driver RESTRAINT: Seat Belt & SIR
TYPE OF INJURY: Right hand where 4th finger joins broken, Laceration on head
TREATED: IF SO, WHERE:

[redacted]

**********ADR INFORMATION**********

EXTERNAL CASE NUMBER: DATE:
TITLE NAMES:
BUSINESS: % BUSINESS: 0
ACCIDENT: DATE OF ACCIDENT:
DESCRIPTION OF DAMAGE:
PURCHASE/LEASE: 0 DATE OF PURCHASE/LEASE:
MILEAGE AT PURCHASE: 0 PURCHASE/LEASE AS:
DOES OWNER HAVE POSESSION OF VEHICLE:
RESOLUTION SOUGHT:

**********BRC CONTACT INFORMATION**********

NAME: [redacted]
COMPANY:
ADDRESS:

Hollister, MO 65672-5247

CONTACT NUMBER: 1
CONTACT TYPE: 'Injured'
CONTACT PHONE: [redacted]

[redacted]

G E N E R A L M O T O R S C O R P O R A T I O N
C H E V R O L E T D I V I S I O N
G M R E S T R I C T E D

CUSTOMER: [redacted]
ADDRESS:
HOME PHONE:

Columbia , MD 21045-4345

CASE NUMBER:	1-22735616	VIN:	1G1YY32G5Y5112632
		MODEL YEAR:	2000
DATE OPENED:	2002-08-07	SERIES:	Corvette
DATE CLOSED:	2002-11-22	MILEAGE:	18983.0000000
SOURCE:	Phone	DELIVERY DATE:	
BRC TYPE:	PARYes	DEALER NAME:	Criswell Chevrolet, Inc.
BRC PARENT:		DEALER ADDRESS:	503 Quince Orchard Rd,Gaithersburg,MD,20878-1497,USA

**********GENERAL CASE INFORMATION**********

M02 Linkage
0 REPAIR ATTEMPT(S) Inoperative

**********WORK HISTORY**********

BODY DAMAGE; ; 2002-08-07
2002-08-07

410-992-3539 1-22735616 follow up on body damage; ; 2002-08-09
2002-08-07

dlr Cresswell 1-22735616; ; 2002-08-12
2002-08-12

1-22735616; ; 2002-08-12
2002-08-13

up date for par case; ; 2002-08-13
2002-08-12

par case BEST TO CONTACT AT WORK NUMBER 301-286-8337; ; 2002-08-13
2002-08-13

ASSIGND PAR CASE TO PAUL RUED/57326; ; 2002-08-19
2002-08-14

Service Request Ownership has changed FROM: GRUBEC TO: RUEDP; ; 2002-08-14
2002-08-14

VME- case received; ; 2002-08-14
2002-08-14

Casescan- no finds.; ; 2002-08-14
2002-08-19

service manager; ; 2002-08-19
2002-08-19

FAVM Campbell Bob 914055 8076; ; 2002-08-19
2002-08-19

VME; ; 2002-08-19
2002-08-19

BRC PAR Scanned: 2002-08-19-11.10.31.000000, MSXDocNum: RUE3D60B40; ; 2002-08-19
2002-08-19

FAVM Campbell Bob 914055 8076; ; 2002-08-19
2002-08-19

FAVM Campbell Bob 914055 8076-; ; 2002-08-19
2002-08-19

CRM made third attempt; ; 2002-08-19
2002-08-19

sending 10-day letter; ; 2002-08-19
2002-08-19

Created:BRCPAR_PA0005. SR#1-22735616; ; 2002-08-19
2002-08-19

10-day letter/ CANCEL LETTER; ; 2002-08-29
2002-08-27

Cust seeks follow-up; ; 2002-08-27
2002-08-07

CRM left vme; ; 2002-08-28
2002-08-28

DESCRIPTION OF INCIDENT:; ; 2002-08-28
2002-08-19

service manager; ; 2002-08-29
2002-08-29

Correspondence Rejected - Contact made with customer prior to letter approval.; ; 2002-08-29
2002-08-30

BRC PAR Scanned: 2002-08-29-17.12.53.000000, MSXDocNum: RUE3D6E074; ; 2002-09-19
2002-09-12

request status; ; 2002-09-12
2002-09-12

service manager; ; 2002-09-12
2002-09-19

FAVM Campbell Bob 914055 8076-; ; 2002-09-19
2002-09-23

CRM advised cust; ; 2002-09-23
2002-09-23

service manager; ; 2002-09-23
2002-09-23

BUSINESS SUMMARY:; ; 2002-09-23
2002-09-24

ASSIGNED FTT CASE TO RUTHE BOYCE/57611; ; 2002-11-22
2002-09-24

BRC PAR Scanned: 2002-09-24-11.12.38.000000, MSXDocNum: RUE3D8F269; ; 2002-11-22
2002-09-24

Service Request Ownership has changed FROM: RUEDP TO: BOYCER; ; 2002-09-24
2002-10-28

REQUESTING RO AND SUBLET; ; 2002-10-28
2002-11-08

Z1242; ; 2002-11-22
2002-11-08

FTT Crm closing file; ; 2002-11-22
2002-11-12

BRC PAR Scanned: 2002-11-12-15.06.35.000000, MSXDocNum: RUE3DD10CE; ; 2002-11-22
2002-11-13

BRC PAR Scanned: 2002-11-13-15.07.58.000000, MSXDocNum: LOT3DD25C0; ; 2002-11-22
2002-11-14

Dlr called; ; 2002-11-14
2002-11-15

Crm contacted dlr at 301-590-1451; ; 2002-11-15
2002-11-15

Wesley called; ; 2002-11-15
2002-11-22

Service Request has been Closed Satisfied.; ; 2002-11-22

**********PAR INFORMATION**********

INCIDENT DATE: 2002-05-25 INCIDENT TIME: 19:22:00.000000
INCIDENT LOCATION: 6159 Encounter Row Columbia MD. 21045

DRIVER NAME: DRIVER AGE:
DRIVER DISABILITY:

OWNER DESCRIPTION: parked in front of garage about 2 feet away. Cust got out and opened updoor and got back in veh put it in gear and couldn't tell steering wheel was locked in place and cust ran into door frame of garage.

ALLEGED DEFECTIVE COMPONENT: Body damage on drivers side nose cone

INCIDENT RESULT:
POLICE REPORT: ROAD CONDITION: Dry ROAD SURFACE: Concrete
NUMBER OF PEOPLE: BODY INJURY:
INJURIES:

WAS ANOTHER VEHICLE INVOLVED:
NUMBER OF VEHICLES: 0

PROPERTY DAMAGE:

WAS VEHICLE INSURED: INSURANCE COMPANY NAME:
INSURANCE COMPANY ADDRESS:
AGENT NAME:
AGENT PHONE NUMBER:

MORE INFORMATION:
MAINTENANCE LOCATION:
CURRENT LOCATION OF VEHICLE: at home
NOTIFY NAME: Driver

WAS VEHICLE INSPECTED: Steering and Suspension Sys
INSPECTORS NAME: DealershipINSPECTION DATE: 2002-09-10
14:40:00.000000
MILEAGE AT INSPECTION:
WHERE WAS INSPECTION DONE:

WAS VEHICLE ROAD TESTED:
ROAD TEST DESCRIPTION:
ROAD TEST RESULT:
COMP INSPECTED:
INVESTIGATIVE SUMMARY:
PAR STATUS:

**********PAR INFORMATION**********

SOURCE:
TRANSACTION:
REQUEST TYPE:
REPURCHASE REASON:

DEALER BAC:
DEALER NAME:
DEALER ADDRESS: , ,
CONTACT: ,
PHONE NUMBER:
FAX NUMBER:
PRODUCT CODE:
BODY TYPE:
TRIM:
ENGINE TYPE:
TRANSMISSION:
VEHICLE DRIVEABLE:
MILEAGE @ BUY-BACK: 0
BRC WARRANTY DATE:
MSRP:
NADA: 0
SALES TAX:

DEPRECIATION:
UPGRADE:
AFTERMARKET:
LEASE TERM:
DAMAGE:
OTHER:
BRANCH:
NAME:
ACCOUNT NUMBER:
INTEREST RATE:
INTEREST PAID:
DEALER BUYOUT:

ACCOUNT BALANCE:
LEGAL:
LEGAL TYPE:
LEMON LAW:
DEALER ADMINISTRATION:
VEHICLE DESTINATION:
RELEASE:
LIEN PAYOFF:
TITLE BRAND:

REPLACEMENT VIN:

**********BODILY INJURY**********

NUMBER OF INJURIES: 0
COMMENTS:

NAME:
LOCATION:
ADDRESS: ,
CITY/STATE: ,
PHONE NUMBER:
SEATING POSITION:
RESTRAINT:
TYPE OF INJURY:

TREATED: IF SO, WHERE:

**********ADR INFORMATION**********

EXTERNAL CASE NUMBER: DATE:
TITLE NAMES:
BUSINESS: % BUSINESS: 0
ACCIDENT: DATE OF ACCIDENT:
DESCRIPTION OF DAMAGE:
PURCHASE/LEASE: 0 DATE OF PURCHASE/LEASE:
MILEAGE AT PURCHASE: 0 PURCHASE/LEASE AS:
DOES OWNER HAVE POSESSION OF VEHICLE:
RESOLUTION SOUGHT:

**********BRC CONTACT INFORMATION**********

NAME: CONTACT NUMBER: 1
COMPANY: CONTACT TYPE:
CONTACT PHONE:

ADDRESS:

WO1PATE ID: TE41FV GMNA PRE-AUTHORIZATION 2003/11/11 14:24:46

PRSW CODE: 5187

DIV	DLR CODE	RO NBR	LBR OP	AUTH CODE	VIN	TOTAL
13	14126	239994	Z1242	WRGLY	1G1YY32G5Y5112632	_1580 . 36

COMMENTS: ISSUE TO PAY DEALER FOR REPAIRS DUE TO PRODUCT ALLEGATION WITH STEERING CONCERN AS A GOODWILL GESTURE FOR CUSTOMER SATISFACTION. TH

COMMENTS:

COMMENTS:

COMMENTS:

PF: 3-EXIT 4-CLM INQUIRY 5-CLM DETAIL 6-CLM COMMENTS
9-REJ DETAIL 10-DEBIT 12-MANUAL DB

MESSAGE: SUBMIT THE PRE-AUTHORIZATION?? (PF1 = YES , PF2 = NO)

CRISWELL

503 Quince Orchard Rd
Gaithersburg, Md 20878
(301) 948-0880
(301) 670-1849 (FAX)

Send to: CHEVROLET	From: Jeff Walker / JOHN BIERMAN (301) 212-4482 301-212-4629
Attention: PAUL KUED	Date: 8-29-02
Office Location:	Office Location:
Fax Number: 866-293-0805	Phone Number:

- ☐ Urgent
- ☐ Reply ASAP
- ☐ Please comment
- ☑ Please review
- ☐ For your information

Total pages, including cover: /

Comments:

DAVID BETZ
2000 CORVETTE BODY DAMAGE

08/29/2002 at 08:58 AM
78354

Job Number:

CRISWELL AUTOMOTIVE
License #:78354
PLEASE CALL US FOR AN APPOINTMENT TODAY!
503 QUINCE ORCHARD RD
GAITHERSBURG, MD 20878
(301)948-0880

PRELIMINARY ESTIMATE

Written by: CHRISTOPHER BURR #
Adjuster:

Insured: [redacted]
Owner:
Address:
Evening:

Claim #
Policy #
Deductible:
Date of Loss:
Type of Loss:
Point of Impact:

Inspect Location: CRISWELL AUTOMOTIVE
503 QUINCE ORCHARD RD
GAITHERSBURG, MD 20878

Business: (301)948-0880

Insurance Company:

Days to Repair

2000 CHEV CORVETTE 8-5.7L-FI 2D CNVT SILVER Int:
VIN: 1G1YY32G5Y5112632 Lic: Prod Date: Odometer: 19427

Air Conditioning	Tilt Wheel	Cruise Control	
Intermittent Wipers	Keyless Entry	Theft Deterrent/Alarm	
Dual Mirrors	Traction Control	Clear Coat Paint	
Power Steering	Power Brakes	Power Windows	
Power Locks	Power Driver Seat	Power Antenna	
Power Mirrors	Anti-Lock Brakes (4)	Driver Air Bag	
Passenger Air Bag	4 Wheel Disc Brakes	Leather Seats	
Bucket Seats	Automatic Transmission	Aluminum/Alloy Wheels	

NO.	OP.	DESCRIPTION	QTY	EXT. PRICE	LABOR	PAINT
1		FRONT BUMPER				
2	Repl	Add for fog lamps	1		0.5	
3*	Rpr	Bumper cover			5.0	3.2
4		Add for Clear Coat				1.3
5		O/H bumper assy			3.1	
6	Repl	Emblem	1	31.40	Incl.	
7*	Refn	Trim cover w/name				1.0
8		FRONT LAMPS				
9	R&I	RT Headlamp door			0.4	
10	R&I	LT Headlamp door			0.4	
11*	Refn	RT Headlamp door				1.0
12		Add for Clear Coat				0.2
13*	Refn	LT Headlamp door				1.0
14		Overlap Minor Panel				-0.2

08/29/2002 at 08:58 AM
78354

Job Number:

[redacted]

2000 CHEV CORVETTE 8-5.7L-FI 2D CNVT SILVER Int:

NO.	OP.	DESCRIPTION	QTY	EXT. PRICE	LABOR	PAINT
15		Add for Clear Coat				0.2
16		HOOD				
17	Refn	Hood				3.2
18		Overlap Minor Panel				-0.2
19		Add for Clear Coat				1.2
20		FENDER				
21	Refn	RT Fender				2.2
22		Overlap Major Adj. Panel				-0.4
23		Add for Clear Coat				0.4
24*		BLEND FOR COLORMATCH	1			
25	Refn	LT Fender				2.2
26		Overlap Major Adj. Panel				-0.4
27		Add for Clear Coat				0.4
28*		BLEND FOR COLORMATCH	1			
29*	R&I	FRT WHEELS FOR PAINT AND JACK			1.0 M	
		CAR				1.0
30*	Rpr	WETSAND AND BUFF FINISH				
31*	Subl	WASH AND WAX EXTERIOR	1	65.00 X		
32*	Repl	CAR COVER	1	8.00 T	0.3	
33*	Repl	FLEX ADDITIVE	1	5.00 T		
34*		HAZARDOUS WASTE CHARGE	1	3.00 X		
		Subtotals ==>		112.40	10.7	17.3

Parts		31.40
Body Labor	9.7 hrs @ $ 38.00/hr	368.60
Paint Labor	17.3 hrs @ $ 38.00/hr	657.40
Mechanical Labor	1.0 hrs @ $ 82.00/hr	82.00
Paint Supplies	17.3 hrs @ $ 18.00/hr	311.40
Sublet/Misc.		81.00
SUBTOTAL		$ 1531.80
Sales Tax	$ 355.80 @ 5.0000%	17.79
GRAND TOTAL		$ 1549.59
ADJUSTMENTS:		0.00
Deductible		
CUSTOMER PAY		$ 0.00
INSURANCE PAY		$ 1549.59

09/29/2002 at 08:58 AM Job Number:
78354

PRELIMINARY ESTIMATE

2000 CHEV CORVETTE 8-5.7L-FI 2D CNVT SILVER Int:

ALL WORKMANSHIP AND PARTS ARE GUARRANTEED FOR 1 YEAR, UNLIMITED MILEAGE, FROM DATE PERFORMED.

.

CRISWELL AUTOMOTIVE THANKS YOU FOR YOUR PATRONAGE.

.

PLEASE COME AGAIN!

Estimate based on MOTOR CRASH ESTIMATING GUIDE. Unless otherwise noted all items are derived from the Guide DRICF97 Database Date 4/2002 and the parts selected are OEM-parts manufactured by the vehicles Original Equipment Manufacturer. Asterisk (*) or Double Asterisk (**) indicates that the parts and/or labor information provided by MOTOR may have been modified or may have come from an alternate data source. Non-Original Equipment Manufacturer aftermarket parts are described as AM or Qual Repl Parts. Used parts are described as LKQ, Qual Recy Parts, RCY, or USED. Reconditioned parts are described as Recon. Recored parts are described as Recore. NAGS Part Numbers and Prices are provided from National Auto Glass Specifications, Inc. Pound sign (#) items indicate manual entries.

Pathways - A product of CCC Information Services Inc.

GMWA Pre-Authorization Form

Check VIN LOOKUP and WINS for the following information:

Ownership (1st, 2nd, 3rd):	1st
Delivery Date:	11/26/99
Used Purchase Date:	
Where Purchased?	
Service Contract (Y or N)	N
Warr. Blk/Branded Title (Y or N):	N

File Number:	1-22735616		
Vehicle Identification Number:	1G1YY32G6Y5112632		
Mileage	20,993		
Dealership Contact:	John Bleman	Title:	Svc Mgr
Division (1s-cad, 1s-pon, 4s-gmc, 13-chev, 13-cad, 11-Buick):	Chevrolet		
Dealer Code:	13-14128		
Repair Order # (6 digits)	230094		
Labor Operation Code:	Z1242	Total:	$ 1,580.36
Labor Operation Code:		Total:	

List Specifics Below, DO NOT use the word "Defective"

Complaint:	Cust s/s steering locked
Cause:	Steering
Correction:	Dealer repaired veh
Justification:	FOR CUST SATISFACTION AND CUST GOODWILL

PAR CRM:	Paul Rued
Date Entered/Forwarded:	11/08/02
FTT CRM:	RUTHE BOYCE

W01PATH ID: TS41FV GMNA PRE-AUTHORIZATION 2002/11/11 14:24:46

PRSN CODE: 5187

DIV	DLR CODE	NO NBR	LBR OP	AUTH CODE	VIN	TOTAL
13	14126	239994	Z1242	WAGLP	1G1YY32G5Y5112632	1580 . 36

COMMENTS: ISSUE TO PAY DEALER FOR REPAIRS DUE TO PRODUCT ALLEGATION WITH STEERING CONCERN AS A GOODWILL GESTURE FOR CUSTOMER SATISFACTION. TH

COMMENTS:

COMMENTS:

COMMENTS:

PF: 3-EXIT 4-CLM INQUIRY 5-CLM DETAIL 6-CLM COMMENTS
9-REJ DETAIL 10-DEBIT 12-MANUAL DB

MESSAGE: SUBMIT THE PRE-AUTHORIZATION? (PF1 = YES ; PF2 = NO)

08/19/2002 HISTORY LISTING 3010
08:57:33 PAGE 1

CUSTOMER NAME [redacted] SERIAL NO. : 1G1YY32G5Y5112632

R.O NO. : 209824 R.O DATE : 06/10/2002 R.O TYPE : S
MILEAGE : 19427 ADVISOR NO. : 926

JOB NUMBER : 1 OPERATION 13CVZ OP. DESC. STEERING
SALE TYPE : W TECHNICIAN NO(S). 952
COMPLAINT : CUSTOMER STATES THAT THE STEERING IS INOP
CAUSE : OPEN
CORRECTION : RELAY PINS BURNT, REPLACED RELAY, STILL LOCKING, TRACED WIRI NG AND FOUND OPEN FROM RECALL WIRING, REPARIED WIRING, RETES TED, FINE

WARRANTY : CLAIM NO. OPERATION NO. CLAIM NO. OPERATION NO.
209824 W6626

JOB NUMBER : 2 OPERATION 88CVZRENTAL OP. DESC. RENTAL CAR
SALE TYPE : W TECHNICIAN NO(S). 2
COMPLAINT : CRISWELL RENTAL CAR.

WARRANTY : CLAIM NO. OPERATION NO. CLAIM NO. OPERATION NO.
209824 Z7903

R.O NO. : 208271 R.O DATE : 06/03/2002 R.O TYPE : S
MILEAGE : 18983 ADVISOR NO. : 926

JOB NUMBER : 1 OPERATION 13CVZ OP. DESC. STEERING
SALE TYPE : W TECHNICIAN NO(S). 952
COMPLAINT : CUSTOMER STATES STEERING WHEEL LOCKED UP AGIAN WITH TOP DOWN AND HOT OUTSIDE, UNLOCKED WITH TOP UP AND AC RUNNING AFTER 15 MINUTES
CAUSE : OPEN IN COLUMN LOCK.
CORRECTION : REPLACED COLUMN LOCK MOTOR

WARRANTY : CLAIM NO. OPERATION NO. CLAIM NO. OPERATION NO.
208271 Z7501

JOB NUMBER : 2 OPERATION 88CVZRENTAL OP. DESC. RENTAL CAR
SALE TYPE : W TECHNICIAN NO(S). 2
COMPLAINT : CRISWELL RENTAL CAR.

WARRANTY : CLAIM NO. OPERATION NO. CLAIM NO. OPERATION NO.
208271 Z7901

R.O NO. : 206934 R.O DATE : 05/25/2002 R.O TYPE : S
MILEAGE : 18750 ADVISOR NO. : 610

JOB NUMBER : 1 OPERATION 13CVZ OP. DESC. STEERING

SALE TYPE : W TECHNICIAN NO(S). 952
COMPLAINT : CUSTOMER STATES THAT THE STEERING LOCKED AND UNLOCKED 20 MIN LATER. STEERING RECALL WAS DONE AT ANOTHER DEALER THEN PROBLEM STARTED
CAUSE : UNABLE TO DUPLICATE CUSTOMERS CONCERN AT THIS TIME
CORRECTION : INSPECTED PREVIOUS RECALL, ALL WORK DONE PROPERLY

JOB NUMBER : 2 OPERATION 88CVZRENTAL OP. DESC. RENTAL CAR
SALE TYPE : W TECHNICIAN NO(S). 2
COMPLAINT : CRISWELL RENTAL CAR.
SAFETY ISSUE

WARRANTY : CLAIM NO. OPERATION NO. CLAIM NO. OPERATION NO.
206934 Z7903

JOB NUMBER : 3 OPERATION 11CVZ OP. DESC. STAND BRAKE REPAIRS
SALE TYPE : I TECHNICIAN NO(S). 952
COMPLAINT : CUSTOMER STATES THAT THE PARKING BRAKE GOES UP TOO FAR
CAUSE : LOOSE
CORRECTION : RECOMMENDED PARKING BRAKE ADJUSTMENT, EST. 182.00, DECLINED

JOB NUMBER : 4 OPERATION 20CVZ1 OP. DESC. ELECTRICAL REPAIRS
SALE TYPE : W TECHNICIAN NO(S). 952
COMPLAINT : CUSTOMER STATES THAT THE SEAT SETTING ON MEMORY "1" AND "2" WORKS SOMETIMES
CAUSE : UNABLE TO DUPLICATE CUSTOMERS CONCERN AT THIS TIME
CORRECTION : OPERATING TO SPECIFICATION AT THIS TIME

WARRANTY : CLAIM NO. OPERATION NO. CLAIM NO. OPERATION NO.
206934 N9995

COMMENTS : 301-286-8337

R.O NO. : 146966 R.O DATE : 04/20/2001 R.O TYPE : S
MILEAGE : 12472 ADVISOR NO. : 391

JOB NUMBER : 1 OPERATION 90CVZ OP. DESC. BODY
SALE TYPE : W TECHNICIAN NO(S). 537
COMPLAINT : CUSTOMER STATES THAT THE LEFT HEADLIGHT ASSY WILL NOT RETRACT--- PLEASE CHECK AND ADVISE.
CAUSE : SHIM HEADLIGHT MOTOR ACTUATOR PER BULLETIN

WARRANTY : CLAIM NO. OPERATION NO. CLAIM NO. OPERATION NO.
146966 N3231

R.O NO. : 120026 R.O DATE : 10/02/2000 R.O TYPE : S
MILEAGE : 10264 ADVISOR NO. : 391

JOB NUMBER : 1 OPERATION 07CVZ OP. DESC. MANUAL TRANS REPAIRS
SALE TYPE : W TECHNICIAN NO(S). 537
COMPLAINT : CLUTCH CLATTERING..INSTALL FLYWHEEL CLUTCH ASSEMBLY (SOP) PE
R BOB WISMAN
CAUSE : FOUND CLUTCH AND BRGS.DEFECTIVE GRINDING
CORRECTION : REPL COMPLETE CLUTCH ASSY

WARRANTY : CLAIM NO. OPERATION NO. CLAIM NO. OPERATION NO.
120026 J1420

JOB NUMBER : 2 OPERATION 88CVZRENTAL OP. DESC. RENTAL CAR
SALE TYPE : W TECHNICIAN NO(S). 537
COMPLAINT : CRISWELL RENTAL CAR PER WARRANTY
CORRECTION : COMPLETE

WARRANTY : CLAIM NO. OPERATION NO. CLAIM NO. OPERATION NO.
120026 Z7903

COMMENTS : RESERVED RENTAL PER LORAINA AT 2:30 ON 9/25

R.O NO. : 116962 R.O DATE : 09/06/2000 R.O TYPE : S
MILEAGE : 9810 ADVISOR NO. : 391

JOB NUMBER : 1 OPERATION 07CVZ OP. DESC. MANUAL TRANS REPAIRS
SALE TYPE : W TECHNICIAN NO(S). 2
COMPLAINT : C/S CLUTCH SLIPPING
CAUSE : TEST DROVE VEHICLE WITH BOB W...STATES MATERIAL OF CLUTCH
PLATE COMING APART..GRINDS IN GEARS ONLY SOMETIMES
CORRECTION : SPECIAL ORDER FLYWHEEL ASSY KIT

R.O NO. : 86676 R.O DATE : 11/26/1999 R.O TYPE : P
MILEAGE : 5 ADVISOR NO. : 519

JOB NUMBER : 1 OPERATION 26CVZ OP. DESC. PDI ONLY OPERATIONS
SALE TYPE : W TECHNICIAN NO(S). 537 585
COMPLAINT : SERVICE AND CLEAN SOLD 14.5 GALS OF GAS PDI 1.4
CORRECTION : COMPLETED

WARRANTY : CLAIM NO. OPERATION NO. CLAIM NO. OPERATION NO.
5112632

R.O NO. : 86664 R.O DATE : 11/26/1999 R.O TYPE : S
MILEAGE : 10 ADVISOR NO. : 391

JOB NUMBER : 1 OPERATION 08CVZ OP. DESC. EXHAUST REPAIRS

SALE TYPE : I TECHNICIAN NO(S). 537
COMPLAINT : INSTALL CORSA TOURING EXHAUST PACKAGE
CHARGE TO DEAL
CAUSE : COMPLETED

CRISWELL

TO: Paul Reed

COMPANY: Com

FROM: Wesley

~~301-948-0680~~ EXT. 301 - 590 - 1451 (Direct)
EST. 7-4 M-F

DATE: 11-4-02

PAGE 1 OF 7

MESSAGE: Repairs made as goodwill.

Please review for acceptance.

Call to acknowledge receipt of fax.

Thanks

Wes

Tax I.D. # 0097039 0

E.I.N. 52-095 0184

503 Quince Orchard Road, Gaithersburg, Maryland 20878
301-948-0680 Fax 301-948-0921

GMC

#9724

Business Resource Center

20993 mileage

Fax

CAll + DT app.
E.T. in comp.

To: Don Bierman
Company:
Phone:
Fax: 3016701849

21242

From: Paul M Rued
Phone: 800-231-1841/57320
Fax: 866-293-0805
Date: Monday, September 23, 2002 2:35:00 PM
Pages: 01
(not including cover)

Comments:
I have offerred repairs on Mr. Batz's vehicle(VIN-1G1YY32G8Y5112632). Mr. Batz accepts. Here is the E1242 guidelines by which your dealership would get paid for the body repair.
Paul M Rued
GM/PAR

CRISWELL

CHEVROLET

CVWB239994

LOTUS

503 QUINCE ORCHARD RD., GAITHERSBURG, MD 20878 (301) 948-0880
www.criswellauto.com

CVWB239994

CUSTOMER NO. 124080	ADVISOR CHRISTOPHER BURR 388	TAG NO. 9774	INVOICE DATE 10/31/02	INVOICE NO. CVWB239994
[redacted]	LABOR RATE	LICENSE NO.	MILEAGE 20,993	COLOR SEBRING SIL	STOCK NO. 001309
	YEAR/MAKE/MODEL 00/CHEVROLET/CORVETTE/2 DOOR CONVERT		DELIVERY DATE 11/26/99	DELIVERY MILES 5
	VEHICLE I.D. NO. 1G1YY32G5Y5112632		SELLING DEALER NO.	PRODUCTION DATE
	P.T.& NO.	P.O. NO.	R.O. DATE 10/14/02	
	COMMENTS			

LABOR & PARTS--
[illegible]
REPAIR FRT BUMPER DAMAGE PER GM FAX - SEE ATTATCHED COPY +
EST
ATTN WES CODE Z1242 SEE BACK OF HARD COPY
CMD REPAIR ON BODY DAMAGE
R+I BUMPER AND HEADLAMP DOORS AND REPAIR AND REINSTALL AFTER
PAINTING AND REPLACE EMBLEM

PARTS	QTY	FP-NUMBER	DESCRIPTION	U/COST	E/COST	U/PRICE	
JOB # 1	1	10250164	EMBLEM 7.032	18.84	18.84	26.38	26.38
			JOB # 1 COST TOTAL		18.84		
			JOB # 1 TOTAL PARTS				26.38

JOB # 1 TOTAL LABOR & PARTS 410.61

[illegible]
REFINISH
WES AND CODE Z1242
REFINISH FRONT BUMPER COLOR COAT AND CLEAR HOOD, FENDERS AND
HD LAMP DOORS FOR COLOR MATCH

JOB # 2 TOTAL LABOR & PARTS 604.95

[illegible]
CRISWELL RENTAL CAR.
RENTAL CAR PROVIDED DURING REPAIR.
12 DAYS OF RENTAL PROVIDED.

JOB # 4 TOTAL LABOR & PARTS 0.00

S.O.G. & SUPPLIES--
JOB # 2 1.0 PAINT MATERIALS @ 205.030 /UNIT 205.03
TOTAL - SOS 205.03

MISC------CODE--------DESCRIPTION-------------------CONTROL NO-----
JOB # 4 CR CRISWELL RENTAL 239994 359.27
TOTAL - MISC 359.27

R/O TAX 0.00
R/O TOTALS 1580.36

WARRANTY CLAIM DETAIL TOTALS--

CLAIM	TOTAL
239994	0.00
CLAIM TOTALS	0.00

APPROVED BY SIGNATURE

FOR YOUR INFORMATION AND ACKNOWLEDGEMENT:

TERMS: CASH ON DELIVERY

Prices are based on flat rate manual unless specified otherwise. Mechanical check out time on vehicles will be a minimum of one half hour at the current hourly rate if work is declined on vehicle.

SHOP MATERIAL: A CHARGE EQUIVALENT TO ___% OF TOTAL REPAIR ORDER CHARGES IS INCLUDED FOR MATERIALS USED ON YOUR VEHICLE. APPLICABLE SUPPLY ITEMS ARE NUTS, BOLTS, WASHERS, PINS, AERO SPRAYS, SOLVENT, RAGS, TOWELS, BATTERY CLEANERS, ETC.

ENVIRONMENTAL CONCERNS, AS WELL AS FEDERAL AND STATE REGULATIONS GOVERNING DISPOSAL HAVE FORCED US TO CHARGE FOR THE EXPENSE INCURRED TO PROPERLY STORE AND ARRANGE DISPOSAL AND/OR RECYCLING OF OIL, TIRES, COOLANT, BATTERIES, METAL PARTS AND CLEANING SOLVENTS USED IN THE REPAIR AND MAINTENANCE OF YOUR VEHICLE.

ALL PARTS ARE NEW UNLESS OTHERWISE SPECIFIED

WARRANTY: 12,000 MILES OR 12 MONTHS ON NEW G.M. PARTS AND LABOR. 4,000 MILES OR 90 DAYS ON NEW NON-G.M. PARTS AND LABOR. NO WARRANTY ON USED PARTS.

THIS VEHICLE HAS BEEN TESTED OR TEST DRIVEN WHEN NEEDED AND MECHANICAL WORK WAS PERFORMED SATISFACTORILY

X ______________________
CUSTOMER'S SIGNATURE

NO CLAIMS WITHOUT THIS INVOICE
THANK YOU

 WARRANTY COPY-W [CONTINUED ON NEXT PAGE] 17:18:35

SERVICE INVOICE

10/11/2002 at 12:51 PM
78354

Job Number:

CRISWELL AUTOMOTIVE
License #:78354
PLEASE CALL US FOR AN APPOINTMENT TODAY!
503 QUINCE ORCHARD RD
GAITHERSBURG, MD 20878
(301)948-0880

PRELIMINARY ESTIMATE

239994
9724

Written by: CHRISTOPHER BURR #
Adjuster:

Insured: [redacted]
Owner:
Address:
Evening:

Claim #
Policy #
Deductible:
Date of Loss:
Type of Loss:
Point of Impact:

Inspect Location: CRISWELL AUTOMOTIVE
503 QUINCE ORCHARD RD
GAITHERSBURG, MD 20878

Business: (301)948-0880

Insurance Company:

Days to Repair

2000 CHEV CORVETTE 8-5.7L-FI 2D CNVT SILVER Int:
VIN: 1G1YY32G5Y5112632 Lic: Prod Date: Odometer: 19427

Air Conditioning	Tilt Wheel	Cruise Control
Intermittent Wipers	Keyless Entry	Theft Deterrent/Alarm
Dual Mirrors	Traction Control	Clear Coat Paint
Power Steering	Power Brakes	Power Windows
Power Locks	Power Driver Seat	Power Antenna
Power Mirrors	Anti-Lock Brakes (4)	Driver Air Bag
Passenger Air Bag	4 Wheel Disc Brakes	Leather Seats
Bucket Seats	Automatic Transmission	Aluminum/Alloy Wheels

NO.	OP.	DESCRIPTION	QTY	EXT. PRICE	LABOR	PAINT
1		FRONT BUMPER				
2	Repl	Add for fog lamps	1		0.5	
3*	Rpr	Bumper cover			5.0	3.2
4		Add for Clear Coat				1.3
5		O/H bumper assy			3.1	
6	Repl	Emblem	1	31.40	Incl.	
7*	Refn	Trim cover w/name				1.0
8		FRONT LAMPS				
9	R&I	RT Headlamp door			0.4	
10	R&I	LT Headlamp door			0.4	
11*	Refn	RT Headlamp door				1.0
12		Add for Clear Coat				0.2
13*	Refn	LT Headlamp door				1.0
14		Overlap Minor Panel				-0.2

?

Del Fran
Bill Gm

10/11/2002 at 12:51 PM Job Number:
78354

PRELIMINARY ESTIMATE

2000 CHEV CORVETTE 8-5.7L-FI 2D CNVT SILVER Int:

NO.	OP.	DESCRIPTION	QTY	EXT. PRICE	LABOR	PAINT
15		Add for Clear Coat				0.2
16		HOOD				
17	Refn	Hood				3.2
18		Overlap Minor Panel				-0.2
19		Add for Clear Coat				1.2
20		FENDER				
21	Refn	RT Fender				2.2
22		Overlap Major Adj. Panel				-0.4
23		Add for Clear Coat				0.4
24#		BLEND FOR COLORMATCH	1			
25	Refn	LT Fender				2.2
26		Overlap Major Adj. Panel				-0.4
27		Add for Clear Coat				0.4
28#		BLEND FOR COLORMATCH	1			
29#	R&I	FRT WHEELS FOR PAINT AND JACK CAR			1.0 M	
30#	Rpr	WETSAND AND BUFF FINISH				1.0
31#	Subl	WASH AND WAX EXTERIOR	1	65.00 X		
32#	Repl	CAR COVER	1	8.00 T	0.3	
33#	Repl	FLEX ADDITIVE	1	5.00 T		
34#		HAZARDOUS WASTE CHARGE	1	3.00 X		
		Subtotals ==>		112.40	10.7	17.3

Parts		31.40
Body Labor	9.7 hrs @ $ 38.00/hr	368.60
Paint Labor	17.3 hrs @ $ 38.00/hr	657.40
Mechanical Labor	1.0 hrs @ $ 82.00/hr	82.00
Paint Supplies	17.3 hrs @ $ 18.00/hr	311.40
Sublet/Misc.		81.00
SUBTOTAL		$ 1531.80
Sales Tax	$ 355.80 @ 5.0000%	17.79
GRAND TOTAL		$ 1549.59
ADJUSTMENTS:		
Deductible		0.00
CUSTOMER PAY		$ 0.00
INSURANCE PAY		$ 1549.59

Rental Expense 11548

BETZ

[redacted]

2002 CHEVY GREEN

ODOMETER IN	7,963		10/14/2002 15.96
ODOMETER OUT	7,812		10/14/2002 11.33
FUEL OUT	171		
FUEL ALLOW	2,700		
OVERMILEAGE CHG	0		

DATE DUE
Expiration of Contract AM PM
Or On Demand

Gas Out: 8/8
Gas In : 8/8

RENTAL RATES DO NOT INCLUDE FUEL

0 Hours	@	0.00 =	0.00
5 Days	@	26.91 =	134.55
1 Weeks	@	187.67 =	187.67
0 Months	@	0.00 =	0.00
0 X Days	@	0.00 =	0.00
0 Miles	@	0.24 =	0.00
Other			0.00
Net Time Plus Miles			322.22
0.0 Gallons @		1.95	0.00
			0.00
Sub Total			322.22
Sales Tax		11.500%	37.05
Sub Total			359.27
Misc:			0.00
			0.00
Sub Total			359.27
Less: Deposits			0.00
Less: Payments			0.00
Amount Due			359.27

Receipts/Due:
Amt Due - IN 359.27

ONLY THE BELOW NAMED PERSONS ARE AUTHORIZED AS ADDITIONAL DRIVERS. IF NONE, PRINT "NONE" ACROSS THIS SECTION AND HAVE SIGNED BY CUSTOMER.

DAMAGE:
EXTERIOR: OUT BODY ____ FENDERS ____ TIRES # ____
IN
OUT WHEELCOVERS ____ LIGHTS ____
IN
INTERIOR: OUT UPHOLSTERY ____ RADIO ____ MATS ____
IN
OUT ACCESSORIES
IN

REMARKS:

Notice to customers renting in Maryland:
The daily rental fee is based on a 24-hour period. The time the rental begins is shown on this rental agreement.

The insurance that you maintain on your own vehicle provides primary coverage for the replacement vehicle. Coverage that we maintain on the replacement vehicle is secondary.

Credit Charges. In the event Customer directs Licensee to bill charges hereunder to any other person, or organization, such person or organization and Customer shall be jointly and severally liable for all such charges. CUSTOMER EXPRESSLY AUTHORIZES LICENSEE TO PROCESS A CREDIT CARD VOUCHER, IF ANY, IN HIS NAME FOR CHARGES MADE HEREUNDER.

FUEL	
OUT	IN
E	E
¼	¼
½	½
¾	¾
F	F

RO# 239994

POS#

COT# 246 WRCS

WARNING
- Read carefully all conditions on the reverse side.
- You are responsible for all traffic violations.
- ONLY MINIMUM LIABILITY INSURANCE IS PROVIDED AS STATED ON THE REVERSE SIDE.

Customer has read both sides of this agreement and agrees to the terms and conditions thereof.
Customer authorizes Licensee to process a credit card voucher, if any, in Customer's name.
Customer may be prosecuted if vehicle is not returned when due.

X

999 999

REPAIR GUIDELINES FOR DEALERSHIP

1. USE LABOR OPERATION CODE **Z1242** FOR PRODUCT ALLEGATION CLAIM ONLY...EXCLUDING CAMPAIGN, SPECIAL POLICY, CUSTOMER PAY, AND WARRANTY CLAIM(S). THESE ITEMS MUST GO ON A SEPARATE LINE DUE TO THE FACT THAT WE ARE NOT USING Z1242 LABOR OP.

2. REPAIRS MUST BE DONE AT **WARRANTY RATE WITHOUT TAX**. PLEASE PROVIDE SUBLET (BODYWORK AND RENTAL VEHICLE) WITH YOUR **TAX ID #**

3. SET UP AN ITEMIZED REPAIR ORDER SHOWING PARTS AND LABOR CHARGES

4. RO **MUST** SHOW DOLLAR AMOUNT AT WARRANTY RATE. **CANNOT SAY $0 OR WARRANTY**

5. PROVIDE CUSTOMER WITH A RENTAL VEHICLE IF NEEDED UP TO $30 PER DAY, PUT RENTAL CHARGES ON THE REPAIR ORDER

6. PLEASE FAX THE FOLLOWING ITEMS BACK.....
   - ITEMIZED REPAIR ORDER
   - COPY OF ALL RECEIPTS
     EX... TOW, RENTAL, SUBLET BODYWORK

7. ANYTHING THAT YOU NEED FOR GM TO PAY REGARDING THE PRODUCT ALLEGATION CLAIM, **MUST** BE ON THE RO. IF IT IS NOT, WE **CANNOT** SUBMIT FOR PAYMENT.

8. **DO NOT** SUBMIT FOR PAYMENT, **IT WILL REJECT IF YOU DO.** A GMWA PROCESSOR WILL CONTACT YOU TO SHOW YOU WHEN AND HOW TO SUBMIT AFTER IT'S BEEN SUBMITTED IN OUR SYSTEM.

9. ANY REIMBURSEMENT TO THE CUSTOMER **MUST** BE APPROVE BY PRODUCT ALLEGATION AGENT.

G E N E R A L M O T O R S C O R P O R A T I O N
C H E V R O L E T D I V I S I O N
G M R E S T R I C T E D

CUSTOMER:
ADDRESS: [redacted] Lousia , VA 23093
HOME PHONE:

CASE NUMBER:	1-59281340	VIN:	1G1YY12S715121699
		MODEL YEAR:	2001
DATE OPENED:	2002-12-30	SERIES:	Corvette
DATE CLOSED:	2003-02-17	MILEAGE:	9300.0000000
SOURCE:	Phone	DELIVERY DATE:	
BRC TYPE:	PARYes	DEALER NAME:	Dominion Short Pump, Inc.
BRC PARENT:		DEALER ADDRESS:	12050 West Broad St,Richmond,VA,23233-1001,USA

**********GENERAL CASE INFORMATION**********

M01 General
0 REPAIR ATTEMPT(S) Inoperative

**********WORK HISTORY**********

Veh complaint; ; 2002-12-30
2002-12-30

Pre-Par form; ; 2002-12-31
2002-12-31

Service Request Ownership has changed FROM: COOPERJU TO: BOYCER; ; 2002-12-31
2002-12-31

Ownership Escalated to BRC; ; 2002-12-31
2002-12-31

THIS FILE HAS BEEN ASSIGNED TO PAUL RUED AT 57346; ; 2003-01-03
2002-12-31

Service Request Ownership has changed FROM: BOYCER TO: RUEDP; ; 2002-12-31
2002-12-31

servicer; ; 2002-12-31
2002-12-31

CASESCAN- NO FINDS.; ; 2002-12-31
2002-12-31

Acknowledgement VME; ; 2002-12-31
2003-01-02

Cust states received vme at home; ; 2003-01-02
2003-01-02

DESCRIPTION OF INCIDENT:; ; 2003-01-02
2003-01-02

FAVM Moon Thomas 404082 8220; ; 2003-01-02
2003-01-17

insurance agent/ USAA ANna/800-531-8222/ 34017; ; 2003-01-17
2003-01-20

insurance agent/ USAA ANna/800-531-8222/ 34017; ; 2003-01-20
2003-01-23

servicer; ; 2003-01-23
2003-02-17

Veh not inspected at this time; ; 2003-02-17
2003-02-17

++Business Summary++; ; 2003-02-17
2003-02-17

closing file; ; 2003-02-17
2003-02-17

Service Request has been Closed Satisfied.; ; 2003-02-17

**********PAR INFORMATION**********

INCIDENT DATE: 2002-12-29 INCIDENT TIME: 15:30:00.000000
INCIDENT LOCATION: West broad street richmond VA

DRIVER NAME: DRIVER AGE:
DRIVER DISABILITY: No

[redacted]ER DESCRIPTION: Changing lanes in highway to go into left lane when cust went to change lanes steering wheel lock up back end came around, cust spun around right side hit middle strip of highway, front of veh hit Van in front

ALLEGED DEFECTIVE COMPONENT: steering column

INCIDENT RESULT:
POLICE REPORT: Y ROAD CONDITION: Dry ROAD SURFACE: Asphalt
NUMBER OF PEOPLE: 1 BODY INJURY: N
INJURIES:

WAS ANOTHER VEHICLE INVOLVED:
NUMBER OF VEHICLES: 0

PROPERTY DAMAGE:

WAS VEHICLE INSURED: INSURANCE COMPANY NAME:
INSURANCE COMPANY ADDRESS:
AGENT NAME:
AGENT PHONE NUMBER:

MORE INFORMATION:
MAINTENANCE LOCATION: Dominion chevrolet
CURRENT LOCATION OF VEHICLE: at friends house
NOTIFY NAME: Owner

[redacted]AS VEHICLE INSPECTED: INSPECTORS NAME: INSPECTION DATE:
[redacted]EAGE AT INSPECTION:
[redacted]ERE WAS INSPECTION DONE:

WAS VEHICLE ROAD TESTED:
ROAD TEST DESCRIPTION:
ROAD TEST RESULT:
COMP INSPECTED:

INVESTIGATIVE SUMMARY:
[redacted]R STATUS:
**********PAR INFORMATION**********

SOURCE:
TRANSACTION:
REQUEST TYPE:
REPURCHASE REASON:

DEALER BAC:
DEALER NAME:
DEALER ADDRESS: , ,
CONTACT: ,
PHONE NUMBER:
FAX NUMBER:
PRODUCT CODE:
BODY TYPE:
TRIM:
ENGINE TYPE:
TRANSMISSION:
VEHICLE DRIVEABLE:
MILEAGE @ BUY-BACK: 0
BRC WARRANTY DATE:
MSRP:
NADA: 0
SALES TAX:

DEPRECIATION:
UPGRADE:
AFTERMARKET:
LEASE TERM:
DAMAGE:
OTHER:
BRANCH:
NAME:
ACCOUNT NUMBER:
INTEREST RATE:
INTEREST PAID:
DEALER BUYOUT:
[redacted]CCOUNT BALANCE:
LEGAL:
LEGAL TYPE:
LEMON LAW:
DEALER ADMINISTRATION:
VEHICLE DESTINATION:
RELEASE:
LIEN PAYOFF:
TITLE BRAND:

REPLACEMENT VIN:
**********BODILY INJURY**********

NUMBER OF INJURIES: 0
COMMENTS:

NAME:
LOCATION:
ADDRESS: ,
CITY/STATE: ,
PHONE NUMBER:
SEATING POSITION:
RESTRAINT:
TYPE OF INJURY:
TREATED:
IF SO, WHERE:

**********ADR INFORMATION**********

EXTERNAL CASE NUMBER:
DATE:
TITLE NAMES:
BUSINESS:
% BUSINESS: 0
[redacted]CIDENT:
DATE OF ACCIDENT:
[redacted]SCRIPTION OF DAMAGE:
PURCHASE/LEASE: 0
DATE OF PURCHASE/LEASE:
MILEAGE AT PURCHASE: 0
PURCHASE/LEASE AS:
DOES OWNER HAVE POSESSION OF VEHICLE:
RESOLUTION SOUGHT:

**********BRC CONTACT INFORMATION**********

NAME:
COMPANY:

ADDRESS:

CONTACT NUMBER: 1
CONTACT TYPE:
CONTACT PHONE:

G E N E R A L M O T O R S C O R P O R A T I O N
C H E V R O L E T D I V I S I O N
G M R E S T R I C T E D

CUSTOMER: [redacted]
ADDRESS: Jacksonville ,
FL 32258
HOME PHONE:

CASE NUMBER:	1-64469573	VIN:	1G1YY32G5Y5132928
		MODEL YEAR:	2000
DATE OPENED:	2003-01-16	SERIES:	Corvette
DATE CLOSED:	2003-01-28	MILEAGE:	32071.0000000
SOURCE:	Phone	DELIVERY DATE:	
BRC TYPE:	PARYes	DEALER NAME:	Gordon Chevrolet,Inc.
BRC PARENT:		DEALER ADDRESS:	1166 Blanding Blvd,Orange Park,FL,32065-6738,USA

**********GENERAL CASE INFORMATION**********

M41 Column / Ignition Lock / Parts
0 REPAIR ATTEMPT(S) Sticks

**********WORK HISTORY**********

PAR CASE/BODILY INJURY; ; 2003-01-16
2003-01-16

PRE-PAR FORM / BODILY INJURIES; ; 2003-01-17
2003-01-17

Service Request Ownership has changed FROM: ELLISONR TO: BOYCER; ; 2003-01-17
2003-01-17

Ownership Escalated to BRC; ; 2003-01-17
2003-01-17

THIS FILE HAS BEEN ASSIGNED TO STACEY PAUL AT 57845; ; 2003-01-20
2003-01-20

Service Request Ownership has changed FROM: BOYCER TO: PAULS; ; 2003-01-20
2003-01-20

Made contact see initail contact activity; ; 2003-01-20
2003-01-20

Outbound call made contact; ; 2003-01-20
2003-01-20

Svc Mgr; ; 2003-01-20
2003-01-20

AVM Bartnick John 404082 8124; ; 2003-01-20
2003-01-20

Fulfilled:BRCPAR_PA0041. SR#1-64469573; ; 2003-01-20
2003-01-20

seeking medical compensation; ; 2003-01-20
2003-01-20

No inspection needed - Sent to ESIS; ; 2003-01-20
[redacted]3-01-20

No decision yet made - Sent to ESIS; ; 2003-01-20
2003-01-20

No offer made; ; 2003-01-20
2003-01-20

Vin search performed; ; 2003-01-20
2003-01-20

Service Request has been Closed Satisfied.; ; 2003-01-20
2003-01-21

SR in Status of Closed has been Re-Opened by PAULS; ; 2003-01-21
2003-01-21

Brand quality Engineer Dave Peacy 586-575-3539; ; 2003-01-21
2003-01-22

ESIS rep Debbie; ; 2003-01-22
2003-01-23

ESIS rep Debbie; ; 2003-01-23
2003-01-28

ESIS 1-800-888-0164; ; 2003-01-28
[redacted]3-01-28

Dave Peacy 586-575-3539; ; 2003-01-28
2003-01-28

Service Request has been Closed Satisfied.; ; 2003-01-28
Clayton Glisson

**********PAR INFORMATION**********

INCIDENT DATE: 2003-01-05 INCIDENT TIME: 02:00:00.000000
INCIDENT LOCATION: Collins Road, Duval Co., Jacksonville FL

DRIVER NAME: DRIVER AGE:
DRIVER DISABILITY: none

OWNER DESCRIPTION: cust driving alone approaching T in road prepared to turn and lost power and steering column locked up; cust collided with tree; injuries to right hand and thumb resulting in surgery; abrasions to knees; no other known injuries at this time.

ALLEGED DEFECTIVE COMPONENT: alledges lost power in veh when steering column locked up; alledges 3rd time steering column has locked up

INCIDENT RESULT:
POLICE REPORT: Y ROAD CONDITION: Dry ROAD SURFACE: Asphalt
NUMBER OF PEOPLE: 1 BODY INJURY: Y
[redacted]URIES:

WAS ANOTHER VEHICLE INVOLVED:
NUMBER OF VEHICLES: 0

PROPERTY DAMAGE:

WAS VEHICLE INSURED:
INSURANCE COMPANY NAME:
INSURANCE COMPANY ADDRESS:
AGENT NAME:
AGENT PHONE NUMBER:
MORE INFORMATION: insurance claim #PD50B-3181783-01
MAINTENANCE LOCATION: dealer
CURRENT LOCATION OF VEHICLE: dealership
NOTIFY NAME: Relative

WAS VEHICLE INSPECTED:
INSPECTORS NAME: Inspection Not PerformedINSPECTION DATE:
MILEAGE AT INSPECTION:
WHERE WAS INSPECTION DONE:

WAS VEHICLE ROAD TESTED:
ROAD TEST DESCRIPTION:
ROAD TEST RESULT:
COMP INSPECTED:
INVESTIGATIVE SUMMARY:
PAR STATUS:

**********PAR INFORMATION**********

SOURCE:
TRANSACTION:
REQUEST TYPE:
REPURCHASE REASON:

DEALER BAC:
DEALER NAME:
DEALER ADDRESS: , ,
CONTACT: ,
PHONE NUMBER:
FAX NUMBER:
PRODUCT CODE:
BODY TYPE:
TRIM:
ENGINE TYPE:
TRANSMISSION:
VEHICLE DRIVEABLE:
MILEAGE @ BUY-BACK: 0
BRC WARRANTY DATE:
MSRP:
NADA: 0
SALES TAX:

DEPRECIATION:
UPGRADE:
AFTERMARKET:
LEASE TERM:
DAMAGE:
OTHER:
BRANCH:
NAME:
ACCOUNT NUMBER:
INTEREST RATE:
INTEREST PAID:
DEALER BUYOUT:

ACCOUNT BALANCE:
LEGAL:
LEGAL TYPE:
LEMON LAW:
DEALER ADMINISTRATION:
VEHICLE DESTINATION:
RELEASE:
LIEN PAYOFF:
TITLE BRAND:

REPLACEMENT VIN:

**********BODILY INJURY**********

NUMBER OF INJURIES: 0
COMMENTS:

NAME: [redacted]
ADDRE
CITY/
PHONE

LOCATION:

SEATING POSITION: Driver RESTRAINT: Seatbelt
TYPE OF INJURY: Right Hand & Thumb/Knedes abrasions
TREATED: IF SO, WHERE:

**********ADR INFORMATION**********

EXTERNAL CASE NUMBER: DATE:
TITLE NAMES:
BUSINESS: % BUSINESS: 0
ACCIDENT: DATE OF ACCIDENT:
DESCRIPTION OF DAMAGE:
PURCHASE/LEASE: 0 DATE OF PURCHASE/LEASE:
MILEAGE AT PURCHASE: 0 PURCHASE/LEASE AS:
DOES OWNER HAVE POSESSION OF VEHICLE:
RESOLUTION SOUGHT:

**********BRC CONTACT INFORMATION**********

NAME: [redacted]isson CONTACT NUMBER: 1
COMPANY: [redacted] CONTACT TYPE: 'Injured'
CONTACT PHONE: [redacted]

ADDRESS:

TECHNICAL ASSISTANCE SYSTEM

*** *GM RESTRICTED* ***

Case No:	*5868429*	***VIN Number:***	*1G1YY22G9Y5106438*
Date Opened:	*09/06/2002*	***Model Year:***	*00*
Date Closed:		***Series:***	*CORVETTE*
Dealer Code:	*B04564*	***Mileage:***	*28416*
Address:	*MERIT CHEVROLET CO MAPLEWOOD*	***State:***	*MN*
Dealer Phone:			

SYMPTOM ABSTRACT--- COLUMN LOCK STEERING COLUMN WONT UNLOCK NO CO
RESOLUTION ABSTRACT-
UCC CODE 1———
UCC-1 DESCRIPTION--- STEERING
UCC CODE 2———
UCC-2 DESCRIPTION—
UCC CODE 3———
UCC-3 DESCRIPTION—

09/06/2002 11:30:07 SBD TEMPLATE - RICHARDSON
STRATEGY BASED DIAGNOSTICS

_2_ NUMBER OF TIMES IN FOR THE SAME CONDITION
_2_ NUMBER OF DAYS VEHICLE IN DEALERSHIP FOR SAME CONDITION
_N_ Y / N IS THE VEHICLE MODIFIED/NON-PRODUCTION ACCESSORIES (LIST BELOW)

CALLER'S NAME (FIRST, LAST, AND POSITION)
MIKE TRIVISKI TECH
CUSTOMER CONCERN -
STEERING COLUMN WONT UNLOCK AT TIMES. NO MESSAGE OR MILS ON, ENGINE RUNS AND VEHICLE WILL MOVE WITHOUT STALLING.
DEALER COMMENTS/DIAGNOSIS -(DTC'S, PARTS, REPAIRS, DUPLICATED, SI SEARCH, COMPARE TO LIKE VEHICLE?)
NO CODES STORED, UNABLE TO DUPLICATE COMPLAINT. VEHICLE HAS HAD CAMPAIGN 01022 PERFORMED. VEHICLE IS A MANUAL TRANS.
VEHICLE WAS BOUGHTBACK FOR FUEL GAUGE CONCERN.
TAC RECOMMENDATION -
ADVISE TECH TO OBTAIN MORE INFORMATION FROM CUSTOMER. GET SPECIFICS SUCH AS HOW LONG HAD VEHICLE BEEN DRIVEN/PARKED BEFORE COMPLAINT OCCURED? HOW OFTEN DOES COMPLAINT OCCUR? HOW LONG DOES IT LAST AND WHAT IS DONE TO GET IT UNLOCKED?

TECHNICAL ASSISTANCE SYSTEM

**** GM RESTRICTED ****

Case No:	*6213971*			***VIN Number:***	*1G1YY32G015116593*
Date Opened:	*01/30/2003*			***Model Year:***	*01*
Date Closed:				***Series:***	*CORVETTE*
Dealer Code:	*B06903*			***Mileage:***	*20401*
Address:	*KUHIO MOTORS INC*	*LIHUE*	*HI*	***State:***	*HI*
Dealer Phone:					

SYMPTOM ABSTRACT— COLUMN LOCK STEERING ALLEGED COLUMN LOCK WHE
RESOLUTION ABSTRACT-
UCC CODE 1———
UCC-1 DESCRIPTION— STEERING
UCC CODE 2———
UCC-2 DESCRIPTION—
UCC CODE 3———
UCC-3 DESCRIPTION—

01/30/2003 15:04:46 SBD TEMPLATE - RADZIOCH
STRATEGY BASED DIAGNOSTICS

_1_ NUMBER OF TIMES IN FOR THE SAME CONDITION
_1_ NUMBER OF DAYS VEHICLE IN DEALERSHIP FOR SAME CONDITION
_N_ Y / N IS THE VEHICLE MODIFIED/NON-PRODUCTION ACCESSORIES (LIST BELOW)

CALLER'S NAME RICHARD RARALIO

CUSTOMER CONCERN - ALLEGED THE STEERING WHEEL LOCKED WHEN DRIVING AT LOW SPEEDS.

DEALER COMMENTS/DIAGNOSIS - TECH STATES THE VEHICLE IS WORKING PROPERLY NOW. TECH STATES NO DTC IN ANY CONTROL MODULE. TECH HAS THIS MASSAGED THAT TELLS HIM NOT TO DO ANYTHING TO THIS VEHICLE(CHS2003000)

TAC RECOMMENDATION - ADVISED TECH PER A000266
1. CHECK BOTH 'A' PILLAR GROUNDS G201 & G202.
2. CONNECT A TECH II & CHECK THE IGNITION KEY INPUT/OUTPUT STATUS (WIGGLE THE KEY WHEN DOING THIS). SOME EARLY MODEL YB'S (97 & 98) DO NOT UTILIZE THE STEERING COLUMN LOCK RELAY. IN THOSE VEHICLE W/O THE RELAY, YOU MUST DISCONNECT THE COLUMN LOCK MOTOR CONNECTOR FIRST BEFORE CHECKING KEY STATUS ON TECH II. AFTER CHECKING KEY STATUS THE TECH MUST PULL THE BCM

FUSE TO CLEAR IT OUT OF FAIL ENABLE MODE.

3. CHECK THE IGNITION SWITCH CONNECTOR FOR LOOSE CONNECTORS OR POOR PIN RETENTION.

4. CHECK THE COLUMN LOCK RELAY LOCATED NEXT TO THE BCM BY PLACING FINGERTIPS ON THE RELAY & FEEL IT

ENERGIZE WHEN ACTIVATING THE COLUMN MOTOR. THEN PLACE FINGERTIPS ON THE CASE OF THE BCM AND YOU SHOULD FEEL A BUZZING NOISE INSIDE INDICATING THE INTERNAL RELAY IS FUNCTIONING.

01/30/2003 15:04:46 HISTORY - RADZIOCH

TECHNICAL ASSISTANCE SYSTEM

**** GM RESTRICTED ****

Case No:	*6261598*	***VIN Number:***	*1G1YY22G0V5109266*
Date Opened:	*02/19/2003*	***Model Year:***	*97*
Date Closed:		***Series:***	*CORVETTE*
Dealer Code:	*B06223*	***Mileage:***	*48000*
Address:	*FRIENDLY CHEVROLET ESCALON*	***State:***	*CA*
Dealer Phone:			

SYMPTOM ABSTRACT— DRIVE LOCK STEERING STEERING LOCKED WHILE DRI
RESOLUTION ABSTRACT-
UCC CODE 1———
UCC-1 DESCRIPTION— STEERING
UCC CODE 2———
UCC-2 DESCRIPTION—
UCC CODE 3———
UCC-3 DESCRIPTION—

02/19/2003 11:58:40 SBD TEMPLATE - HAWKINS
STRATEGY BASED DIAGNOSTICS

_1_ NUMBER OF TIMES IN FOR THE SAME CONDITION
_2_ NUMBER OF DAYS VEHICLE IN DEALERSHIP FOR SAME CONDITION
_N_ Y / N IS THE VEHICLE MODIFIED/NON-PRODUCTION ACCESSORIES (LIST BELOW)

CALLER'S NAME (FIRST, LAST, AND POSITION) STEVE LOOGMAN TECH

CUSTOMER CONCERN - ALLEGED THAT STEERING WHEEL LOCKED WHILE BACKING OUT OF DRIVEWAY.

DEALER COMMENTS/DIAGNOSIS -(DTC'S, PARTS, REPAIRS, DUPLICATED, SI SEARCH, COMPARE TO LIKE VEHICLE?)
DEALER STATES THERE WAS NO DAMAGE, PROPERTY DAMAGE AND OR PERSONNEL INJURY AS A RESULT OF THIS INCIDENT.
DEALER STATES THEY FILED A PRODUCT REPORT OVER 24 HRS AGO.
DEALER STATES THEY HAD HISTORY CODES IN THE BCM AS FOLLOWS B2587 B2592.

TAC RECOMMENDATION -
TAC ADVISED DEALER NOT TO TOUCH VEHICLE AND TO IMMEDIATELY FILE A PRODUCT REPORT AS PER CHS20030001.
TAC ADVISED DEALER OF BULLETIN # 02-00-89-002A WHICH OUTLINES THE

PROCEDURE FOR THIS ACTION.
TAC ADVISED DEALER SINCE NO RESPONSE TO THEIR PRODUCT REPORT FOR OVER 24 HRS TO CALL IN AND REPORT AGAIN AND ASK FOR INSTRUCTIONS.
TAC PERFORMED VIS AND FOUND NO OPEN CAMPAIGNS OR RECALLS ON THIS VEHICLE

MIKE HAWKINS
02/19/2003 11:58:40 HISTORY - HAWKINS

GM622B
EA02-031

ATTACHMENT "9"

ADMINISTRATIVE MESSAGE

Message Date: 01/23/2003 **Admin Number:** CHS20030002

Originating Dept:	
Subject:	1997-2003 Chevrolet Corvette Steering Column Lock Mechanism Engagement During Vehicle Operation
Action Required:	Submit a Field Product Report (FPR) Immediately
Contact Person: (for Wholesale)	**Name:** Dave Peacy **Phone:** 586-575-3539 **Email:** Dave Peacy/US/GM/GMC @ GM **Fax:**
Contact Person: (for Wholesale)	**Name:** **Phone:** **Email:** **Fax:**
Contact Person: (for Wholesale)	**Name:** **Phone:** **Email:** **Fax:**
Dealership cc: (Recommended Distribution):	Dealer Principal, Service Manager

Message Categorization Information:

Priority:	N
Message Type:	Service
Category:	None
Revision Reference:	CHS20030001
Release Date:	01/23/2003

To (Dealer): ALL CHEVROLET DEALERS

To (GM Internal:) FCN Team/US/GM/GMC@GM, Dave Peacy/US/GM/GMC@GM, Karen Doty/US/GM/GMC@GM, Loren Rusk/US/GM/GMC@GM

URGENT - DISTRIBUTE IMMEDIATELY

DATE: January 13,2003.

SUBJECT: Request for customer complaint vehicle that has allegedly experienced steering column lock mechanism engagement during vehicle operation.

MODELS: 1997-2003 Chevrolet Corvette

TO: All Chevrolet Dealers

ATTN: Service Manager and Service Advisor

GM Service and Parts Operations is requesting your assistance. We are looking for any 1997-2003 model year Chevrolet Corvette that allegedly has experienced steering column lock engagement during vehicle operation. If you have a customer complaint alleging that the steering column lock engaged during vehicle operation, please submit a Field Product Report (FPR) immediately. See Service Bulletin 02-00-89-002A for FPR instructions.

We are interested in knowing about any Corvette that has allegedly had this occur. It is VERY IMPORTANT that the vehicle not be disturbed once the condition is reported. DO NOT insert the key into the ignition lock cylinder. The ignition lock cylinder MUST remain in the 'Off' position. The vehicle should be transported via flat bed truck to the dealership and an FPR submitted. GM personnel may wish to visit your dealership to inspect the involved vehicle.
When submitting your FPR please make sure to provide your name, the dealership's name, location and a telephone number where you can be contacted along with the Vehicle Identification Number (VIN) of the subject vehicle and a brief description of its condition.
You will be contacted within 24 hours to advise you how to proceed and of our intention to visit your dealership.
We greatly appreciate your assistance.
END OF MESSAGE

GM SERVICE AND PARTS OPERATIONS

GM622B
EA02-031

ATTACHMENT "14"

"GM CONFIDENTIAL" MATERIAL HAS BEEN REMOVED FROM THIS ATTACHMENT AND SUPPLIED TO THE OFFICE OF THE CHIEF COUNSEL

GM622B
EA02-031

ATTACHMENT DELPHI

"CONFIDENTIAL" MATERIAL HAS BEEN REMOVED FROM THIS ATTACHMENT AND SUPPLIED TO THE OFFICE OF THE CHIEF COUNSEL.

GM622B
EA02-031

ATTACHMENT DELPHI

DELPHI

Product Regulations & Investigations
Michael J. McKale
Manager

CL03-004-001
memo

DATE: March 21, 2003

FROM: Michael J. McKale

SUBJECT: 1997-2001 Corvette Electric Column Lock IR EA02-031

TO: Michael Plotzke

Attached is Delphi's response to questions 10 through 19 of the NHTSA Information Request EA02-031 (GM 622B). At this time we are continuing to gather material and we will be supplementing the materials in the Quality Assurance Section and in the Delphi / GM Communications Section.

The documents that are attached to this cover letter are considered to be non-proprietary. Other documents in response to these questions including the Delphi Product Specification, the Mid-Lux / Delphi Subsystem Technical Specification specifiation dated 20AU99, and certain Quality Control specifications that were contained in certain presentations (Pages marked), which are considered to be proprietary, are provided under separate cover along with the appropriate affidavit for maintaining confidentiality. We ask that you treat these materials accordingly.

If you have any questions, please do not hesitate to call me at 248 813 3362.

Michael J. McKale
Manager
Product Regulations and Investigations

Question 10
One action that may be related to the alleged defect is planned.
One action that may be related to the alleged defect has been completed at Delphi's request:

Action	Start Date	End Date	Objective	Responsible	Conclusions
Rebound Test	9/27/2002	9/30/2002 Complete	Evaluation of 26050960 and 26089807 w/o dynamic braking	Fasco/Invensys/Honeywell	See Attached report for details. Source of the document is Invensys.
Evaluation of Original 1997.2 Model Year System	April 2003	May 2003	Evaluation of Dynamic Braking	Honeywell & Delphi	

Switch Operation
By design, this ECL feedback switch must open prior to the possibility of locking the column even if a column were constructed of all parts in their worst-case conditions. The following truth table explains the meaning of this switch:

	Column Unlocked	*Column Locked*
Switch Open	Unknown	Unknown
Switch Closed	True	False

Definition of Rebound
The term rebound refers to the motion (opposite the previous motion) of the carrier that is caused by the release of energy stored in the gear train of the ECL. This happens because when the ECL is commanded to a lock or unlock, the BCM does not remove electrical power from the ECL prior to the mechanical end-of-travel being reached by the carrier. As a result, the ECL carrier collides with the end-of-travel stops and the motor and its kinetic energy are dissipated in the gear train. This causes temporary deformation of the components. This energy is then released when the electric power is removed from the motor. This can be compared to the energy stored in a spring. Rebound is problematic when the carrier travel (and hence the bolt travel) is sufficient to cause the ECL feedback switch to open. Due to build tolerances in the ECL feedback switch position, some units require less carrier travel than others to open the ECL feedback switch. It should be noted, that this event takes place prior to vehicle motion (during the start cycle).

Explanation of the Test Results
These tests were run with two sets of parts. The first set, CPXX were units of the current production design that have had durability cycling of approximately one life (50,000 cycles). The second set of parts, PPAPXX are parts from the durability test leg of the product validation test for 26089807 (Durability test is run with dynamic braking

provided by the SPDT relay. All parts passed this test without rebound. Refer to appendix A, test log 02-0048.) These sets of ECLs were run without any dynamic braking to show that the rebound was similar. Rebound was noted, but the measurement of the bolt position after rebound was not recorded. Engineers at Fasco/Invensys/Honeywell did not consider the observations of this test to be abnormal.

Assessment of the Issues

"Rebound" does not imply that the steering column is physically locked nor does it necessarily constitute a safety issue. It is Delphi's engineering opinion that a vehicle is not safe to be driven if the ECL feedback switch is not closed because the vehicle steering cannot be guaranteed. No testing, field returns, warranty parts, test samples, development samples, nor other units are known to have ever caused the steering to lock due to a rebound event.

Facsimile

invensys
Sensor Systems

Date: 10/15/02
Time: _____

Please deliver the following pages to:
NAME: Jim Rowland
FIRM: _____
LOCATION: _____
FAX: _____
SENDER: A. Stone
PHONE : _____
EMAIL: _____

No. of Pages Transmitted: 4 (Includes this Page)

(If any portion is not received or not legible, please advise.)

Special Instructions (if any):

Message (if any):
Received Test Reports

Invensys Sensor Systems
1100 Airport Road Shelby North Carolina 28150 USA
Telephone +1 704 482 9582 Engineering Facsimile +1 704 481 1741 www.invensys.com

CL03-004-004

Product Test Laboratory
1100 Airport Rd.
Shelby, NC 28150

invensys

Sensor Systems

Product Test Laboratory
Product Validation Report #: *02-0108*
Engineering Request
Delphi Saginaw Electronic Column Lock Assembly
Invensys Part #: *1740-0002 & 1740-0014*
Specification #: *See details*
Sample Size: *12*
Build Date: *N/A*

Tested By: C. Allen Smith **Date:** 10-14-02
(Technician)

Test Facilities Manager: _____ **Date:** 10/14/02

CL03-004-005

Product Test Laboratory
1100 Airport Rd.
Shelby, NC 28150

invensys

Sensor Systems

Type of Test:	Engineering Request
Test Log #:	02-0108
Customer/Part Description:	Delphi Saginaw ECL
Invensys Part #:	1740-0002 & 1740-0014
Test Description:	Durability Analysis w/out dynamic braking
Sample Size:	12
Build Date:	N/A
Technician:	Larry Kane & Alan Smith
Start Date:	9/27/02
Finish Date:	9/30/02

Description of Testing:

The testing that was requested is a comparison of p/n 1740-0002 & p/n 1740-0014 in a durability test without the benefit of dynamic braking as a part of the circuit. This was accomplished by replacing the SPDT relay with a SPST relay. The SPDT relay, when in its free state, completes a circuit across the motor. The SPST relay does not have this feature.

The samples tested were current product, 1740-0002, and identified during the testing as CPXX, and New Design, 1740-0014, and identified as PPAPXX. Six samples from each design were electrically connected to the Saginaw durability tester and allowed to operate in a free state.

The durability test selected was Test #7. Test #7 is programmed to cycle the samples for 9748 cycles. The ECL assembly were energized at 14 volts dc for the unlock cycle and 9 volts dc for the lock cycle. The temperature setup was to start at room ambient and ramp to 60°C in 2 hours.

The voltage and temperature were verified prior to startup.

Setup Parameter	*Measured Value*	*Equipment*	*ID #*	*Calibration Date*	*Calibration Due*
14.0 Vdc	13.97Vdc	Fluke 79 III	MM77180061	5/21/02	11/21/02
9.0Vdc	8.99Vdc	Fluke 79 III	MM77180061	5/21/02	11/21/02
60°C	67°C	Omega HH12	TT-711032	9/19/02	12/19/02

The test was started on 9/27/02 at approximately 4:00pm and allowed to complete over that weekend.

CL03-004-006

Product Test Laboratory
1100 Airport Rd.
Shelby, NC 28150

invensys

Sensor Systems

Tester Analysis:

Fault Code	CP20	CP23	CP24	CP25	PPAP37	PPAP47	PPAP36	PPAP33	PPAP28
U-0 Unlock Pass	9740	1796	4	1173	172	173	24	948	429
U-2 Unl.-Rebound									
L-2 Lock Wrong Start									

All samples, with the exception of CP22, CP21, & PPAP34, exhibited rebound without the benefit of dynamic braking.

CP20 exhibited rebound after 9168 cycles and at a temperature average of 56.85°C.

CP23 exhibited rebound after 93 cycles while the temperature was at room ambient and continued to rebound until the end of the test.

CP24 exhibited rebound at the 4th cycles and never recovered.

CP25 exhibited rebound after 1067 cycles and continued to rebound until the end of the test. Average temperature for this sample was 57°C.

PPAP28 started rebounding after 398 cycles and continued until the end of the test.

PPAP33 started rebounding after 780 cycles and continued until the end of the test.

PPAP36 started to rebound after the 2nd cycle and continued until the end of the test.

PPAP37 exhibited rebound after the 62nd cycle and continued until the end of the test.

PPAP47 exhibited rebound after the 24th cycle and continued until the end of the test.

CL03-004-007

Question 11
All 26050960 and 26089807 ECLs are 100% interchangeable. The 26050960 ECL is no longer produced and would be replaced by the 26089807 ECL.

Question 12

Date	Description	Reason	Original Part#	New Part #	Status	Disposition of Stock	Service Available	Inter-changeability
1/1/2003	ECL with bearing at motor shaft / casting interface	Better Reliability	26050960	26089807	Old part production ceased	Use	Yes 1/1/2003	Yes
1/31/2003	Motor Insertion Fixture	Improved Assembly Quality	26089807	26089807	Process change only –No change to ECL	Use	Yes 1/31/2003	Yes
4/2003	Update drawing to reflect part as manufactured	Engineering Record update of non-functional dimensions	26089807	26089807	Record Update Only -No change to ECL	Use	Yes TBD	Yes
6/2003	PTC change (No Change to ECL Performance)	Old PTC made obsolete by manufacturer	26089807	TBD Part number to change at GM's request.	Planned No change to ECL performance	Use	Yes TBD	Yes

CL03-004-012

Question 13

a. Any requested ECLs will be provided with the Delphi or Fasco/Invensys/Honeywell response (assuming parts are available at Fasco/Invensys/Honeywell).

b. One Steering Column Assembly part number 10336589 (current production) is provided. This column exhibits the same locking components as the 1998 service steering columns. Any differences are in other column parts not associated with the locking system.

c. Two Shield Assembly, Shaft Lock, part number 26045147 are provided.

Question 14

a. Delphi Specification is 26053015 revision 025. See Attached.
GM Specification is 26087216 revision 001. See Attached.

b. Specification change history is included as the last page of each specification.
See Attached.
The only change to 26053015 since engineering release has been the change of the thermal storage test from 48 hours at 105°C to 48 hours at 90°C. This change occurred on January 28, 1996.

There have been no changes to 26087216.

c. Testing requirements are listed in the specification.
Description of the how each testing process was conducted is contained in the specification instructions.
Name and type of testing and measurement equipment is not specified.

d. Test results are given in Appendix A.

e. No changes or additions were made to the testing requirements.

f. Not applicable.

Confidential CL Numbers

CL03-004-016
Thru
CL03-004-058

NHTSA-IR (EA02-031)
Question #15

CL03-004-059

Question 15

a. The source of the document is Delphi but the author and date are unknown.

b. The requested documents are included as Appendix B. Reference documents B-2, C-1, D-1, E-4, S, J-1, J-3, J-4, N, and K-1 are all included.

c. The terminology PPAP, Interim A, Interim D, are defined by the AIAG documentation. A copy is included in Appendix C.
The term engineering permit refers to a procedure at Delphi Saginaw. Per Delphi Saginaw Procedure G1302 the following description is given:
"**ENGINEERING PERMIT**
1.0 PURPOSE
The purpose of this procedure is to establish a system for documenting decisions which grant permission to deviate from the product drawing or specification requirements on a temporary basis. The system will use Engineering permits, DS 1507 and DS 1508, issued by Product Engineering (see attached sheets) to assure due care."

d. This question is addressed by General Motors.

e. The steering column and its components are required to pass performance testing prior to production. This testing is known as Product Validation. The validation of the column is recorded in the Program Test Plan. One of the product validation tests required in this column program test plan is the vendor validation of the subject component by the supplier. In this case the ECL is the subject component and Fasco/Invensys/Honeywell is the supplier. The vendor validation summary is kept on file at Delphi; the detailed results are kept on file at Fasco/Invensys/Honeywell. The described testing in the component technical specification (CTS) constitutes the vendor validation. The CTS and test results are included in the response to question #14. Please refer to appendix A.

f. Fasco/Invensys/Honeywell was unable to demonstrate the reliability of all 44 components during the durability test in test leg #4 as required by the CTS. In their testing some late-in-life units did not move when commanded.

g. Development and testing of designs has occurred at Fasco/Invensys/Honeywell for several years. This has culminated in the successful validation and PPAP of the new part 26089807. This new ECL has overcome the shortcomings of the previous design by addition of a bearing at the worm end of the motor shaft. Detailed description of the actions will be included in the Delphi and Fasco/Invensys/Honeywell responses.

h. This question is addressed by General Motors.

i. This question is addressed by General Motors.

j. This question is addressed by General Motors.

k. This question is addressed by General Motors.

l. The out-of-print condition of the switch actuator refers to the improper manufacture of a stainless steel stamping used to actuate the feedback switch in the ECL. ECLs built with this "out-of-print" actuator failed to maintain switch closure when the ECL was unlocked and the motor was stalled. This caused the vehicle to continue to attempt to unlock the ECL for 650mS. After this time had

elapsed, the motor was turned off and the BCM considered the event to be a "fail to unlock". The vehicle is unlocked, but not able to be driven.
The attached documents show the Delphi's 5 phase, the GM PR/R, corrective action report from Fasco/Invensys/Honeywell and the presentation from Fasco/Invensys/Honeywell given to Delphi. This presentation details the response at Fasco/Invensys/Honeywell.

ECLs were replaced in all affected vehicles that were brought in for service.

DELPHI
Automotive Systems
Plant 6

5-Phase Problem Solving Report

5 Phase #: 9601
5-Phase Revision #: 3

[redacted]: C. Watz	Department(s): 82	Champion: B. Stone / Fasco
Initiating Report: PR/R	P/N or Process: 26070626	Issue Date: 1/5/99
Initiating Report #: 05-99-1Y-0464	Car Body: Y-Car	Required Answer Date: 2/2/99
Attachments to file: Yes	Defect Code: 2500	Quality Contact Person: C. Watz
Assembly Plant: Bowling Green	Defect Name: Electric Column Lock Inoperative	
References: See 5-Phase #9002		

I. Problem Description(s) or Quantification:
Electric column lock (ECL). Unlock feedback switch is not made (open circuit) when the ECL is unlocked. This results in a "Fail Enable Mode" code being set in the vehicle. As a result, the column will not lock.

Person Responsible: J. Rouleau Phone Number: (8) 357-3133 Date Identified: 12/17/98

II. Immediate Action(s):
1. All steering columns pulled back to be certified for proper ECL operation (12/17/98).
2. All steering columns at sequence house (Vassar Industries) certified with light box and ECL connector marked with pink paint marker.
3. All suspect components pulled back from stock and sent back to supplier (Fasco). Certified ECL's from supplier expedited to Delphi Saginaw. Connectors marked with yellow or orange paint marks (12/17/98).

Containment Not Required (Authorization Needed): ___ *Authorization:* _____

Comments:

Person Responsible: C. Watz Phone Number: (8) 357-4625 Date Implemented: 12/17/98

III. Root Cause Determination(s):
1. Unlock feedback switch (actuator), which activates the switch, had a slight bow that caused decreased actuator travel necessary to close the switch when assembled.
2. Heat stake process at supplier (Fasco) was found to exasperate bow condition.
3. Incident ECL's were not captured by end of line testers due to tester sequence not having duplicate logic used by the vehicle.

Person Responsible: Fasco / T. Willette Phone Number: (704) 485-9582 Date Determined: 12/17/98

IV. Corrective Action Plan (CAP): Target Date
1. Measurement technique revised on actuator at punch press. Measurement fixture made to simulate the actuator in assembled condition (18DE98).
2. Misform condition in die corrected (18DE98).
3. Controls (temperature, time, pressure) have been placed on the heat stake operation (3/2/99).
4. End of line tester at Fasco being modified to be same as vehicle (13JA99).
5. End of line testers at Saginaw being modified to duplicate vehicle (12JA99).

Person Responsible: Fasco / J. Fields Phone Number: (8) 357-4237 Date Implemented: 1/12/99

Superintendent's Approval _____ 85-2B

Print Name Date Signature Other Potential Processes

V. Verification/Validation of CAP(s): *(Completed By Quality Assurance)*

Person Responsible: Phone Number: Date Verified:

PR/R # 05-99-1Y-0464

**** GENERAL MOTORS CORPORATION ****
MCD BOWLING GREEN

PROBLEM REPORT / RESOLUTION

** Current Production **

#9601

****
* PR/R's Issued M-Y-T-D: 3 *
* For Noted Part # & Supplier*
****

pplier Code: 33580007 ** ON-LINE **

TO: DELPHI-S - SAGINAW PLT 6 (SB6)
3900 HOLLAND RD
SAGINAW, MI 48601

Routing:

Buyer #: GPS

PR/R Status - Date	
Discovered	: 12/16/98-1
Issued	: 01/05/99
Init. Resp	: 01/06/99
Pending Final:	
Proj. Date	:
Rejected	:
Final Resp.	: 01/20/99
Rejected	:
RESOLVED	: 03/22/99-L

[illegible]ber:	26047460	PDT Code	:	Lot/Run/Date:	N/A
[illegible]e :	COLUMN ASM	Dwg. Number:	N/A		
dy Style :	1YA00	Eng.Chg.Lvl:	N/A	Qty. Check'd:	660
C Code :		Trace ID # :		Qty. N/C :	16
sc 1 :				Ttl.Qty.Susp:	660
sc 2 :	17-30	Sketch	: UNAVAILABLE	Est.Qty. N/C:	16
sc 3 :		Via	:		

C Subject: SPILL-STRG COL LK MESSAGE DISPLAYED
thod of Verification: GAGES

C Description:

HAVE HAD 5 REPORTED FAILURES WITH ''SERVICE COLUMN LOCK'' MESSAGE
OADCAST ON THE DIC. THE COLUMN WOULD NOT LOCK. ON MONITORING THE
LUMN LOCK STATUS IT WAS NOTICED THAT THE COLUMN LOCK WAS IN A
FAIL ENABLE MODE''. THE UNIT WAS RETURNED FOR YOUR ANALYSIS. A COST
COVERY FOR THE REPLACEMENT OF THE COLUMN LOCKS (ECL'S) WILL FOLLOW.
RIS WATZ WAS NOTIFIED.

ported By: SURESH NAIR
Title: REL. ENGR. Ph. #: 8-281-8131

****

CL03-004-063

tial Response 01/06/99:

Short Term Corrective Action Taken:
LED BACK ALL SUSPECT ECL COMPONENTS FRO DELPHI STOCK TO RETURN TO
PLIER (FASCO). EXPEDITED CERTIFIED MATERIAL FROM SUPPLIER TO SAGINAW
2/16/98). CERTIFIED ALL STOCK AT SEQUENCE HOUSE (VASSAR) AND PUT
NT MARK ON ECL CONNECTOR. CERTIFIED MATERIAL PER RACK #543 SEQUENCE
16261).
Disposition of N/C Material: Return to supplier
Conforming Material Shipping Date: 12/17/98
Supplier Contact: CHRIS WATZ
Title: QUALITY SUPV. Ph. #: 8-357-4625

****

al Response 01/20/99:

Root Cause:
TERMINED TO BE THE UNLOCK FEEDBACK SWITCH (ACTUATOR), WHICH ACTIVATES
S[illegible]CH, HAD A SLIGHT BOW THAT CAUSED DECREASED ACTUATOR TRAVEL
CESSARY TO CLOSE THE SWITCH WHEN ASSEMBLED. INCIDENT ECL'S WERE NOT
PTURED BY END OF THE LINE TESTERS DUE TO TESTER SEQUENCE NOT HAVING
PLICATE LOGIC USED BY THE VEHICLE.
Process Correction and Preventative Action Taken:
MEASUREMENT TECHNICQUE REVISED ON ACTUATOR @ PUNCH PRESS. MEASUREMENT
KTURE MADE TO SIMULATE THE ACTUATOR IN ASSEMBLED CONDITION (18DE98).
MISFORM CONDITION IN CONTACT DIE CORRECTED (18DE98).
END OF LINE TESTER MODIFIED @ SUPPLIER FASCO (13JA99).
END OF LINE TESTERS @ SAGINAW MODIFIED TO DUPLICATE VEHICLE (12JA99).
Effective Date: 01/12/99
Verified By: CHRIS WATZ
Title: QUALITY SUPV. Ph. #: 8-357-4625

****

solved Response 03/22/99:

SOLVED - NO FAILURES SINCE IMPLEMENTATION OF FINAL LINE CHECKER.
EAKPOINT JOB # 17731.
Verified By: SURESH NAIR
Title: REL. ENGR. Ph. #: 8-281-8131

****

****

lted 05-99-1Y-0464 01/11/99 08:26:17
om: (05) - MCD BOWLING GREEN By: SURESH NAIR
one: 8-281-8131

ITS Performed (field:old value:new value):
antity Checked : 9 : 660 :
antity N/C : 9 : 16 :
tal Quantity Suspect: 9 : 660 :

RITIES EDITED.

9601

FASCO
CONTROL PRODUCTS

Corrective Action Request

CAR # 0723

This Section to be Filled in by the Initiator

Initiator: Tim Willette
Phone: 364
Date Opened:01/28/99
Location of where the nonconformance was found: Delphi Saginaw
Location of where the nonconformance originated from: Fasco
Type of Issue: Customer
Customer : Delphi Saginaw
Customer Location: Plant 6
Fasco Part #: 17400002
Customer Part #:
Quantity of parts returned from the customer: 4
Return Material Authorization #
Return Goods #:
Nonconformance: Intermittant micro switch
Source of CAR: Customer Complaint

Quality Engineer: Tim Willette/QUALITY/SHELBY/FASCO
Manager: Mike Skillman

This Section to be Filled in by the Manager

Manager Response

Champion:
Anticipated Completion: Days

This Section to be Filled in by the Champion

Problem Definition: 2 Micro-switches verified as intermittant (briefly closes) during plunger movement. Unable to electronically verify intermittant defect in other two returned units.

Containment Action: 100% sort product at Saginaw using electronic tester. 100% sort current inventory at Fasco using a scope checking during plunger extension and retraction. (three actuation cycles per switch)

Root Cause: Crimp height shift downward (low end/under spec) due to crimp head replacement. Crimping operation bowed cover causing the actuator assembly to move toward the plunger carrier assembly. During plunger extension, the carrier would contact the actuator on the 90 degree end causing the micro switch to briefly close. The escape path of the defective switches was aided by the tester fault codes not accurately defining the condition of failure. (intermittant failure wrongly labeled as switch point datum error to previous print revision) which misdirected investigation into root cause. Continued production with short crimp heights allowed several INTERMITTANT switches to escape the final test. Also, the multi-meter sort established for the intermittant condition during plunger retraction was not capable of detecting this condition during plunger extension.

Corrective Action: - Crimping operation (height) adjusted to no longer bow the top. (now within spec - ongoing study for process stability and improvement - action plan for improvement being developed) Test time added to final test cycle looking for intermittant condition to increase reliability of containing future intermittant conditions. Final tester fault codes revised to accurately designate actual fault condition.

Corrective Action Verification: 1) Continue scope sort (after final test) for minimum of 1200 pieces with no rejects (during plunger extension and retraction - to be documented with test log) 2) Documented capability of crimp operation

CAR 723

Team Members Wade Landis, Steve Davis, Bobby Warren, Tim Wiletta

Follow-up Audit to be completed from 01/23/2000 to 02/06/2000

This Section to be Filled in by the Manager or Auditing Authority

Manager Approval

Has Corrective Action been effectively implemented?

DELPHI
Automotive Systems
Plant 6

5-Phase
Problem Solving Report

5 Phase #: 9002
5-Phase Revision #: 3

: C. Watz
nitiating Report: CCR
nitiating Report #: 980799
Attachments to file:
Assembly Plant: Bowling Green
References: See 5-Phase #9801

Department(s): 62
P/N or Process: 26050980
Car Body: Y-Car
Defect Code: 2500
Defect Name: Electric Column Lock Inoperative

Champion: B. Stone / Fasco
Issue Date: 12/21/98
Required Answer Date: 1/18/99
Quality Contact Person: C. Watz

I. Problem Description(s) or Quantification:
Electric column lock (ECL). Unlock feedback switch is not made (open circuit) when the ECL is unlocked. This results in a "Fail Enable Mode" code being set in the vehicle. As a result, the column will not lock.

Person Responsible: J. Rouleau Phone Number: (8) 357-3133 Date Identified: 12/17/98

II. Immediate Action(s):
1. All steering columns pulled back to be certified for proper ECL operation (12/17/98).
2. All steering columns at sequence house (Vassar Industries) certified with light box and ECL connector marked with pink paint marker.
3. All suspect components pulled back from stock and sent back to supplier (Fasco). Certified ECL's from supplier expedited to Delphi Saginaw. Connectors marked with yellow or orange paint marks (12/17/98).

Containment Not Required (Authorization Needed): ___ *Authorization:* _____

Comments:

Person Responsible: C. Watz Phone Number: (8) 357-4625 Date Implemented: 12/17/98

III. Root Cause Determination(s):
1. Unlock feedback switch (actuator), which activates the switch, had a slight bow that caused decreased actuator travel necessary to close the switch when assembled.
2. Incident ECL's were not captured by end of line testers due to tester sequence not having duplicate logic used by the vehicle.

Person Responsible: Fasco / T. Willette Phone Number: (704) 485-8582 Date Determined: 12/17/98

Target Date:

IV. Corrective Action Plan (CAP):
1. Measurement technique revised on actuator at punch press. Measurement fixture made to simulate the actuator in assembled condition (18DE98).
2. Misform condition in die corrected (18DE98).
3. End of line tester at Fasco being modified to be same as vehicle (13JA99).
4. End of line testers at Saginaw being modified to duplicate vehicle (11JA99).

Person Responsible: Fasco / J. Fields Phone Number: (8) 357-4237 Date Implemented: 1/8/99

Superintendent's Approval _____
Print Name Date Signature Other Potential Processes

V. Verification/Validation of CAP(s): *(Completed By Quality Assurance)*
New 5-Phase issued (9601). This 5-Phase is canceled.

Person Responsible: D. Gudritz Phone Number: Date Verified: 1/5/99

DELPHI
Automotive Systems
Plant 6

5-Phase Problem Solving Report

5 Phase #: 9002
5-Phase Revision #: 2

Initiator: C. Watz | Department(s): 82 | Champion: B. Stone / Fasco
Initiating Report: CCR | P/N or Process: 26050960 | Issue Date: 12/21/98
Initiating Report #: 980799 | Car Body: Y-Car | Required Answer Date: 1/18/99
Attachments to file: | Defect Code: 2500 | Quality Contact Person: C. Watz
Assembly Plant: Bowling Green | Defect Name: Electric Column Lock Inoperative
References:

I. Problem Description(s) or Quantification:

Electric column lock (ECL). Unlock feedback switch is not made (open circuit) when the ECL is unlocked. This results in a "Fail Enable Mode" code being set in the vehicle. As a result, the column will not lock.

Person Responsible: J. Rouleau | Phone Number: (8) 357-3133 | Date Identified: 12/17/98

II. Immediate Action(s):

1. All steering columns pulled back to be certified for proper ECL operation (12/17/98).
2. All steering columns at sequence house (Vassar Industries) certified with light box and ECL connector marked with pink paint marker.
3. All suspect components pulled back from stock and sent back to supplier (Fasco). Certified ECL's from supplier expedited to Delphi Saginaw. Connectors marked with yellow or orange paint marks (12/17/98).

Containment Not Required (Authorization Needed): ___ *Authorization:* _____

Comments:

Person Responsible: C. Watz | Phone Number: (8) 357-4625 | Date Implemented: 12/17/98

III. Root Cause Determination(s):

1. Unlock feedback switch (actuator), which activates the switch, had a slight bow that caused decreased actuator travel necessary to close the switch when assembled.
2. Incident ECL's were not captured by end of line testers due to tester sequence not having duplicate logic used by the vehicle.

Person Responsible: Fasco / T. Willette | Phone Number: (704) 485-9582 | Date Determined: 12/17/98

IV. Corrective Action Plan (CAP):

Target Date:

1. Measurement technique revised on actuator at punch press. Measurement fixture made to simulate the actuator in assembled condition (18DE98).
2. Misform condition in die corrected (18DE98).
3. End of line tester at Fasco being modified to be same as vehicle (13JA99).
4. End of line testers at Saginaw being modified to duplicate vehicle (08JA99) 11 JA99

Person Responsible: Fasco / J. Fields | Phone Number: (8) 357-4237 | Date Implemented: 1/8/99

Superintendent's Approval _____ 85-28

Print Name | Date | Signature | Other Potential Processes

V. Verification/Validation of CAP(s): *(Completed By Quality Assurance)*

Person Responsible: | Phone Number: | Date Verified:

902a

Delphi Saginaw

5-Phase Meeting

January 8th, 1999

BTR Vehicle Controls

FASCO
CONTROLS CORPORATION

CL03-004-070

Problem Definition (Delphi)

The ECL was sending the vehicle ECU intermittent information as to rather the units was in Lock or Unlock position.

Note: the vehicle will not operate if the column is in the Lock state; fail safe mechanism.

Containment Action

100% sort using a 14V power supply and a multimeter across the switch leads: looking for resistance when the unit is powered and the plunger is fully retracted (unlock position).

Corrective Action(s)

- Revise measurement technique on actuator at punch press. A measurement fixture was made to simulate the actuator assembled condition.

- Correct misform condition in die. Due to the change in the measurement system the actuator height will require adjustment.

Corrective Action Verification

- Demonstrate capability of actuator in punch press with new measurement system
- Verification of no rejects during end of line audit

Note: Follow-up Audits Due 01/29/99

Question 16

a. Fasco/Invensys/Honeywell product validation data on file at Delphi was provided in Appendix A.
b. Delphi product validation data was provided in Appendix A.
c. This question is addressed by General Motors.
d. Fasco/Invensys/Honeywell quality assurance data will be provided by Honeywell.
e. Delphi quality assurance data is provided in Appendix D.
f. This question is addressed by General Motors.

Document Source	Testing Performed	Testing Entity	Date of Test	Test Procedure	Results
DEVELOPMENTAL					
Delphi Dev #509 TO# 113536	Theft Protection	Delphi	19Dec95	DTP-5014-XX	Conformed
DESIGN VALIDATION					
Delphi DV #509 TO# 115498	ECL Durability	Delphi	19Aug95	ETS.1020.VIII-C	Conformed
Delphi DV #509 TO# 113536	Theft Protection	Delphi	19Dec95	DTP-5014-XX	Conformed
Delphi DV #509 TO# 117084	Vendor Validation ECL	Fasco / Invensys / Honeywell	31Jan96	26053015	Non-Conformance
PRODUCT VALIDATION					
Delphi PV #509 TO# 119452	Column Mech Wear	Delphi	20Aug96	ETS.1020.3.1.2	Non-Conformance
Delphi PV #509 TO# 119463	ECL Durability	Delphi	20Aug96	ETS.1020.4.2.4.4	Non-Conformance
Delphi PV #509 TO# 124229	ECL Durability	Delphi	16Sep97	ETS.1020.4.2.4.4	Conformance
Delphi PV # TO# 119474	Theft Protection	Delphi	25Jun96	DTP.5014.1.20	Conformance
Delphi PV # TO# 119869	Vendor Validation ECL	Fasco / Invensys / Honeywell	06May96	26053015	Conformance
Delphi PV # 579 TO# 123225	Theft Protection	Delphi	09Dec96	DTP.5014-XX	Conformance
Delphi PV # 579 TO#123816	Theft Protection	Delphi	05Feb97	DTP.5014-XX	Conformance
Delphi PV # 2036 TO# 232277	ECL Durability	Delphi	14Oct02	ETS.1020.4.2.4.4	Non-Conformance
Delphi PV # 2036 TO#232278	Vendor Validation	Fasco / Invensys / Honeywell		ETS-1190-2 26053015	Non-Conformance

DELPHI

Product Regulations & Investigations
Michael J. McKale
Manager

CL03-004a-001
memo

DATE: March 26, 2003

FROM: Michael J. McKale

SUBJECT: 1997-2001 Corvette Electric Column Lock IR EA02-031

TO: Michael Plotzke

The attached is information to supplement Delphi's response to question 16e regarding Delphi's Quality Assurance data. As noted there is a functional test of all ECL's at the end of the assembly process. This is a pass/fail test and records of individual parts are not kept.

The documents that are attached to this cover letter are considered to be non-proprietary.

If you have any questions, please do not hesitate to call me at 248 813 3362.

Michael J. McKale
Manager
Product Regulations and Investigations

Farrand, Bob

From: Field, Joel B
Sent: Wednesday, March 19, 2003 1:16 PM
To: Farrand, Bob; Lemanski, Leah
Subject: ECL tester information

Here is the information on the ECL test box first is used in Plant 6 on the assemble line. The ECL tester is a microprocessor controlled voltage measurement device. Its purpose is to verify the operation of the ECL module after it is mounted on a steering column. The tester connectos to the steering column via an interconnect harness and urethane connector assembly. The harness assembly is connected to the amphenol connector in the fron of the tester. Once the connection is made, the tester detects the connection and starts the test. The module is tested by first applying 12 volts to extend the ECL lock bolt, locking the column. The operator is prompted to verify that the column is locked. The tester then applies 5 volts to retract the lock bolt, unlocking the column. The operator is then prompted to verify the lock bolt is unlocked. The tester re-extends the lock bolt with 12 volts, then retracts with 12 volts, checking that there is no contact bounce. The tester then displays any faults that were generated during the test. Should the tester indicate a fault, the test can be rerun by pressing any key on the keypad or by pressing the reset button. If no faults were generated, the tester indicates that the test has passed. The display remains constant until the operator disconnects the tester from the column. The tester is then ready to connect to the next column. During the test, current is monitored to insure that there is no excessive current draw. The output of the power supply and the status of the lock bolt contacts are indicated on the 3 amber lights located above the tester keypad.

Joel Field
Delphi Saginaw Steering Systems
Plant 6
989-757-4237

CL03-004a-002

Now "Honeywell (Name Change) 12-10-02

P.O. #9[illegible]4114

ELECTRICAL

RECEIVING INSPECTION QUALITY CONTROL RECORD

Plant No. 6

Vendor Invensys Sensor Part Name Lock Actuator Part No. 26050960 Move to ____

Latest Blueprint Change 16 Jan 98 Rev. 07F Lab. Requirements: Frequency Each Ship. Pcs. ____ Material Spec. -

Sample Requirements (To Be Inspected Per Listed Characteristics) On Skip Lot ✓ Insp. Every 01 Shipment [illegible] 8/21/02

[ ] Inspect ____ Pcs. Per. Bin ____ On Self Cert ____ Insp. Every ____ Shipment

[✓] Inspect Per Established Sample Plan A

Vendor SPC Dim #3 KPC'S ON PRINT #

N/R = Not Required N/A = Not Applicable AC = Accept REJ = Reject NC = No Ck

1 ____ 5 ____ 9 ____

2 ~~REF. SET-UP SHEETS FOR~~ 10 ____

3 ____ 11 ____

4 ~~APPLICABLE GAGES~~ 12 ____

Heat Treat Yes [ ] No [✓]

N.D.T. 100 Pcs/Lab Yes [ ] No [✓]

To be Plated Yes [ ] No [✓]

[signature] 6-12-02

Approved by (Supervisor) Date

Quality Record of Incoming Material

Date Rec'd	[illegible] No.	No. Cont.	Lab No.	Lab Sub. Date	Lot Size	Sample Size	No. of Defects	Heat No.	Lot No.	[illegible] No.	Disposition	Date Insp.	Insp. By	Remarks
9-20-02	YF84757	2	NR	NA	768	47	0				AC	9-20	[illegible]	
9-24	91888	2	NR	NA	736	47	0				AC	9-24	[illegible]	
9-27-2	92746	2	LC2468	9/30	832	Lab	only							
10-25-02	98555	1	NR	NA	288	47	0				AC	10-25	[illegible]	
12-11-02	08920	1			64	20	20				REJ	12-11	[illegible]	not approved - Honeywell

DS2019 Rev. June 1997 Ref. Proc. G1747 SEE REVERSE SIDE FOR ADDITIONAL DATA

CL03-004a-003

NHTSA-IR (EA02-031)
Question #17

CL03-004-082

Question 17
All known Delphi communications regarding the ECL are included in Appendix E.

These documents will follow as quickly as possible.

DELPHI

Product Regulations & Investigations
Michael J. McKale
Manager

CL03-004b-001
memo

DATE: March 27, 2003

FROM: Michael J. McKale

SUBJECT: 1997-2001 Corvette Electric Column Lock IR EA02-031

TO: Michael Plotzke

The attached is information to supplement Delphi's response to question 17 regarding communications between Delphi and GM. These communications were initiated by a Delphi employee, even through emails were replied back and forth. They do not represent communications that were initiated by GM personnel.

The documents that are attached to this cover letter are considered to be non-proprietary.

If you have any questions, please do not hesitate to call me at 248 813 3362.

Michael J. McKale
Manager
Product Regulations and Investigations

Y-Car ECL Task Team Minutes – Update 1/23/01

Next Meeting
TBD

Team Members: (* indicates participation in the 1/17/01 meeting)

*Jeremy Mattson (D-S)	Al Adams (GM)	Dave Peacy (GM)	Jim Danahy (GM)
Shilpan Amin (GM)	Alan Hinkle (GM)	*Jim Rouleau (D-S)	Surya Chintamilli (GM)
Ricardo Pastor (D-S)	Jason Stombaugh (GM)	Eric Finn (GM)	*Steve Davis (Invensys)
Bob Larsen (D-S)	Steve Loche (D-D)	Tim Willette (Invensys)	Andy Brenz (GM)
Suresh Nair (GM)	Ron Asmar (GM)	Doug Gentry (D-D)	*Drew Hallochak (GM)
Wade Landis			

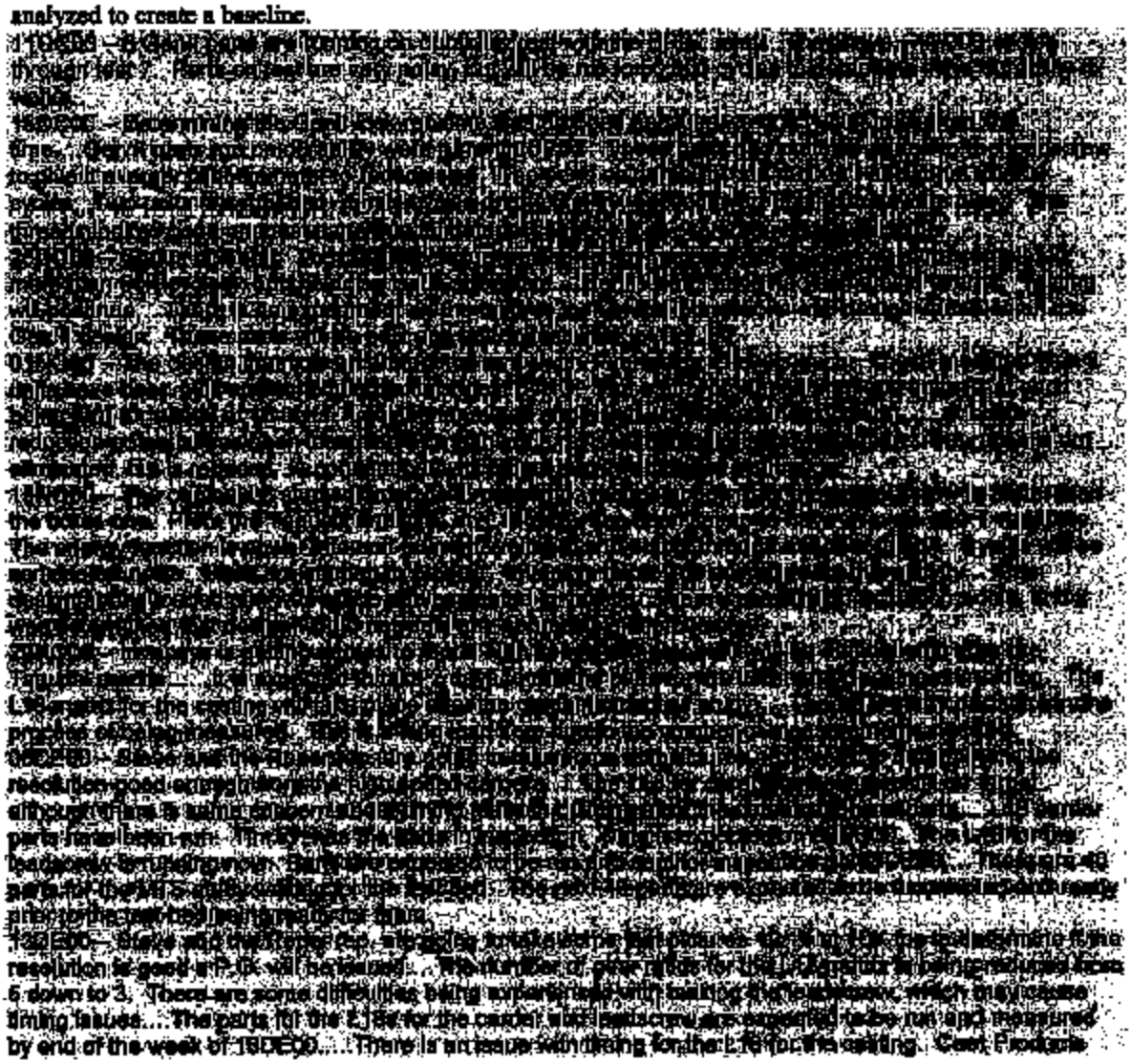
ECL Component Issues

[redacted]

2) ECL Durability Binding

8/08/00: The idea to add a switch in the lock direction was determined not feasible. There is not sufficient room to package a switch in the lock direction. The idea to reduce the lock time by a calibration change needs further investigation to determine the appropriate timing. Al Adams will issue a PCE for the calibration change when the timing information is determined.
8/16/00: Delphi is investigating new noise dampening ideas: 1. Modify the lead screw and carrier geometry (change pilot diameters), 2. Add spring to side-load the carrier and to de-lash the fit with the lead screw, 3. Material changes (dampening materials/fillers).....Initial readings to determine the necessary lock run-time taken at Invensys were not representative due to poor quality of parts. New tests will be run once better parts (lead screw/casting) are available around 8/25.
8/22/00: The single shot casting tool may not be production feasible. Two backup designs are being developed, items 5 and 8 from the brainstorming matrix. J. Rouleau to have demo part for item 8 using a T&T controller and current pot asm approx. 8/31.
8/29/00: A solenoid is being investigated to stop the ratcheting noise at the end of the leadscrew travel. Most of the materials have arrived for evaluation of the wear fixes. A new leadscrew insert has arrived which would take out some of the side-to-side lash between the leadscrew and carrier. New castings /(graphite tool) should be available this week. Still on track for the 19OC decision date for the recovery plans. Dave Hill would like to see the results of a shock absorbing rubber bumper. No effect on noise – the noise transmission path is better, but the sound quality is the same.
9/12/00: There is not a noise elimination solution for the Red X yet. The change of materials on the leadscrew for durability reasons may have an effect.... Enough new castings should be available for putting parts on test in a few weeks (end of sept.)....The latest Acme thread of the leadscrew and the carrier mesh together well....Ongoing durability testing will occur, Jim Rouleau at Invensys defining the tests to be run and the quantities....Ricardo Pastor has indicated that the new casting tool was $70,000, with an overall tooling bill of $180,000.
9/20/00: Invensys to provide information on the lock time necessary to always guarantee a locked ECL on Gen I. This information would be used to determine if we want to make a software change reduce the lock travel time. This change could be made to either Gen I or II designs. In addition, there is the possibility that the BCM made need changes for reasons unrelated to the ECL. This may be a good opportunity to add this feature in.....One working model has been developed utilizing the solenoid feature to reduce/eliminate noise. This design is more complex and must utilize a relay circuit to work. The feature does make the part quieter by not allowing the carrier to skip threads, but the design appears to be slightly louder than the

Gen I design.....No tooling fixes have been found to reduce actuation noise problem. The wear resistance problem is driving the material property changes. We cannot optimize for both noise and wear.
9/27/00: Invensys to provide test results of the lowest voltage possible that can still lock within 650ms in Gen I parts. Preliminary results from J. Rouleau on 12 parts with a 1.5Ω resistor at +85° showed that 5.1V was the lowest voltage that all parts could lock within 650ms.....Some Gen II housing are cast, but they need some machining. Parts should be built and placed on test by week of 10/2. Durability testing will be started once the material selection has been made for the leadscrew.....The solenoid noise reduction concept works from a logic point of view. Power applied to the solenoid would need to be delayed (50-70ms). Stacks look possible , but the design is complex and could lead to reliability issues. A new solenoid would need to be designed since no off-the-shelf solenoid exists for this application.
10/09/00: For the current ECL, there are two proposed short term Robustness improvements. The first improvement involves investigating to determine if the production population can be truncated. This would involve reducing sensitivity to rebound by segregating those units with the lowest switch point to lock bolt position separation, and reducing sensitivity to binds by segregating those units that draw a lesser amount of current and/or higher bolt actuation rate. The second proposal is to complete on-going reliability tests. The proposed tests and quantities to be run have been defined. There would be a two week test period that will allow for 7000 cycles to be completed. Twelve pieces will be run per 2 weeks with the option of replacing 10 units and continuing 2 to failure. Testing will be done at the most servere conditions for bind and rebound (high temperature, high voltage, and no mechanical loading). Data will be collected and analyzed to create a baseline.



[redacted]

GM Electrical

Service / Dealership interface

11) Aftermarket ECL override kit

8/29/00: Greg Benson has ordered off the internet (C5 solutions) an after-market ECL disable kit. This kit is selling very well and the use of this kit could be affecting our warranty numbers for the 2000 MY.
9/12/00: Al Adams and Jim Rouleau believe that override system could still function if battery power was lost. The person would have to cycle the key once, then they would be able to drive the vehicle.
9/20/00: Evaluation continues into how this kit works, but it is believed a latching relayed is being used.
10/04/00: A. Brenz has determined that the override kit is not a latching relay. It provides feedback for BCM only when you unlock. This may cause trouble in field if you have a dead battery. Andy will double check this with A. Adams.

11a) Determine how to override the current ECL

9/20/00: Investigation into using a latching relay continues. A bench test is running (run to 30,000 cycles with no failures). There is concern that oxidation could build up on the contacts due to the large current controlling a small current. This could cause bouncing on scope trace. However, proper material selection (silver/tin contacts) should be able to eliminate this.
9/27/00: The bench test continues on our latching relay with no bouncing seen after 150,000 cycles.
[redacted]

ECL)...An idea to not allow the lock to move would be to short the motor leads. This would have to be run on a shaker test to check vibration effects. Jim and Steve to brainstorm on how to do this permanently and cost effectively.

Warranty

12) Latest Month of build IPTV/customer verbatims 2001 SOP

8/22/00: Eric Finn has reported that no 2001 SOP warranty information is available yet for the ECL.
8/29/00: A 2001 with 190 miles on it exhibited an ECL issue - - but it was gear train binding - - they were able to tap onto the ECL to function the ECL - - pull key, wait 10 sec message - - -
9/12/00: Bob Larson, J. Rouleau, and Jim Barnes are trying to determine why there are spikes in the IPTV chart around early 99 and Jan/Feb 2000. They are looking through Invensys' records for process or flow changes, etc.
9/20/00: The spike around Jan/Feb 2000 is believed to be due to not enough exposure. The chart is just shifting, and we may see this spike move into the summer months. The spike in early 1999(after the actuator quality spill) has not been explained yet and is still under investigation.
9/27/00: Some processes were implemented at Invensys around the warranty chart spike in early 1999, which could be contributing factors. Invensys to investigate this further.
10/04/00: Eric has reported that there have been two repairs charged to labor code E7501 (ECL replace) on the 2001 Corvette. However, neither was related to a malfunction of the column failing to lock/unlock.

[redacted]

18OC00 – Report on the Saudia Arabia vehicle was supplied to the regional representative.

[redacted]

14) Warranty returns

10/4/00: B. Larsen verified that the warranty part return system is on and working.

[redacted]

Misc

[redacted]

[redacted]

18) Continuous Feedback Controller (absolute position sensing)

8/29/00: Gen II ECL units have been modified adding a potentiometer. When the soft stops are reached, the motor will be allowed to coast to a stop– as parts become available this week, the 270 power T&T controller will be used to demonstrate - - will the scan rate be fast enough to stop the ECL before the hardstop – all the modifications made to the parts are external - - the hard/soft stop settings cannot be modified on the 270 controller – maybe S5S?
9/20/00: Some parts have been built with pot asm, however, the power T&T controller has not been fast enough (10ms loop time) to give repeatable control. In order to demonstrate, the memory was set short of the end of travel. Then it would reach memory position and coast to the end of travel w/o hitting hard. Would the spdt relay even allow the motor to coast or would it just stop?....This concept shows that continuous feedback can work w/ the proper hardware (high cost). Because the travel in Gen I design is too short, this concept would have to be used in the Gen II. Also, if BCL didn't lock all the way, a jog feature algorithm would need to be added to the BCM to complete the lock travel. This is not a short-term idea, 2004MY implementation, but it may be a true fix (concept is on hold until after BCL review meeting).

19) New BCM Algorithm - & Low Voltage Lock

8/29/00: Chips to be modified with a new cal value for unlock time read - - look at switch at 100 msec instead of 250 ms. Also, being investigated is the possibility of adding a resistor to the key out switch circuit - - - tests at Saginaw to zero in on optimum lock direction voltage... for demonstration purposes, start with a 4 Ohm resistor - - will a resistor in the circuit affect any other function in the vehicle -- monitoring of key out sensing circuit?
9/12/00: Modifying the current BCM to have it look for the lock switch at 100msec is not currently being pursued due to cost and timing.... Andy is having Jason Stombaugh evaluate a 2.2 ohm resistor in the key out switch circuit. Testing will be done at the extreme temperatures to ensure the BCL can lock/unlock at all times....Jim Rouleau is also investigating the necessary resistor for the key out switch circuit. This development is being worked out at Invensys the week of 9/11. Testing will be run at cold temps.
9/20/00: The resistor in key-out circuit could still be offered as a service kit to pre '98MY BCL's.....Andy B. has bench tested the 2.2ohm resistor at system voltage (12.5V) over the temperature extremes. In addition, bench tests have been run with the 2.2ohm resistor and by varying the voltage. This test found that the system will stop locking at 9.5V.
9/29/00: Once the cold testing data is collected, the resistor and wattage values will be determined. The parts to be run with the resistors and spdt relays will then be retrofitted with the proper components, which will take approximately 1 week.
10/4/00: During bench testing with a 1.3Ω, 1 watt resistor, Andy has noticed that the running current did not change in the lock/unlock directions. Only the stall current was found to change. A short to battery was simulated with these parts and the resistors were found to glow red hot for ~10s before they gave out at low system voltage. At high system voltage, the resistor gives right away. Possibility of adding fuses would be evaluated if the resistor is shown to work as intended.
[redacted]

20) Preparation for possible customer satisfaction recall

9/5/00: Dave Hill and Dave Peacy are considering a "customer satisfaction" recall to replace all ECL's from approximately March 1998 to 2001 SOP, approx. 67,000 vehicles. The 1998 BCM has the ability to drive a relay (SPST or SPDT), however, the 1997 BCM does not have the ability to run a relay. The ECL's would be replaced with the SPDT relay and possibly a resistor in the key-out switch circuit.
9/12/00: Delphi Saginaw has asked its suppliers how quickly they could produce 33,000 units. An answer from suppliers is due the end of September….Bill Jackson of Delphi Saginaw is working to determine how many by-pass have been used by contacting dealerships.
9/20/00: The spdt relay may bring the warranty numbers back to levels prior to the introduction of the spst relay….The field fix could possibly be recently built Gen I design units, the spdt, and the added resistor.
9/27/00: Invensys/Delphi determined plan to produce enough recall parts. Invensys evaluating a 2nd and 3rd shift and premium time to lead time for parts.
10/4/00: The resistor to test with will be 1.5 ohms…..Invensys is still trying to determine the leadtime to produce 33,000 units. They are collecting information from overseas suppliers (motors, ball bearings) for leadtimes and the premium time charges. Leadtime could be dependent on when we kick off. Due to Chinese New Year, kicking off after this could cause a 4-6 week delay.
10/9/00: Current warranty data shows that the '00MY rate is less than 50 IPTV. Delphi evaluated what the IPTV would be with the following field initiatives: 1. Recently built ECLs, 2. SPDT relay, Power reduction resistor in key-out circuit. In addition, a recent dealer survey found that 49% was "service light", 44% column lock binds/ no starts, and 7% was other problems. Based on this and assuming that the relay is 80% effective in eliminating rebounds, the result would be a 19.6 IPTV at 360 days.
11OC00 – Bearings are special ordered from Japan and are the long lead item (20 week lead time).

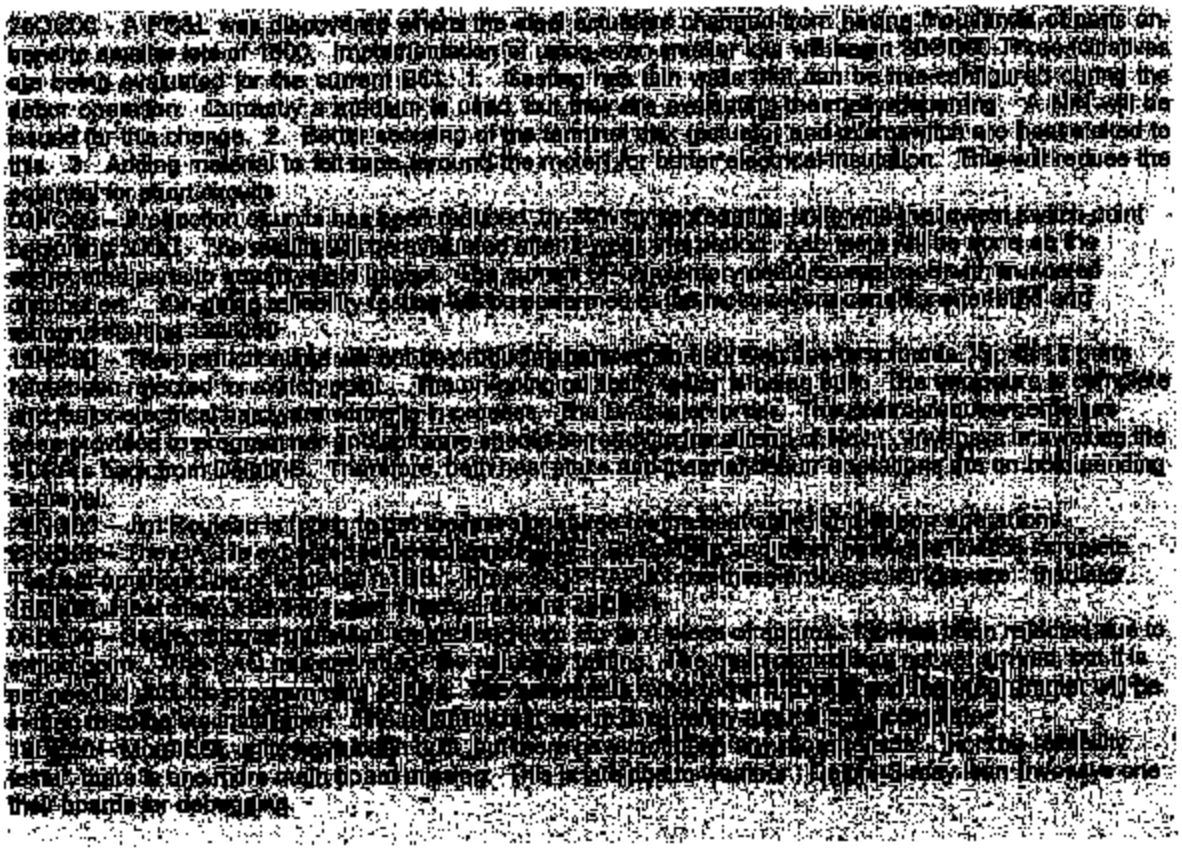
21) Lock Manual Transmission Vehicles in Reverse

9/20/00: The Oldsmobile Alero is currently doing this for M/T vehicles.

22) New Gear Train on Gen II package (full thread)

10/4/00: Invensys has been working on developing a new ECL concept. The noise issue is addressed, the level is similar to the Gen I design, but the duration is longer (approx. 50ms). The idea is to use an alternative steeper pitch angle, where less turns on the screw allow the same travel. If you design the leadscrew to be rigid, the concept designs you out of the binding issue. Because gear efficiency decreases, the torque needs to increase and the gear ratio changes (from 15:1 to 18:1). This concept does bias the rebound issue. However, there are several things will help reduce this possibility: 1. Higher motor screw ratio reduces backdriving efficiency, 2. SPDT relay (dynamic braking), 3. Better actuator switch positioning, 4. Unit would have to rebound farther to contact the lock plate.
Developmental testing of this design will begin around 10OC00 with molded parts off of old modified tools. If the concept passes developmental tests, tools will be modified to produce DV level parts. DV testing would take place from Nov. to Dec.
[illegible]

23) Robustness Improvements and further "Deep Dive" analysis



Y-Car ECL Task Team Minutes – 9/20/00

Next Meeting
Wednesday, September 27, 3-4, Meet-me-line #877-322-9654; pass code 459704 (New)

Team Members: (* indicates participation in the 9/20/00 meeting)

*Jeremy Mattson (D-S)	*Al Adams (GM)	Dave Peacy (GM)	Jim Danahy (GM)
*Shilpan Amin (GM)	*Alan Hinkle (GM)	Jim Rouleau (D-S)	Surya Chinimilli (GM)
*Ricardo Pastor (D-S)	Jason Stombaugh (GM)	Eric Finn (GM)	Steve Davis (Invensys)
Bob Larsen (D-S)	Steve Loche (D-D)	Tim Willette (Invensys)	*Andy Brenz (GM)
Suresh Nair (GM)	Ron Asmar (GM)	*Doug Gentry (D-D)	

ECL Component Issues

[redacted]

2) ECL Durability Binding

8/08/00: The idea to add a switch in the lock direction was determined not feasible. There is not sufficient room to package a switch in the lock direction. The idea to reduce the lock time by a calibration change needs further investigation to determine the appropriate timing. Al Adams will issue a PCE for the calibration change when the timing information is determined.
8/16/00: Delphi is investigating new noise dampening ideas: 1. Modify the lead screw and carrier geometry (change pilot diameters), 2. Add spring to side-load the carrier and to de-lash the fit with the lead screw, 3. Material changes (dampening materials/fillers).....Initial readings to determine the necessary lock run-time taken at Invensys were not representative due to poor quality of parts. New tests will be run once better parts (lead screw/casting) are available around 8/25.
8/22/00: The single shot casting tool may not be production feasible. Two backup designs are being developed, items 5 and 8 from the brainstorming matrix. J. Rouleau to have demo part for item 8 using a T&T controller and current pot asm approx. 8/31.
8/29/00: A solenoid is being investigated to stop the ratcheting noise at the end of the leadscrew travel. Most of the materials have arrived for evaluation of the wear fixes. A new leadscrew insert has arrived which would take out some of the side-to-side lash between the leadscrew and carrier. New castings /(graphite tool) should be available this week. Still on track for the 190C decision date for the recovery plans. Dave Hill would like to see the results of a shock absorbing rubber bumper. No effect on noise – the noise transmission path is better, but the sound quality is the same.
9/12/00: There is not a noise elimination solution for the Red X yet. The change of materials on the leadscrew for durability reasons may have an effect.... Enough new castings should be available for putting parts on test in a few weeks (end of sept.)....The latest Acme thread of the leadscrew and the carrier mesh together well....Ongoing durability testing will occur, Jim Rouleau at Invensys defining the tests to be run and the quantities....Ricardo Pastor has indicated that the new casting tool was $70,000, with an overall tooling bill of $180,000.
9/20/00: Invensys to provide information on the lock time necessary to always guarantee a locked ECL on Gen I and II parts. This information would be used to determine if we want to make a software change reduce the lock travel time. This change could be made to either Gen I or II designs. In addition, there is the possibility that the BCM made need changes for reasons unrelated to the BCL. This may be a good opportunity to add this feature in.....One working model has been developed utilizing the solenoid feature to reduce/eliminate noise. This design is more complex and must utilize a relay circuit to work. The feature does make the part quieter by not allowing the carrier to skip threads, but the design appears to be slightly louder than the Gen I design.....No tooling fixes have been found to reduce actuation noise

problem. The wear resistance problem is driving the material property changes. We cannot optimize for both noise and wear.

Determine the ECL GEN I&II locking "run time" at 9V at -40°C and +85°C – Davis 9/27
Investigate reducing the ECL lock direction drive time – S. Loche/Adams 9/27
Provide 16 DV/PV level ECL Gen II parts for GM vehicle level evaluation – Davis Oct. 9
-10 parts for MPG testing and 6 parts for electrical lab.
Provide updates to ECL Gen II timeline – J. Rouleau 7/25

Provide developmental concept for the solenoid noise fix – Rouleau 10/01
Define the ongoing durability tests and the quantities to be run at Invensys – Rouleau 9/19
-Invensys to provide ideas to Delphi by 9/22 – S. Davis

Noise Reduction Plan:		
Noise Contribution Analysis	01AU00 – 21AU00	complete
Development of fixes	21AU00 – 04SE00	complete
DV Tooling	04SE00 – 09OC00	
DV testing and evaluation	09OC00 – 19OC00	
Wear Reduction Plan:		
Development of fixes	27JL00 – 11AU00	complete
DV Tooling	11AU00 – 21SE00	
DV testing and evaluation	21SE00 – 19OC00	
- Production Tooling	TBD	
- PV Testing	TBD	
- PPAP of New ECL	TBD	
- Implementation of New ECL	SOP 2002 MY	

[redacted]

<u>GM Electrical</u>

[redacted]

<u>Service / Dealership interface</u>

11) Service repair procedures

8/29/00: Greg Benson has ordered off the internet (C5 solutions) an aftermarket ECL disable kit. This kit is selling very well and the use of this kit could be affecting our warranty numbers for the 2000 MY.
9/12/00: Al Adams and Jim Rouleau believe that override system could still function if battery power was lost. The person would have to cycle the key once, then they would be able to drive the vehicle.
9/20/00: Evaluation continues into how this kit works, but it is believed a latching relayed is being used.

Action: Evaluate the aftermarket override kit to determine how it works – Brenz/Adams

9/12/00: A latching relay type design is being evaluated to override the ECL system.
9/20/00: Investigation into using a latching relay continues. A bench testing is running (so far has run to 30,000 cycles with no failures). There is concern that oxidation could build up on the contacts due to the large current controlling a small current. This could cause bouncing on scope trace However, proper material selection should be able to eliminate this.

Action: How can we override the current ECL system for service (for automatic transmission vehicle)? – Team 9/27 Gentry/Hinkle/Brenz/Adams

Warranty

12) Latest (as of 7/1) Month of build IPTV

9/12/00: Bob Larson, J. Roulesu, and Jim Barnes are trying to determine why there are spikes in the IPTV chart around early 99 and Jan/Feb 2000. They are looking through Invensys' records for process or flow changes, etc.
9/20/00: The spike around Jan/Feb 2000 is believed to be due to not enough exposure. The chart is just shifting, and we may see this spike move into the summer months. The spike is early 1999(after the actuator quality spill) has not been explained yet and is still under investigation.

Action: Invensys to continue looking for information into the spike of early '99 – T. Willette 9/22
Action: Provide the latest month of build warranty data – Finn (as available)

12a) Customer Verbatims – 2001 SOP

8/22/00: Eric Finn has reported that no 2001 SOP warranty information is available yet for the ECL.
8/29/00: A 2001 with 190 miles on it exhibited an ECL issue - - but it was gear train binding - - they were able to tap onto the ECL to function the ECL - - pull key, wait 10 sec message - - -

Action: Provide customer verbatims on warranty data for the percentage of Rebound vs. Gear Train Binding. Also, provide the breakdown on drive-in vs. tow-in. - Finn – (provide info as available)

[redacted]

14) Warranty returns

Action: Update warranty chart for the latest returns- Willette 7/27
Provide status of Delphi S warranty evaluations – Larsen 7/27
-Latest batch of parts (50-60) should have been sent to Invensys
-Provide updates of all model year warranty part returns including 2001 MY– Larsen (as available)

[redacted]

Misc

[redacted]

18) Continuous Feedback Controller (absolute position sensing)

8/29/00: Gen II BCL units have been modified adding a potentiometer. When the soft stops are reached, the motor will be allowed to coast to a stop– as parts become available this week, the 270 power T&T controller will be used to demonstrate - - will the scan rate be fast enough to stop the BCL before the hardstop – all the modifications made to the parts are external - - the hard/soft stop settings cannot be modified on the 270 controller – maybe S5S?
9/20/00: Some parts have been built with pot asm, however, the power T&T controller has not been fast enough (10ms loop time) to give repeatable control. In order to demonstrate, the memory was set short of the end of travel. Then it would reach memory position and coast to the end of travel w/o hitting hard. Would the spdt relay even allow the motor to coast or would it just stop?....This concept shows that continuous feedback can work w/ the proper hardware (high cost). Because the travel in Gen I design is too short, this concept would have to be used in the GenII. Also, if BCL didn't lock all the way, a jog feature algorithm would need to be added to the BCM to complete the lock travel. This is not a short term idea (2004MY implementation), but it may be a true fix.

Action: Developmental concept demonstration – Rouleau complete

19) New BCM Algorithm - & Low Voltage Lock

8/29/00: Chips to be modified with a new cal value for unlock time read - - look at switch at 100 msec instead of 250 msec. Also, being investigated is the possibility of adding a resistor to the key out switch circuit - - - tests at Saginaw to zero in on optimum lock direction voltage... for demonstration purposes, start with a 4 Ohm resistor - - will a resistor in the circuit affect any other function in the vehicle – monitoring of key out sensing circuit?
9/12/00: Modifying the current BCM to have it look for the lock switch at 100msec is not currently being pursued due to cost and timing.... Andy is having Jason Stombaugh evaluate a 2.2 ohm resistor in the key out switch circuit. Testing will be done at the extreme temperatures to make the ECL can lock/unlock at all times....Jim Rouleau is also investigating the necessary resistor for the key out switch circuit. This development is being worked out at Invensys this week of 9/11. Testing will be run at cold temps.
9/29/00: The resistor in key-out circuit could still be offered as a service kit to pre '98MY ECL's.

Action: Results of 2.2 ohm resistor at temperature extremes – Brenz/Stombaugh
Determine the proper resistor wattage – Brenz
Evaluate software changes to look at switch earlier – Adams/Gentry
Run 12 new parts/12 return parts on validation tests w/ resistor and spdt relay – Invensys

20) Preparation for possible customer satisfaction recall

9/5/00: Dave Hill and Dave Peacy are considering a "customer satisfaction" recall to replace all BCL's from approximately March 1998 to 2001 SOP, approx. 67,000 vehicles. The 1998 BCM has the ability to drive a relay (SPST or SPDT), however, the 1997 BCM does not have the ability to run a relay. The ECL's would be replaced with the SPDT relay and possibly a resistor in the key-out switch circuit.
9/12/00: Delphi Saginaw has asked its suppliers how quickly they could produce 33,000 units. An answer from suppliers is due the end of September....Bill Jackson of Delphi Saginaw is working to determine how many by-pass have been used by contacting dealerships.
9/20/00: The spdt relay may bring the warranty numbers back to levels prior to the introduction of the spst relay....The field fix could possibly be recently built Gen I design units, the spdt, and the added resistor.

Action: Determine the correct resistor to use – Rouleau/Brenz 9/27
Determine the revised IPTV with the SPDT and resistor – Delphi
Determine if Delphi's sub-suppliers have the capability to produce enough parts for the possible recall (approx. 33,000 units) – Rouleau/Pastor 9/29
Determine how many by-pass kits have been sold – D. Peacy/Bill Jackson

21) Lock Manual Transmission in Reverse

9/20/00: The Oldsmobile Alero is currently doing this for M/T vehicles.
Action: Determine what it would take to implement this – Team

Y-Car ECL Task Team Minutes – 9/27/00

Next Meeting
Wednesday, October 4, 3-4, Meet-me-line #877-322-9654; pass code 459704 (New)

Team Members: (* indicates participation in the 9/27/00 meeting)

*Jeremy Mattson (D-S)	*Al Adams (GM)	Dave Peacy (GM)	Jim Danahy (GM)
*Shilpan Amin (GM)	*Alan Hinkle (GM)	Jim Rouleau (D-S)	Surya Chinimilli (GM)
*Ricardo Pastor (D-S)	Jason Stombaugh (GM)	Eric Finn (GM)	*Steve Davis (Invensys)
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8/29/00: A solenoid is being investigated to stop the ratcheting noise at the end of the leadscrew travel. Most of the materials have arrived for evaluation of the wear fixes. A new leadscrew insert has arrived which would take out some of the side-to-side lash between the leadscrew and carrier. New castings /(graphite tool) should be available this week. Still on track for the 19OC decision date for the recovery plans. Dave Hill would like to see the results of a shock absorbing rubber bumper. No effect on noise – the noise transmission path is better, but the sound quality is the same.
9/12/00: There is not a noise elimination solution for the Rod X yet. The change of materials on the leadscrew for durability reasons may have an effect.... Enough new castings should be available for putting parts on test in a few weeks (end of sept.)....The latest Acme thread of the leadscrew and the carrier mesh together well....Ongoing durability testing will occur, Jim Rouleau at Invensys defining the tests to be run and the quantities....Ricardo Pastor has indicated that the new casting tool was $70,000, with an overall tooling bill of $180,000.
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9/27/00: Invensys to provide test results of the lowest voltage possible that can still lock within 650ms in Gen I parts. Preliminary results from J. Rouleau on 12 parts with a 1.5Ω resistor at +85° showed that 5.1V was the lowest voltage that all parts could lock within 650ms.....Some Gen II housing are cast, but they need some machining. Parts should be built and placed on test by week of 10/2. Durability testing will be started once the material selection has been made for the leadscrew.....The solenoid noise reduction concept works from a logic point of view. Power applied to the solenoid would need to be delayed (50-70ms). Stacks look possible , but the design is complex and could lead to reliability issues. A new solenoid would need to be designed since no off-the-shelf solenoid exists for this application.

Determine the ECL GEN I locking "run time" at 9V at –40°C and +85°C – Davis 9/27 complete
-Gen II locking run time TBD when parts are available – Davis TBD
Investigate reducing the ECL lock direction drive time – S. Loche/Adams 9/27 cancel
Provide 16 DV/PV level ECL Gen II parts for GM vehicle level evaluation – Davis Oct. 9
-10 parts for MPG testing and 6 parts for electrical lab.
Provide updates to ECL Gen II timeline – J. Rouleau 7/25

Provide developmental concept for the solenoid noise fix – Rouleau 10/01 complete
Define the on-going durability tests and the quantities to be run at Invensys – Rouleau 9/19
-Invensys to provide ideas to Delphi by 10/4 – S. Davis

Noise Reduction Plan:

Noise Contribution Analysis	01AU00 – 21AU00	complete
Development of fixes	21AU00 – 04SE00	complete
DV Tooling	04SE00 – 09OC00	complete
DV testing and evaluation	09OC00 – 19OC00	running

Wear Reduction Plan:

Development of fixes	27JL00 – 11AU00	complete
DV Tooling	11AU00 – 21SE00	complete
DV testing and evaluation	21SE00 – 19OC00	running

- Production Tooling	TBD	On hold
- PV Testing	TBD	On hold
- PPAP of New ECL	TBD	On hold
- Implementation of New ECL	SOP 2002 MY	On hold

Gen II progress / decision review scheduled for 19OC00

[redacted]

GM Electrical

[redacted]

Service / Dealership interface

11) Service repair procedures

8/29/00: Greg Benson has ordered off the internet (C5 solutions) an after-market ECL disable kit. This kit is selling very well and the use of this kit could be affecting our warranty numbers for the 2000 MY.
9/12/00: Al Adams and Jim Rouleau believe that override system could still function if battery power was lost. The person would have to cycle the key once, then they would be able to drive the vehicle.
9/20/00: Evaluation continues into how this kit works, but it is believed a latching relayed is being used.
10/04/00: A. Brenz has determined that the override kit is not a latching relay. It provides feedback for BCM only when you unlock. This may cause trouble in field if you have a dead battery. Andy will double check this with A. Adams.

Action: Evaluate the aftermarket override kit to determine how it works – Brenz complete

9/20/00: Investigation into using a latching relay continues. A bench test is running (run to 30,000 cycles with no failures). There is concern that oxidation could build up on the contacts due to the large current controlling a small current. This could cause bouncing on scope trace However, proper material selection (silver/tin contacts) should be able to eliminate this.
9/27/00: The bench test continues on our latching relay with no bouncing seen after 150,000 cycles.

Action: How can we override the current ECL system for service (for automatic transmission vehicle)? – Team 9/27 Gentry/Hinkle/Brenz/Adams

Warranty

12) Latest (as of 7/1) Month of build IPTV

9/12/00: Bob Larson, J. Rouleau, and Jim Barnes are trying to determine why there are spikes in the IPTV chart around early 99 and Jan/Feb 2000. They are looking through Invensys' records for process or flow changes, etc.
9/20/00: The spike around Jan/Feb 2000 is believed to be due to not enough exposure. The chart is just shifting, and we may see this spike move into the summer months. The spike in early 1999(after the actuator quality spill) has not been explained yet and is still under investigation.
9/27/00: Some processes were implemented at Invensys around the warranty chart spike in early 1999, which could be contributing factors. Invensys to investigate this further.

Action: Invensys to continue looking for information into the spike of early '99 – T. Willette 10/4
Action: Provide the latest month of build warranty data – Finn (as available)

12a) Customer Verbatims – 2001 SOP

8/22/00: Eric Finn has reported that no 2001 SOP warranty information is available yet for the ECL.
8/29/00: A 2001 with 190 miles on it exhibited an ECL issue - - but it was gear train binding - - they were able to tap onto the ECL to function the ECL - - pull key, wait 10 sec message - - -
10/04/00: Eric has reported that there have been two repairs charged to labor code E7501 (ECL replace) on the 2001 Corvette. However, neither was related to a malfunction of the column failing to lock/unlock.

Action: Provide customer verbatims on warranty data for the percentage of Rebound vs. Gear Train Binding. Also, provide the breakdown on drive-in vs. tow-in. - Finn – (as available)

[redacted]

14) Warranty returns

10/4/00: B. Larsen verified that the warranty part return system is on and working.

Action: Update warranty chart for the latest returns- Willette 7/27
Provide status of Delphi S warranty evaluations – Larsen 7/27 NEED UPDATE
-Latest batch of parts (50-60) should have been sent to Invensys
-Provide updates of all model year warranty part returns including 2001 MY– Larsen (as available)

Action: Provide analysis report on Saudia Arabia vehicle to regional representative – Brenz complete
-Shilpan has report and send it to the appropriate person after reviewing
[redacted]

Misc

[redacted]

18) Continuous Feedback Controller (absolute position sensing)

8/29/00: Gen II ECL units have been modified adding a potentiometer. When the soft stops are reached, the motor will be allowed to coast to a stop– as parts become available this week, the 270 power T&T controller will be used to demonstrate - - will the scan rate be fast enough to stop the ECL before the hardstop – all the modifications made to the parts are external - - the hard/soft stop settings cannot be modified on the 270 controller – maybe S5S?
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Action: Developmental concept demonstration – Rouleau complete

19) New BCM Algorithm - & Low Voltage Lock

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10/4/00: During bench testing with a 1.3Ω, 1 watt resistor, Andy has noticed that the running current did not change in the lock/unlock directions. Only the stall current was found to change. A short to battery was simulated with these parts and the resistors were found to glow red hot for ~10s before they gave out at low system voltage. At high system voltage, the resistor gives right away. Possibility of adding fuses would be evaluated if the resistor is shown to work as intended.

Action: Results of 2.2 ohm resistor at temperature extremes – Brenz complete
Determine the proper resistor wattage – Brenz complete
Run 12 new /12 return parts on validation tests w/ resistor and spdt relay – Invensys 10/6
Need to test as many as possible (18 pcs) half w/ 1.5 ohm resistor And half w/o 1.5 resistor. 1.5 ohm resistor must only be place in the lock circuit.

20) Preparation for possible customer satisfaction recall

9/5/00: Dave Hill and Dave Peacy are considering a "customer satisfaction" recall to replace all ECL's from approximately March 1998 to 2001 SOP, approx. 67,000 vehicles. The 1998 BCM has the ability to drive a relay (SPST or SPDT), however, the 1997 BCM does not have the ability to run a relay. The ECL's would be replaced with the SPDT relay and possibly a resistor in the key-out switch circuit.
9/12/00: Delphi Saginaw has asked its suppliers how quickly they could produce 33,000 units. An answer from suppliers is due the end of September....Bill Jackson of Delphi Saginaw is working to determine how many by-pass have been used by contacting dealerships.
9/20/00: The spdt relay may bring the warranty numbers back to levels prior to the introduction of the spst relay....The field fix could possibly be recently built Gen I design units, the spdt, and the added resistor.
9/27/00: Invensys/Delphi determined plan to produce enough recall parts. Invensys evaluating a 2nd and 3rd shift and premium time to lead time for parts.
10/4/00: The resistor to test with will be 1.5 ohms.....Invensys is still trying to determine the leadtime to produce 33,000 units. They are collecting information from overseas suppliers (motors, ball bearings) for leadtimes and the premium time charges. Leadtime could be dependent on when we kick off. Due to Chinese New Year, kicking off after this could cause a 4-6 week delay.

Action: Determine the correct resistor to use – Rouleau/Brenz 10/4 complete
Determine the revised IPTV with the SPDT and resistor – Delphi
Determine if Invensys has the capability to produce enough parts for the possible recall (approx. 33,000 units) – Rouleau/Pastor 9/29
Determine how many by-pass kits have been sold – D. Peacy/Bill Jackson

21) Lock Manual Transmission Vehicles in Reverse

9/20/00: The Oldsmobile Alero is currently doing this for M/T vehicles.

Action: Determine what it would take to implement this – Team

22) Invensys leadscrew pitch change concept

10/4/00: Invensys has been working on developing a new ECL concept. The noise issue is addressed, the level is similar to the Gen I design, but the duration is longer (approx. 50ms). The idea is to use an alternative steeper pitch angle, where less turns on the screw allow the same travel. If you design the leadscrew to be rigid, the concept designs you out of the binding issue. Because gear efficiency decreases, the torque needs to increase and the gear ratio decreases (from 15:1 to 18:1). This concept does bias the rebound issue. However, there are several things will help reduce this possibility: 1. Less efficiency means less rebound, 2. SPDT relay (dynamic braking), 3. Better actuator switch positioning, 4. Unit would have to rebound farther to contact the lock plate. Developmental testing of this design will begin around 10OC00 with molded parts off of old modified tools. If the concept passes developmental tests, tools will be modified to produce DV level parts. DV testing would take place from Nov. to Dec.

Y-Car ECL Task Team Minutes – 8/01/00

Next Meeting
Tues., August 8, 3-4, Meet-me-line #888-422-7124; pass code 644258 (NEW #)

Team Members: (* indicates participation in the 8/01/00 meeting)

*Jeremy Mattson (D-S)	Al Adams (GM)	Dave Peacy (GM)	Jim Danahy (GM)
Shilpan Amin (GM)	Alan Hinkle (GM)	*Jim Rouleau (D-S)	Surya Chinimilli (GM)
Ricardo Pastor (D-S)	Ben Lee (GM)	Eric Finn (GM)	*Steve Davis (Invensys)
Bob Larsen (D-S)	Steve Loche (D-D)	Tim Willette (Invensys)	Andy Brenz (GM)
Dave Lach (D-S)			

ECL Component Issues

1) ECL Rebound

6/27/00: The test report for the SPST relay vs. the SPDT relay has not been submitted to Saginaw, yet.

Action: Provide formal test report for SPST relay versus SPDT relay– S. Davis 6/27 (late)
-Steve D. should receive this week of August 2.

2) ECL Durability Binding

6/27/00: BCM timing for the ECL in the lock direction is hard coded and would require a software change and validation. Al Adams is pursuing cost and timing. . . . . The BCL Gen II component DFMEA should be submitted to GM after shutdown. . . . . Initial softtool parts of the Gen II design are available but exhibit low quality. The carrier and leadscrew threads exhibit a poor match and the prototype castings require 1 day of machining to make functional.
7/26/00: Gen II BCL noise levels: unlock ~55dB, lock ~60dB, ratcheting ~70dB. Looking into reducing the locking time to 250-300msec instead of 650msec.
8/01/00: New ideas to reduce/eliminate noise: 1. Add dampener over springs, 2. Add isolation bushing under screw bearings, 3. Add a switch in lock direction to tell BCM when to shut-off motor. Parts for ideas 1 and 2 may be available Aug. 8.

Provide DV level ECL to GM for noise level review – Rouleau 6/27 (complete)
Investigate the impact of reducing the BCL lock direction drive time – S. Loche/Adams 7/25
Determine the BCL GEN II locking "run time" at –40°C and +85°C – Davis 8/8
Provide the status of the ECL Gen II design noise development – J. Rouleau 8/8
Provide 16 DV/PV level ECL Gen II parts for GM vehicle level evaluation – S. Davis 8/28
-10 parts for MPG testing and 6 parts for electrical lab.
Provide updates to ECL Gen II timeline – J. Rouleau 7/25
-Steve D. is working to update detailed timeline for 8/8

-	Detail Design with FEA & Stacks	10AP00 – 31MY00	original
		15JN00	complete
-	ECL (redesign) DFMEA / PFMEA	04MY00 - 26MY00	original
		- 27JL00	complete
-	Customer Sample for Noise Eval.	02JN00	original
		27JL00	complete
-	Production Tooling	25AP00 – 18AU00	????
-	DV Testing with full stack variances	15JN00 – 15JL00	

- Noise Level Reduction Dev. 01AU00 – 15SE00
- PV Testing 15AU00 – 27SE00
- PPAP of New ECL 27SE00

[redacted]

6) ECL Microswitch Actuator Retention

6/27/00: Implementation status is unknown. Waiting until the Gen II is in production before pursuing this issue further.

Action: When will the heat staking operation be PPAP'd? – T. Willette 7/27 (On hold)

GM Electrical

[redacted]

9) SPDT Relay

6/13/00: Dennis Gonzalez, Electrical Director, has reviewed the ECL DFMEA and recommended minor modifications.

Action:
Complete SPDT relay vehicle level DFMEA – Brenz/Quality Group 7/27
Track progress of electrical retrofit of development vehicles with SPDT relays – Brenz on-going

[redacted]

Service / Dealership Interface

11) Service repair procedures

6/13/00: The exact service action is TBD at this point. The SPDT relay may not be introduced as a service fix. The team is awaiting platform decision on any service action for the summer '00.

Action: Provide ECL service 'action plan' for summer '00 – Brenz/Peacy/Hinkle/Team 7/27
Who would be responsible for writing a service EWO for addition of the SPDT relay–Hinkle 7/27

Warranty

12) Latest (as of 7/1) Month of build IPTV

Action: Provide the latest month of build warranty data – Finn – 8/1

[redacted]

14) Warranty returns

Action: Update warranty chart for the latest returns- Willette 7/27
Provide status of Delphi S warranty evaluations – Larsen 7/27
-Latest batch of parts (50-60) should have been sent to Invensys

[redacted]

Misc

[redacted]

Thanks for everyone's participation.

Regards,
Dave Lach
810-756-7762 (8-333-7762)
david.r.lach@gm.com

Y-Car ECL Task Team Minutes – 8/08/00

Next Meeting
Tues., August 15, 3-4, Meet-me-line #888-422-7124; pass code 644250 (NEW #)

Team Members: (* indicates participation in the 8/08/00 meeting)

*Jeremy Mattson (D-S)	*Al Adams (GM)	Dave Peacy (GM)	Jim Danahy (GM)
Shilpan Amin (GM)	Alan Hinkle (GM)	*Jim Rouleau (D-S)	Surya Chinimilli (GM)
Ricardo Pastor (D-S)	Ben Lee (GM)	Eric Finn (GM)	*Steve Davis (Invensys)
*Bob Larsen (D-S)	Steve Loche (D-D)	Tim Willette (Invensys)	*Andy Brenz (GM)
*Dave Lach (D-S)			

ECL Component Issues

1) ECL Rebound

6/27/00: The test report for the SPST relay vs. the SPDT relay has not been submitted to Saginaw, yet.

Action: Provide formal test report for SPST relay versus SPDT relay– S. Davis 6/27 (late)
-Steve D. should receive this week of August 2.

2) ECL Durability Binding

6/27/00: BCM timing for the ECL in the lock direction is hard coded and would require a software change and validation. Al Adams is pursuing cost and timing. . . . . The ECL Gen II component DFMEA should be submitted to GM after shutdown. . . . . Initial softtool parts of the Gen II design are available but exhibit low quality. The carrier and leadscrew threads exhibit a poor match and the prototype castings require 1 day of machining to make functional.
7/26/00: Gen II ECL noise levels: unlock ~55dB, lock ~60dB, ratcheting ~70dB. Looking into reducing the locking time to 250-300msec instead of 650msec. This is a calibration change. A reduced locking time value would need to be determined.
8/01/00: New ideas to reduce/eliminate noise: 1. Add dampener over springs (hard to find small enough dampeners), 2. Add isolation bushing under screw bearings, 3. Add a switch in lock direction to tell BCM when to shut-off motor.
8/08/00: Need to determine if there is room to package a switch in the lock direction. Al Adams will issue PCE's for the calibration change and for adding a second switch for the lock direction.

Provide DV level ECL to GM for noise level review – Rouleau 6/27 (complete)
Investigate the impact of reducing the ECL lock direction drive time – S. Loche/Adams 7/25
Determine the ECL GEN II locking "run time" at 9V at –40°C and +85°C – Davis 8/8
Provide the status of the ECL Gen II design noise development – J. Rouleau 8/8
Provide 16 DV/PV level ECL Gen II parts for GM vehicle level evaluation – S. Davis 8/28
-10 parts for MPG testing and 6 parts for electrical lab.
Provide updates to ECL Gen II timeline – J. Rouleau 7/25
-Steve D. is working to update detailed timeline for 8/8

- Detail Design with FEA & Stacks	10AP00 – 31MY00	original
	15JN00	complete
- ECL (redesign) DFMEA / PFMEA	04MY00 - 26MY00	original
	- 27JL00	complete

- Customer Sample for Noise Eval.	02JN00	original
	27JL00	complete
- Production Tooling	25AP00 – 18AU00	???
- DV Testing with full stack variances	15JN00 – 15JL00	
- Noise Level Reduction Dev.	01AU00 – 15SE00	
- PV Testing	15AU00 – 27SE00	
- PPAP of New ECL	27SE00 ???	

[redacted]

6) ECL Microswitch Actuator Retention

6/27/00: Implementation status is unknown. Waiting until the Gen II is in production before pursuing this issue further.

Action: When will the heat staking operation be PPAP'd? – T. Willette 7/27 (On hold)

GM Electrical

[redacted]

9) SPDT Relay

6/13/00: Dennis Gonzalez, Electrical Director, has reviewed the ECL DFMEA and recommended minor modifications.

Action:
Complete SPDT relay vehicle level DFMEA – Brenz/Quality Group 7/27
Track progress of electrical retrofit of development vehicles with SPDT relays – Brenz on-going

[redacted]

Service / Dealership interface

11) Service repair procedures

6/13/00: The exact service action is TBD at this point. The SPDT relay may not be introduced as a service fix. The team is awaiting platform decision on any service action for the summer '00.

Action: Provide ECL service 'action plan' for summer '00 – Brenz/Peacy/Hinkle/Team 7/27
Who would be responsible for writing a service EWO for addition of the SPDT relay-Hinkle 7/27

Warranty

12) Latest (as of 7/1) Month of build IPTV

Action: Provide the latest month of build warranty data – Finn – 8/1

[redacted]

14) Warranty returns

Action: Update warranty chart for the latest returns- Willette 7/27
Provide status of Delphi S warranty evaluations – Larsen 7/27
-Latest batch of parts (50-60) should have been sent to Invensys

[redacted]

Misc

[redacted]

Thanks for everyone's participation.

Regards,
Dave Lach
810-766-7762 (8-333-7762)
david.r.lach@gm.com

Y-Car ECL Task Team Minutes – 8/15/00

Next Meeting
Tues., August 22, 3-4, Meet-me-line #888-422-7124; pass code 644250 (NEW #)

Team Members: (* indicates participation in the 8/15/00 meeting)

*Jeremy Mattson (D-S)	*Al Adams (GM)	Dave Peacy (GM)	Jim Danahy (GM)
*Shilpan Amin (GM)	Alan Hinkle (GM)	*Jim Rouleau (D-S)	Surya Chinnmilli (GM)
Ricardo Pastor (D-S)	Ben Lee (GM)	Eric Finn (GM)	*Steve Davis (Invensys)
Bob Larsen (D-S)	Steve Loche (D-D)	Tim Willette (Invensys)	*Andy Brenz (GM)
Dave Lach (D-S)	Suresh Nair (GM)	Ron Asmar (GM)	Doug Gentry (D-D)

ECL Component Issues

1) ECL Rebound

Action: Provide formal test report for SPST relay versus SPDT relay– S. Davis 6/27 Complete
-A 3-page test report was distributed to Delphi Saginaw.

2) ECL Durability Binding

6/27/00: BCM timing for the ECL in the lock direction is hard coded and would require a software change and validation. Al Adams is pursuing cost and timing. . . . . The ECL Gen II component DFMEA should be submitted to GM after shutdown. . . . . Initial softtool parts of the Gen II design are available but exhibit low quality. The carrier and leadscrew threads exhibit a poor match and the prototype castings require 1 day of machining to make functional.
7/26/00: Gen II ECL noise levels: unlock ~55dB, lock ~60dB, ratcheting ~70dB. Looking into reducing the locking time to 250-300msec instead of 650msec. This is a calibration change. A reduced locking time value would need to be determined.
8/01/00: New ideas to reduce/eliminate noise: 1. Add dampener over springs (hard to find small enough dampeners), 2. Add isolation bushing under screw bearings, 3. Add a switch in lock direction to tell BCM when to shut-off motor.
8/08/00: The idea to add a switch in the lock direction was determined not feasible. There is not sufficient room to package a switch in the lock direction. The idea to reduce the lock time by a calibration change needs further investigation to determine the appropriate timing. Al Adams will issue a PCE for the calibration change when the timing information is determined.
8/16/00: Delphi is investigating new noise dampening ideas: 1. Modify the lead screw and carrier geometry (change pilot diameters), 2. Add spring to side-load the carrier and to de-lash the fit with the lead screw, 3. Material changes (dampening materials/fillers).....Initial readings to determine the necessary lock run-time taken at Invensys were not representative due to poor quality of parts. New tests will be run once better parts (lead screw/casting) are available around 8/25.

Provide DV level ECL to GM for noise level review – Rouleau 6/27 (complete)
Investigate the impact of reducing the ECL lock direction drive time – S. Loche/Adams 7/25
Determine the ECL GEN II locking "run time" at 9V at –40°C and +85°C – Davis 8/8
Provide the status of the ECL Gen II design noise development – J. Rouleau 8/8
Provide 16 DV/PV level ECL Gen II parts for GM vehicle level evaluation – S. Davis 8/28
-10 parts for MPG testing and 6 parts for electrical lab.

Provide updates to ECL Gen II timeline – J. Rouleau 7/25
-Steve D. is working to update detailed timeline for 8/22

-	Detail Design with FEA & Stacks	10AP00 – 31MY00	original
		15JN00	complete
-	ECL (redesign) DFMEA / PFMEA	04MY00 - 26MY00	original
		- 27JL00	complete
-	Customer Sample for Noise Eval.	02JN00	original
		27JL00	complete
Noise Reduction Plan:			
	Noise Contribution Analysis	01AU00 – 21AU00	
	Development of fixes	21AU00 – 04SE00	
	DV Tooling	04SE00 – 09OC00	
	DV testing and evaluation	09OC00 – 30OC00	
Wear Reduction Plan:			
	Development of fixes	27JL00 – 11AU00	
	DV Tooling	11AU00 – 21SE00	
	DV testing and evaluation	21SE00 – 12OC00	
-	Production Tooling	25AP00 – ???	
-	PV Testing	29AU00 – ???	
-	PPAP of New ECL	????	

[redacted]

6) BCL Microswitch Actuator Retention (On Hold)

6/27/00: Implementation status is unknown. Once the Gen II design is validated, this issue will not be necessary or pursued further.

Action: When will the heat staking operation be PPAP'd? – T. Willette 7/27 (On hold)

GM Electrical

[redacted]

9) SPDT Relay

6/13/00: Dennis Gonzalez, Electrical Director, has reviewed the ECL DFMEA and recommended minor modifications.
8/15/00: The SPDT relay vehicle level DFMEA is ready for sign-off……The SPDT relay will not be issued as a service fix because it does not address the binding situation.

Action:
Complete SPDT relay vehicle level DFMEA – Brenz/Quality Group 7/27
Track progress of electrical retrofit of development vehicles with SPDT relays – Brenz on-going

[redacted]

Service / Dealership Interface

11) Service repair procedures

6/13/00: The exact service action is TBD at this point. The SPDT relay may not be introduced as a service fix. The team is awaiting platform decision on any service action for the summer '00.

Action: Provide BCL service 'action plan' for summer '00 – Brenz/Peacy/Hinkle/Team 7/27
Who would be responsible for writing a service EWO for addition of the SPDT relay–Hinkle 7/27

Warranty

12) Latest (as of 7/1) Month of build IPTV

Action: Provide the latest month of build warranty data – Finn – 8/1

12a) Customer Verbatims

Action: Provide customer verbatims on warranty data for the percentage of Rebound vs. Gear Train Binding. Also, provide the breakdown on drive-in vs. tow-in. -- Finn – 8/22

[redacted]

14) Warranty returns

Action: Update warranty chart for the latest returns- Willette 7/27
Provide status of Delphi S warranty evaluations – Larsen 7/27
-Latest batch of parts (50-60) should have been sent to Invensys

[redacted]

Misc

[redacted]

Thanks for everyone's participation.

Regards,
Dave Lach
810-756-7762 (8-333-7762)
david.r.lach@gm.com

Y-Car ECL Task Team Minutes – 8/22/00

Next Meeting
Tues., August 29, 3-4, Meet-me-line #888-422-7124; pass code 644250

Team Members: (* indicates participation in the 8/22/00 meeting)

*Jeremy Mattson (D-S)	*Al Adams (GM)	Dave Peacy (GM)	Jim Danahy (GM)
*Shilpan Amin (GM)	Alan Hinkle (GM)	*Jim Rouleau (D-S)	Surya Chinimilli (GM)
Ricardo Pastor (D-S)	Jason Stombaugh (GM)	Eric Finn (GM)	*Steve Davis (Invensys)
Bob Larson (D-S)	Steve Looke (D-D)	Tim Willette (Invensys)	*Andy Brenz (GM)
*Dave Lach (D-S)	Suresh Nair (GM)	Ron Asmar (GM)	*Doug Gentry (D-D)

ECL Component Issues

[redacted]

2) ECL Durability Binding

6/27/00: BCM timing for the ECL in the lock direction is hard coded and would require a software change and validation. Al Adams is pursuing cost and timing. . . . . The ECL Gen II component DFMEA should be submitted to GM after shutdown. . . . . Initial softtool parts of the Gen II design are available but exhibit low quality. The carrier and leadscrew threads exhibit a poor match and the prototype castings require 1 day of machining to make functional.
7/26/00: Gen II ECL noise levels: unlock ~55dB, lock ~60dB, ratcheting ~70dB. Looking into reducing the locking time to 250-300msec instead of 650msec. This is a calibration change. A reduced locking time value would need to be determined.
8/01/00: New ideas to reduce/eliminate noise: 1. Add dampener over springs (hard to find small enough dampeners), 2. Add isolation bushing under screw bearings, 3. Add a switch in lock direction to tell BCM when to shut-off motor.
8/08/00: The idea to add a switch in the lock direction was determined not feasible. There is not sufficient room to package a switch in the lock direction. The idea to reduce the lock time by a calibration change needs further investigation to determine the appropriate timing. Al Adams will issue a PCE for the calibration change when the timing information is determined.
8/16/00: Delphi is investigating new noise dampening ideas: 1. Modify the lead screw and carrier geometry (change pilot diameters), 2. Add spring to side-load the carrier and to de-lash the fit with the lead screw, 3. Material changes (dampening materials/fillers).....Initial readings to determine the necessary lock run-time taken at Invensys were not representative due to poor quality of parts. New tests will be run once better parts (lead screw/casting) are available around 8/25.
8/22/00: The single shot casting tool may not be production feasible. Two backup designs are being developed, items 5 and 8 from the brainstorming matrix. J. Rouleau to have demo part for item 8 using a T&T controller and current pot arm approx. 8/31.

[redacted]

Investigate the impact of reducing the ECL lock direction drive time – S. Looke/Adams 7/25
Determine the ECL GEN II locking "run time" at 9V at –40°C and +85°C – Davis 8/29
Provide 16 DV/PV level ECL Gen II parts for GM vehicle level evaluation – Davis Oct. 8/9
-10 parts for MPG testing and 6 parts for electrical lab.
Provide updates to ECL Gen II timelins – J. Rouleau 7/25
-Steve D. is working to update detailed timeline for 8/22

[redacted]

[redacted]

Noise Reduction Plan:

Noise Contribution Analysis	01AU00 – 21AU00
Development of fixes	21AU00 – 04SE00
DV Tooling	04SE00 – 09OC00
DV testing and evaluation	09OC00 – 30OC00

Wear Reduction Plan:

Development of fixes	27JL00 – 11AU00
DV Tooling	11AU00 – 21SE00
DV testing and evaluation	21SE00 – 12OC00

- Production Tooling	25AP00 – ???
- PV Testing	29AU00 – ???
- PPAP of New ECL	????

[redacted]

6) ECL Microswitch Actuator Retention – Closed Out

GM Electrical

[redacted]

9) SPDT Relay

6/13/00: Dennis Gonzalez, Electrical Director, has reviewed the ECL DFMEA and recommended minor modifications.
8/15/00: The SPDT relay vehicle level DFMEA is ready for sign-off.....The SPDT relay will not be issued as a service fix because it does not address the binding situation.
8/22/00: The DFMEA is almost 100% complete. Ready for Signatures.
Action:

Complete SPDT relay vehicle level DFMEA -- Brenz/Quality Group 7/27
Track progress of electrical retrofit of development vehicles with SPDT relays – Brenz on-going

[redacted]

Service / Dealership interface

[redacted]

Warranty

12) Latest (as of 7/1) Month of build IPTV

Action: Provide the latest month of build warranty data – Finn – 8/29

12a) Customer Verbatims – 2001 SOP

8/22/00: Eric Finn has reported that no 2001 SOP warranty information is available for the BCL.

Action: Provide customer verbatims on warranty data for the percentage of Rebound vs. Gear Train Binding. Also, provide the breakdown on drive-in vs. tdw-in. - Finn – (provide info as available)

[redacted]

14) Warranty returns

Action: Update warranty chart for the latest returns- Willette 7/27
Provide status of Delphi S warranty evaluations – Larsen 7/27
-Latest batch of parts (50-60) should have been sent to Invensys

[redacted]

Misc

[redacted]

Thanks for everyone's participation.

Y-Car ECL Task Team Minutes – 8/29/00

Next Meeting
Tues., September 12, 3-4, Meet-me-line #888-422-7124; pass code 644250

Team Members: (* indicates participation in the 8/29/00 meeting)

*Jeremy Matteson (D-S)	*Al Adams (GM)	Dave Peacy (GM)	Jim Danahy (GM)
*Shilpan Amin (GM)	Alan Hinkle (GM)	*Jim Rouleau (D-S)	Surya Chinimilli (GM)
Ricardo Pastor (D-S)	Jason Stombaugh (GM)	Eric Finn (GM)	*Steve Davis (Invensys)
Bob Larsen (D-S)	Steve Loche (D-D)	Tim Willette (Invensys)	*Andy Bremz (GM)
*Dave Lach (D-S)	Suresh Nair (GM)	Ron Asmar (GM)	*Doug Gentry (D-D)

ECL Component Issues

[redacted]

2) ECL Durability Binding

6/27/00: BCM timing for the ECL in the lock direction is hard coded and would require a software change and validation. Al Adams is pursuing cost and timing. . . . . The ECL Gen II component DFMEA should be submitted to GM after shutdown. . . . . Initial softtool parts of the Gen II design are available but exhibit low quality. The carrier and leadscrew threads exhibit a poor match and the prototype castings require 1 day of machining to make functional.
7/26/00: Gen II ECL noise levels: unlock ~55dB, lock ~60dB, ratcheting ~70dB. Looking into reducing the locking time to 250-300msec instead of 650msec. This is a calibration change. A reduced locking time value would need to be determined.
8/01/00: New ideas to reduce/eliminate noise: 1. Add dampener over springs (hard to find small enough dampeners), 2. Add isolation bushing under screw bearings, 3. Add a switch in lock direction to tell BCM when to shut-off motor.
8/08/00: The idea to add a switch in the lock direction was determined not feasible. There is not sufficient room to package a switch in the lock direction. The idea to reduce the lock time by a calibration change needs further investigation to determine the appropriate timing. Al Adams will issue a PCE for the calibration change when the timing information is determined.
8/16/00: Delphi is investigating new noise dampening ideas: 1. Modify the lead screw and carrier geometry (change pilot diameters), 2. Add spring to side-load the carrier and to de-lash the fit with the lead screw, 3. Material changes (dampening materials/fillers).....Initial readings to determine the necessary lock run-time taken at Invensys were not representative due to poor quality of parts. New tests will be run once better parts (lead screw/casting) are available around 8/25.
8/22/00: The single shot casting tool may not be production feasible. Two backup designs are being developed, items 5 and 8 from the brainstorming matrix. J. Rouleau to have demo part for item 8 using a T&T controller and current pot asm approx. 8/31.

8/29/00: A solenoid is being investigated to stop the ratcheting noise at the end of the leadscrew travel. Most of the materials have arrived for evaluation of the wear fixes. A new leadscrew insert has arrived which would take out some of the side-to-side lash between the leadscrew and carrier. New castings /(graphite tool) should be available this week. Still on track for the 190C decision date for the recovery plans. Dave Hill would like to see the results of a shock absorbing rubber bumper. No effect on noise – the noise transmission path is better, but the sound quality is the same.

[redacted]

Investigate the impact of reducing the ECL lock direction drive time – S. Loche/Adams 7/25
Determine the ECL GEN II locking "run time" at 9V at –40°C and +85°C – Davis 8/29
Provide 16 DV/PV level ECL Gen II parts for GM vehicle level evaluation – Davis Oct. 8/9
-10 parts for MPG testing and 6 parts for electrical lab.
Provide developmental concept for the solenoid noise fix – Rouleau 10/01
Provide updates to ECL Gen II timeline – J. Rouleau 7/25
-Steve D. is working to update detailed timeline for 8/22

Noise Reduction Plan:

Noise Contribution Analysis	01AU00 – 21AU00
Development of fixes	21AU00 – 04SE00
DV Tooling	04SE00 – 09OC00
DV testing and evaluation	09OC00 – 30OC00

Wear Reduction Plan:

Development of fixes	27JL00 – 11AU00
DV Tooling	11AU00 – 21SE00
DV testing and evaluation	21SE00 – 12OC00

- Production Tooling	25AP00 – TBD
- PV Testing	29AU00 – TBD
- PPAP of New ECL	TBD
- Implementation of New ECL	SOP 2002 MY

[redacted]

GM Electrical

[redacted]

Service / Dealership Interface

11) Service repair procedures

8/29/00 – Greg Benson has ordered off the internet an aftermarket ECL disable kit. This kit is selling very well and the use of this kit could be affecting our warranty numbers for the 2000 MY. The kit should be in September 8th.

Action: Evaluate the kit to determine how it works – Team

Action: How can we override the current ECL system for service (for automatic transmission vehicle)? – Team 9/5 Gentry/Hinkle/Brenz/Adams

Warranty

12) Latest (as of 7/1) Month of build IPTV

Action: Provide the latest month of build warranty data – Firm – 9/29

12a) Customer Verbatims – 2001 SOP

8/22/00: Eric Finn has reported that no 2001 SOP warranty information is available yet for the ECL.
8/29/00: A 2001 with 190 miles on it exhibited an ECL issue - - but it was gear train binding - - they were able to tap onto the ECL to function the ECL - - pull key, wait 10 sec message - - -

Action: Provide customer verbatims on warranty data for the percentage of Rebound vs. Gear Train Binding. Also, provide the breakdown on drive-in vs. tow-in. - Finn – (provide info as available)

[redacted]

14) Warranty returns

Action: Update warranty chart for the latest returns- Willette 7/27
Provide status of Delphi S warranty evaluations – Larsen 7/27
-Latest batch of parts (50-60) should have been sent to Invensys
-Provide updates of 2001 MY warranty part returns – Larsen (as available)

[redacted]

Misc

[redacted]

18) Continuous Feedback Controller (absolute position sensing)

8/29/00: Gen II ECL units have been modified adding a potentiometer. When the soft stops are reached, the motor will be allowed to coast to a stop– as parts become available this week, the 270 power T&T controller will be used to demonstrate - - will the scan rate be fast enough to stop the ECL before the hardstop – all the modifications made to the parts are external - - the hard/soft stop settings cannot be modified on the 270 controller – maybe S58?

Action: Development concept demonstration – Rouleau 9/15

19) BCM Coast Algorithm - & Low Voltage Lock

8/29/00: Chips to be modified with a new cal value for unlock time read - - look at switch at 100 msec instead of 250 msec. Also, being investigated is the possibility of adding a resistor to the key out switch circuit - - - tests at Saginaw to zero in on optimum lock direction voltage… for demonstration purposes, start with a 4 Ohm resistor - - will a resistor in the circuit affect any other function in the vehicle – monitoring of key out sensing circuit?

20) Preparation for possible customer satisfaction recall

9/5/00: Dave Hill and Dave Peacy are considering a "customer satisfaction" recall to replace all ECL's from approximately March 1998 to 2001 SOP, approx. 67,000 vehicles (Note: ECL's in vehicles prior to March 1998 would not need to be replaced). The ECL's would be replaced with the SPDT relay and possibly a resistor in the key-out switch circuit.

Action: Determine the correct resistor to use – Rouleau
Determine the revised IPTV with the SPDT and resistor – Team
Determine if Delphi's sub-suppliers have the capability to produce enough parts for the possible recall (How many parts – approx 50% of 67,000??) – Team

21) Lock Manual Transmission in Reverse

Action: Determine what it would take to implement this – Team

Y-Car ECL Task Team Minutes – 7/26/00

Next Meeting
Wed, July 26th, 3-4, Meet-me-line #888-422-7124; pass code 644250 (NEW #)

Team Members: (* indicates participation in the 7/267/00 meeting)

*Jeremy Mattson (D-S)	Al Adams (GM)	Dave Peacy (GM)	Jim Danahy (GM)
*Shilpan Amin (GM)	Alan Hinkle (GM)	*Jim Rouleau (D-S)	*Surya Chinimilli (GM)
Ricardo Pastor (D-S)	Ben Lee (GM)	Eric Finn (GM)	*Steve Davis (Invensys)
Bob Larsen (D-S)	Steve Loche (D-D)	Tim Willette (Invensys)	*Andy Brenz (GM)
*Dave Lach (D-S)			

ECL Component Issues

1) ECL Rebound

6/27/00: The test report for the SPST relay vs. the SPDT relay has not been submitted to Saginaw, yet.

Action: Provide formal test report for SPST relay versus SPDT relay– S. Davis 6/27 (late)

2) ECL Durability Binding

6/27/00: BCM timing for the ECL in the lock direction is hard coded and would require a software change and validation. Al Adams is pursuing cost and timing. . . . . The ECL Gen II component DFMEA should be submitted to GM after shutdown. . . . . Initial softtool parts of the Gen II design are available but exhibit low quality. The carrier and leadscrew threads exhibit a poor match and the prototype castings require 1 day of machining to make functional.

Provide DV level BCL to GM for noise level review – Rouleau 6/27 (late)
Investigate the impact of reducing the ECL lock direction drive time – S. Loche/Adams 7/25
Determine the ECL GEN II locking "run time" at –40°C – Davis 7/25
Provide the status of the ECL Gen II design development – J. Rouleau 7/25
Provide 16 DV level ECL Gen II parts for GM vehicle level evaluation – S. Davis 7/25
Provide updates to ECL Gen II timeline – J. Rouleau 7/25

- Detail Design with FEA & Stacks	10AP00 – 31MY00	original
	15JN00	complete
- ECL (redesign) DFMEA / PFMEA	04MY00 - 26MY00	original
	- 27JL00	95% complete
- Customer Sample for Noise Eval	02JN00	original
	27JL00	revised
- Production Tooling	25AP00 – 15AU00	????
- DV Testing with full stack variances	15JN00 – 15JL00	
- PV Testing	15AU00 – 25SE00	
- PPAP of New ECL	27SE00	

[redacted]

6) ECL Microswitch Actuator Retention

6/27/00: Implementation status is unknown.

Action: When will the heat staking operation be PPAP'd? – T. Willette 7/27

GM Electrical

[redacted]

9) SPDT Relay

6/13/00: Dennis Gonzalez, Electrical Director, has reviewed the ECL DFMEA and recommended minor modifications.

Action:
Complete SPDT relay vehicle level DFMEA – Brenz/Quality Group 7/27
Track progress of electrical retrofit of development vehicles with SPDT relays – Brenz on-going

[redacted]

Service / Dealership interface

11) Service repair procedures

6/13/00: The exact service action is TBD at this point. The SPDT relay may not be introduced as a service fix. The team is awaiting platform decision on any service action for the summer '00.

Action: Provide ECL service 'action plan' for summer '00 – Brenz/Peacy/Hinkle/Team 7/27
Who would be responsible for writing a service EWO for addition of the SPDT relay–Hinkle 7/27

Warranty

12) Latest (as of 7/1) Month of build IPTV

Action: Provide the latest month of build warranty data – Finn – 8/1

[redacted]

14) Warranty returns

Action: Update warranty chart for the latest returns- Willette 7/27
Provide status of Delphi S warranty evaluations – Larsen 7/27

[redacted]

Mike

[redacted]

Thanks for everyone's participation.

Regards,
Dave Lach
810-756-7762 (8-333-7762)
david.r.lach@gm.com

Y-Car ECL Task Team Minutes – 6/6/00

Next Meeting
Tues, June 13th, 3-4, Meet-me-line #888-221-0133 ; pass code 420832

Team Members: (* indicates participation in the 6/6/00 meeting)

*David Lach (D-S)	Al Adams (GM)	Dave Peacy (GM)	Jim Danahy (GM)
Shilpan Amin (GM)	*Alan Hinkle (GM)	*Jim Rouleau (D-S)	Surya Chinimilli (GM)
Ricardo Pastor (D-S)	Ben Lee (GM)	Eric Finn (GM)	*Steve Davis (Invensys)
Bob Larsen (D-S)	Steve Loche (D-D)	Tim Willette (Invensys)	*Andy Brenna (GM)

ECL Component Issues

1) ECL Rebound

5/30/00: Invensys is completing the formal test report comparing the SPDT vs. the SPST relay. The IPTV estimate for warranty improvement for going from the SPST relay to the SPDT relay is ~35% for vehicles built after April-98. This would only help resolve the rebound issue which the vehicle sees as a fail enable fault.

Action: Provide formal test report for SPST relay versus SPDT relay– S. Davis 6/13

2) ECL Durability Binding

6/6/00: 16 DV level parts will be built up for installation into GM durability and development vehicles. Delivery of the parts is targeted for June 30th. This will be approximately 2 weeks after the initiation of design validation testing. A DV level part will be delivered on June 15th for a noise evaluation sample in Saginaw. The part will be then delivered to GM on June19th for vehicle level noise evaluation. The installation will take place in the electrical lab.

The noise level for the proof-of-concept level ECL was 68 dB running constantly. The current ECL noise level is 55 dB but only runs for 200 msec and is difficult to measure (calculate an average reading). Electronics were not available to turn the proof-of-concept part off after 650 msec like the vehicle. The DV level part scheduled for delivery on June 15th should be at a lower noise level due to a reduced carrier spring load (50%). Bench tests have shown a correlation between spring load and noise level. The proof-of-concept part will be delivered to GM this week for review. The team will look strongly at the possibility of reducing the ECL run time during the lock cycle. Measurement of the ECL cycle duration at –40° C will take place during DV testing. A 300-350 msec run time instead of a 650 msec run time would result in only 100-200 msec of ratcheting which could make the ECL ratcheting noise (during the lock cycle) less noticeable to a customer.

All the details drawings for the ECL Gen II redesign are complete, except for the addition of ribs to the cover in the FEA model which will be completed by 6/8/00. Both math and CAD stacks are underway. The component level DFMEA is 75% complete. An initial review has already taken place between Delphi and Invensys. The PFMEA is 30% complete. All new tooling has been kicked off, except for the ECL cover.

Provide dBa and son level test results for proof-of-concept ECL – Rouleau 6/13
Provide proof-of-concept ECL to GM for noise level review – Rouleau 6/13
Investigate the impact of reducing the ECL lock direction drive time – Adams 6/13
Determine the ECL GEN II locking "run time" at –40°C – Davis 7/11

Provide the status of the ECL Gen II design development – J. Rouleau 6/13
Provide 16 DV level ECL Gen II parts for GM vehicle level evaluation – S. Davis 6/30
Provide updates to ECL Gen II timeline – J. Rouleau 6/13

- Detail Design with FEA & Stacks	10AP00 – 31MY00	original
-	15JN00	revised
- BCL (redesign) DFMEA / PFMEA	04MY00 - 26MY00	original
-	15JN00	revised
- Customer Sample for Noise Eval	02JN00	original
	15JN00	revised
- Production Tooling	25AP00 – 15AU00	on-time
- DV Testing with full stack variances	15JN00 – 15JL00	
- PV Testing	15AU00 – 25SE00	
- PPAP of New ECL	27SE00	

3) Analytical Modeling

6/6/00: The FEA model will be complete 6/8. Testing should be complete by next week.

Action: Complete FEA for Gen II redesign – J. Rouleau 6/13/00

[redacted]

7) ECL Microswitch Actuator Retention

6/6/00: No report. Tim Willette has been working with a production improvement team to come up with a solution, however, their information was not available for the meeting.

Action: Continue evaluation of heat staking techniques for securing microswitch – T. Willette 6/13

GM Electrical

[redacted]

9) SPDT Relay

6/6/00: The SPDT relay system level DFMEA is still open (99% complete) awaiting detailed information on some of the Bowling Green quality checks. Additional vehicle level testing of 4+ developmental cars is underway.

Action:
Complete SPDT relay vehicle level DFMEA – Brenz/Quality Group 6/13
Complete electrical evaluation of (4) development vehicles with SPDT relays – Brenz 6/20

[redacted]

Service / Dealership interface

11) Service repair procedures

6/1/00: Should we add the SPDT relay or eliminate the ECL on auto-transmission vehicles for service? A separate meeting is planned for 6/8 to discuss the details.

Action: Provide ECL service 'action plan' for summer '00 – Brenz/Peacy/Hinkle/Team 6/13
Who would be responsible for writing a service EWO for addition of the SPDT relay–Hinkle 6/13

Warranty

12) Latest (as of 7/1) Month of build IPTV

Action: Provide the latest month of build warranty data – Finn – 7/1

[redacted]

14) Warranty returns

Action: Update warranty chart for the latest returns- Willette 6/13
Provide status of Delphi S warranty evaluations – Larsen 6/20

[redacted]

Misc

[redacted]

[redacted]

Thanks for everyone's participation.

Regards,
Dave Lach
810-758-7762 (8-333-7762)
david.r.lach@gm.com

Y-Car ECL Task Team Minutes – 6/13/00

Next Meeting
Tues, June 20th, 3-4, Meet-me-line #888-422-7124; pass code 644150 (NEW #)

Team Members: (* indicates participation in the 6/13/00 meeting)

*David Lach (D-S)	*Al Adams (GM)	Dave Peacy (GM)	Jim Danahy (GM)
Shilpan Amin (GM)	Alan Hinkle (GM)	*Jim Rouleau (D-S)	Surya Chintamilli (GM)
Ricardo Pastor (D-S)	Ben Lee (GM)	Eric Finn (GM)	*Steve Davis (Invensys)
Bob Larsen (D-S)	Steve Loche (D-D)	Tim Willette (Invensys)	*Andy Brenna (GM)

ECL Component Issues

1) ECL Rebound

6/13/00: Additional time is needed to analyze the results of each SPDT and SPST relay part off of the test stand. A test report will be available by 6/20.

Action: Provide formal test report for SPST relay versus SPDT relay– S. Davis 6/20

2) ECL Durability Binding

6/20/00: Delphi management does not feel that the proof-of-concept part is not representative and does not wish to review the part in a vehicle. Instead, the DV level part for noise level review will be expedited. The DV level part will be delivered by 6/23 to Delphi for dB measurements with a vehicle review at GM by 6/27/00.

Per Al Adams, a change to the lock cycle duration from 650 msec to ~ 300 msec would require a software change. Validation and implementation is TBD, but approximately 2 months.

Provide DV level ECL to GM for noise level review – Rouleau 6/27
Investigate the impact of reducing the BCL lock direction drive time – S. Loche/Adams 6/20
Determine the BCL GEN II locking "run time" at –40°C – Davis 7/11
Provide the status of the ECL Gen II design development – J. Rouleau 6/20
Provide 16 DV level ECL Gen II parts for GM vehicle level evaluation – S. Davis 6/30
Provide updates to ECL Gen II timeline – J. Rouleau 6/20

-	Detail Design with FRA & Stacks	10AP00 – 31MY00	original
		15JN00	complete
-	ECL (redesign) DFMEA / PFMEA	04MY00 - 26MY00	original
		20JN00	95% complete
-	Customer Sample for Noise Eval	02JN00	original
		27JN00	revised
-	Production Tooling	25AP00 – 15AU00	on-time
-	DV Testing with full stack variances	15JN00 – 15JL00	
-	PV Testing	15AU00 – 25SE00	
-	PPAP of New ECL	27SE00	

3) Analytical Modeling

6/13/00: The FEA model has been complete. Results show that if the ECL carrier is not allowed to rock, the threads will be strong enough to handle the motor on-set loading. Based upon the results of the FEA, the new ECL design is complete.

Action: Close-out

[redacted]

7) ECL Microswitch Actuator Retention

6/13/00: A supplier design change request form has been submitted from Invensys to Delphi engineering for heat staking of the microswitch to the cover. Implementation is TBD.

Action: When will the heat staking operation be PPAP'd? – T. Willette 6/20

GM Electrical

[redacted]

9) SPDT Relay

6/13/00: Dennis Gonzalez, Electrical Director, has reviewed the ECL DFMEA and recommended minor modifications.
6/6/00: The SPDT relay system level DFMEA is still open (95% complete) awaiting detailed information on some of the Bowling Green quality checks. Additional vehicle level testing of 4+ developmental cars is underway.

Action:
Complete SPDT relay vehicle level DFMEA – Brenz/Quality Group 6/20
Track progress of electrical retrofit of development vehicles with SPDT relays – Brenz on-going

[redacted]

Service / Dealership Interface

11) Service repair procedures

6/13/00: The exact service action is TBD at this point. The SPDT relay may not be introduced as a service fix. The team is awaiting platform decision on any service action for the summer '00.

Action: Provide ECL service 'action plan' for summer '00 – Brenz/Peacy/Hinkle/Team 6/20
Who would be responsible for writing a service EWO for addition of the SPDT relay--Hinkle 6/20

Warranty

12) Latest (as of 7/1) Month of build IPTV

Action: Provide the latest month of build warranty data – Finn – 7/1
Provide ECL accumulative IPTV warranty data – Larsen/Lach 6/20

[redacted]

14) Warranty returns

Action: Update warranty chart for the latest returns- Willette 6/20
Provide status of Delphi S warranty evaluations – Larsen 6/20

[redacted]

Misc

[redacted]

[redacted]

Thanks for everyone's participation.

Regards,
Dave Lach
810-756-7762 (8-333-7762)
david.r.lach@gm.com

Y-Car ECL Task Team Minutes – 6/20/00

Next Meeting
Tues, June 27th, 3-4, Meet-me-line #888-422-7124; pass code 644250 (NEW #)

Team Members: (* indicates participation in the 6/20/00 meeting)

*David Lach (D-S)	*Al Adams (GM)	Dave Peacy (GM)	Jim Danahy (GM)
Shilpan Amin (GM)	*Alan Hinkle (GM)	*Jim Rouleau (D-S)	Surya Chinimilli (GM)
Ricardo Pastor (D-S)	Ben Lee (GM)	Eric Finn (GM)	*Steve Davis (Invensys)
Bob Larsen (D-S)	Steve Loche (D-D)	Tim Willette (Invensys)	*Andy Brenna (GM)
*Jeremy Mattson			

ECL Component Issues

1) ECL Rebound

6/20/00: Additional time is needed to analyze the results of each SPDT and SPST relay part off of the test stand. A test report will be available by 6/20.

Action: Provide formal test report for SPST relay versus SPDT relay– S. Davis 6/20

2) ECL Durability Binding

6/20/00: Delphi management does not feel that the proof-of-concept part is not representative and does not wish to review the part in a vehicle. Instead, the DV level part for noise level review will be expedited. The DV level part will be delivered by 6/23 to Delphi for dB measurements with a vehicle review at GM by 6/27/00.

Per Al Adams, a change to the lock cycle duration from 650 msec to ~ 300 msec would require a software change. Validation and implementation is TBD, but approximately 2 months.

Provide DV level ECL to GM for noise level review – Rouleau 6/27
Investigate the impact of reducing the ECL lock direction drive time – S. Loche/Adams 6/20
Determine the ECL GEN II locking "run time" at –40°C – Davis 7/11
Provide the status of the ECL Gen II design development – J. Rouleau 6/20
Provide 16 DV level ECL Gen II parts for GM vehicle level evaluation – S. Davis 6/30
Provide updates to ECL Gen II timeline – J. Rouleau 6/20

-	Detail Design with FEA & Stacks	10AP00 – 31MY00	original
		- 15JN00	complete
-	ECL (redesign) DFMEA / PFMEA	04MY00 - 26MY00	original
		- 20JN00	95% complete
-	Customer Sample for Noise Eval	02JN00	original
		27JN00	revised
-	Production Tooling	25AP00 – 15AU00	on-time
-	DV Testing with full stack variances	15JN00 – 15JL00	
-	PV Testing	15AU00 – 25SE00	
-	PPAP of New ECL	27SE00	

3) Analytical Modeling

6/13/00: The FEA model has been complete. Results show that if the ECL carrier is not allowed to rock, the threads will be strong enough to handle the motor on-set loading. Based upon the results of the FEA, the new ECL design is complete.

Action: Close-out

[redacted]

7) ECL Microswitch Actuator Retention

6/13/00: A supplier design change request form has been submitted from Invensys to Delphi engineering for heat staking of the microswitch to the cover. Implementation is TBD.

Action: When will the heat staking operation be PPAP'd? – T. Willette 6/20

GM Electrical

[redacted]

9) SPDT Relay

6/13/00: Dennis Gonzalez, Electrical Director, has reviewed the ECL DFMEA and recommended minor modifications.
6/6/00: The SPDT relay system level DFMEA is still open (99% complete) awaiting detailed information on some of the Bowling Green quality checks. Additional vehicle level testing of 4+ developmental cars is underway.

Action:
Complete SPDT relay vehicle level DFMEA – Brenz/Quality Group 6/20
Track progress of electrical retrofit of development vehicles with SPDT relays – Brenz on-going

[redacted]

Service / Dealership Interface

11) Service repair procedures

6/13/00: The exact service action is TBD at this point. The SPDT relay may not be introduced as a service fix. The team is awaiting platform decision on any service action for the summer '00.

Action: Provide ECL service 'action plan' for summer '00 – Brenz/Peacy/Hinkle/Team 6/20
Who would be responsible for writing a service EWO for addition of the SPDT relay–Hinkle 6/20

Warranty

12) Latest (as of 7/1) Month of build IPTV

Action: Provide the latest month of build warranty data – Finn – 7/1
Provide ECL accumulative IPTV warranty data – Larsen/Lach 6/20

[redacted]

14) Warranty returns

Action: Update warranty chart for the latest returns- Willette 6/20
Provide status of Delphi S warranty evaluations – Larsen 6/20

[redacted]

Misc

[redacted]

[redacted]

Thanks for everyone's participation.

Regards,
Dave Lach
810-756-7762 (8-333-7762)
david.r.lach@gm.com

Y-Car ECL Task Team Open Items

NO.	ISSUE DESCRIPTION	REQUESTER OWNER	START DATE	REPORT DATE	ACTION REQUIRED	ISSUE COMMENTS
80	**Y- Car (Corvette) ECL Issues:**					Updated: 1/17/01
001	ECL durability binding	Team Team (1,2,4,5,6,7) S. Davis (3)	27SE00	On hold	1. Provide 18 DV/PV level ECL Gen II+ parts for GM vehicle level evaluation(10 parts for MPG, 6 parts for electrical lab)	
			2. Production implementation-GenII:			
			27SE00	TBD	Production Tooling - on hold	
			27SE00	TBD	PV testing - on hold	
			27SE00	TBD	PPAP of New ECL - on hold	
			27SE00	TBD	Implementation of New ECL – on hold	
			05NO00	17JA01	3. Determine the effectiveness of the lead angle change w/ new test fixtures and high speed camera	
			15NO00	17JA01	4. Update on parts being built and tested from the L18 array (ECL durability tests)	
			15NO00	17JA01	5. Status update on L18 identified for leads crew/carrier molding process	
			15NO00	24JA01	6. Status update on L18 identified for casting of the housing	
			15NO00	17JA01	7. Status update on Mataiobis Taguchi System (MTS) study	
002	How to override the current ECL for service (A/T vehicles)	D. Hill Hallochark (1,2,3) A. Hinkle (4) Hinkle/Peacy (5) J. Rouleau/ S. Davis (6)	15NO00	17JA01	1. Status of obtaining 4 dual coil latching relay parts from Delphi-P	
			15OC00	17JA01	2. Status of relay application approval submitted to Delphi Packard 12/13	
			15NO00	17JA01	3. Status of electrical bench modifications to allow for testing latching relay at different ECL designs (need parts)	
			15NO00	24JA01	4. Labor/time study for dealers to put in latching relay (waiting on part)	
			18DE00	17JA01	5. Verify the time to replace the ECL to ensure it is not too generous	
			15NO00	17JA01	6. Determine best way to retain the lock bolt in the unlocked direction	

Y-Car ECL Task Team Open Items

NO.	ISSUE DESCRIPTION	REQUESTER OWNER	START DATE	REPORT DATE	ACTION REQUIRED	ISSUE COMMENTS
					over life of vehicle	
003	Warranty IPTV data/ return parts	Team E. Finn (1,2) B. Larsen (3)	27SE00 27SE00 27SE00	on going on going on going	1. Provide the latest month of build warranty data 2. Provide customer verbatims on warranty data for the percentage of rebound vs. gear train binding (breakdown of drive-in vs. tow-in) 3. Provide updates of all model year part returns	
004	Robustness Improvements and further "Deep Dive" analysis	Team T. Willette (1,2) D. Thurber (3,4)	30OC00 03NO00 03NO00 03NO00	17JA01 17JA01 31JA01 31JA01	1. Update on segregating parts w/ lowest switch point (after 2-week trial period) 2. Update on on-going reliability testing (12 pieces/two wks, 7000 cycles) 3. Update on production process for a heat stake operation added to the terminal dek (PPAP 02MR01) 4. Update on proposed change to thermal deburr for casting as	

CL03-004-039

Y-Car ECL Task Team Open Items

NO.	ISSUE DESCRIPTION	REQUESTER OWNER	START DATE	REPORT DATE	ACTION REQUIRED	ISSUE COMMENTS
					opposed to tumble deburr (PPAP 23DE01)	
005	Voltage reduction and time reduction in lock direction	Team J. Rouleau (1) Hallochak (2,3) Gentry/ Hallochak (4)	04OC00 20DE00 04OC00 29NO00	On hold 17JA01 17JA01 17JA01	1. Determine the lowest the voltage would have to drop in order to not bind@ high temp (low test priority) 2. Status of acquiring zener parts 3. Status update on zener testing to reduce voltage (waiting on parts) 4. Status of look-up table idea for determining ECL lock run time	20NO00 – The [illegible] switch for the zener testing has been [illegible] and the brackets [illegible] properly. Drew and [illegible] weeks. [illegible] to use the passenger [illegible] duration column lock [illegible] and vehicle voltage. A look-up table could be used to determine the time [illegible] the [illegible] only tested for lock direction, [illegible] also be used in the unlock direction. This idea could help with the [illegible]. 13DE00 – Drew tested a 6.8 V zener in the lock direction. Full voltage in unlock direction, [illegible]. Two zeners were [illegible] able to [illegible] 20DE00 – [illegible] are being obtained from a [illegible] [illegible] 17JA01 – [illegible] a lock-up [illegible] number of [illegible]
006	Preparation for possible customer satisfaction recall	D. Hill R. Pastor (1)	15NO00	17JA01	1. Determine if Delphi has capacity to produce enough plastic switch brackets if ECL is replaced in A/T vehicles	[illegible] for getting components is 12 weeks (this could change by 4 weeks due to Chinese New Year, Jan.). The leadtime to build the ECL's is 11 weeks.

Y-Car ECL Task Team Open Items

	NO.	ISSUE DESCRIPTION	REQUESTER OWNER	START DATE	REPORT DATE	ACTION REQUIRED	ISSUE COMMENTS
	007	Lock Manual Transmission Vehicles in Reverse	D. Hill Team (1)	27SE00	17JA01	1. Determine what it would take to have M/T vehicles lock in reverse	[redacted]
	008	New gear train on Gen II package - development	D. Hill Team (1-9)	04SE00 10OC00 19OC00 20OC10 15NO00 02OC00 19FE01 05MR01 21MY01	10OC00 25OC00 TBD TBD TBD TBD TBD TBD TBD	1. Concept Design complete 2. Concept Validation complete 3. Program Review 4. Prototype Tooling 5. Design Validation 6. Production Tooling 7. Process Capability 8. Product Validation 9. ECL Actuator PPAP	[redacted]

Meeting was cancelled starting 1/24/01. Updates to be covered in weekly CPIT meeting.

CL03-004b-051

Y-Car ECL Task Team Open Items

Y- Car (Corvette) ECL Issues:

Updated: 1/17/01

NO.	ISSUE DESCRIPTION	REQUESTER OWNER	START DATE	REPORT DATE	ACTION REQUIRED	ISSUE COMMENTS
001	ECL durability binding	Team Team (1,2,4,5,6,7) S. Davis (3)	27SE00	On hold	1. Provide 16 DV/PV level ECL Gen II+ parts for GM vehicle level evaluation(10 parts for MPG, 6 parts for electrical lab)	[redacted]
					2. Production Implementation-GenII:	
			27SE00	TBD	Production Tooling - on hold	
			27SE00	TBD	PV testing - on hold	
			27SE00	TBD	PPAP of New ECL - on hold	
			27SE00	TBD	Implementation of New ECL – on hold	
			05NO00	17JA01	3. Determine the effectiveness of the lead angle change w/ new test fixtures and high speed camera	
			15NO00	17JA01	4. Update on parts being built and tested from the L18 array (ECL durability tests)	
			15NO00	17JA01	5. Status update on L18 identified for leadscrew/carrier molding process	
			15NO00	24JA01	6. Status update on L18 identified for casting of the housing	
			15NO00	17JA01	7. Status update on Malalobis Taguchi System (MTS) study	
002	How to override the current ECL for service (A/T vehicles)	D. Hill Hallochak (1,2,3) A. Hinkle (4) Hinkle/Peacy (5) J. Rouleau/ S. Davis (6)	15NO00	17JA01	1. Status of obtaining 4 dual coil latching relay parts from Delphi-P	[redacted]
			15OC00	17JA01	2. Status of relay application approval submitted to Delphi Packard 12/13	
			15NO00	17JA01	3. Status of electrical bench modifications to allow for testing latching relay at different ECL designs (need parts)	
			15NO00	24JA01	4. Labor/time study for dealers to put in latching relay (waiting on part)	
			18DE00	17JA01	5. Verify the time to replace the ECL to ensure it is not too generous	
			15NO00	17JA01	6. Determine best way to retain the lock bolt in the unlocked direction	

CL03-004b-052

Y-Car ECL Task Team Open Items

NO.	ISSUE DESCRIPTION	REQUESTER OWNER	START DATE	REPORT DATE	ACTION REQUIRED	ISSUE COMMENTS
					over life of vehicle	
003	Warranty IPTV data/ return parts	Team E. Finn (1,2) B. Larsen (3)	27SE00 27SE00 27SE00	on going on going on going	1. Provide the latest month of build warranty data 2. Provide customer verbatims on warranty data for the percentage of rebound vs. gear train binding (breakdown of drive-in vs. tow-in) 3. Provide updates of all model year part returns	
004	Robustness Improvements and further "Deep Dive" analysis	Team T. Willette (1,2) D. Thurber (3,4)	30OC00 03NO00 03NO00 03NO00	17JA01 17JA01 31JA01 31JA01	1. Update on segregating parts w/ lowest switch point (after 2-week trial period) 2. Update on on-going reliability testing (12 pieces/two wks, 7000 cycles) 3. Update on production process for a heat stake operation added to the terminal disk (PPAP 02MR01) 4. Update on proposed change to thermal deburr for casting as	

CL03-004b-053

Y-Car ECL Task Team Open Items

NO.	ISSUE DESCRIPTION	REQUESTER OWNER	START DATE	REPORT DATE	ACTION REQUIRED	ISSUE COMMENTS
					opposed to tumble deburr (PPAP 23DE01)	
005	Voltage reduction and time reduction in lock direction	Team J. Rouleau (1) Hallochak (2,3) Gentry/ Hallochak (4)	04OC00 20DE00 04OC00 29NO00	On hold 17JA01 17JA01 17JA01	1. Determine the lowest the voltage would have to drop in order to not bind@ high temp (low test priority) 2. Status of acquiring zener parts 3. Status update on zener testing to reduce voltage (waiting on parts) 4. Status of look-up table idea for determining ECL lock run time	[redacted]
006	Preparation for possible customer satisfaction recall	D. Hill R. Pastor (1)	15NO00	17JA01	1. Determine if Delphi has capacity to produce enough plastic switch breckets if ECL is replaced in A/T vehicles	[redacted]

Y-Car ECL Task Team Open Items

NO.	ISSUE DESCRIPTION	REQUESTER OWNER	START DATE	REPORT DATE	ACTION REQUIRED	ISSUE COMMENTS
007	Lock Manual Transmission Vehicles in Reverse	D. Hill Team (1)	27SE00	17JA01	1. Determine what it would take to have M/T vehicles lock in reverse	[illegible] Team is still looking into this because we cannot use the [illegible] 130 shifter.
008	New gear train on Gen II package - development	D. Hill Team (1-9)	04SE00 10OC00 19OC00 20OC10 15NO00 02OC00 19FE01 05MR01 21MY01	10OC00 25OC00 TBD TBD TBD TBD TBD TBD TBD	1. Concept Design complete 2. Concept Validation complete 3. Program Review 4. Prototype Tooling 5. Design Validation 6. Production Tooling 7. Process Capability 8. Product Validation 9. ECL Actuator PPAP	10OC00 – Concept validation was [illegible] [illegible] experiments will help determine whether the design is [illegible]. It may lead to a Gen II [illegible] [illegible] test.

Meeting was cancelled starting 1/24/01. Updates to be covered in weekly CPIT meeting.

CL03-004b-055

Y-Car Electric Column Lock
Warranty Task Team
Meeting Minutes – 14SE99 & 21SE99

To:	Shilpan Amin Al Adams David Peacy	Eric Finn Jim Rouleau FASCO – Steve Davis	Don Begin Jim Danahy Vince Letosky	Ben Lee
From:	David Lach			
Cc:	Greg Benson Jagir Sooch	Bob Izak Jason Cronkright	Ricardo Pastor	Fermet Lewis

Summary of Findings:

The team has root caused 4 separate failure modes which have shown up in ECL warranty. The IPTV for E7501 (Locking Parts, Strg Col Replace) with 180 days exposure for vehicle build dates of Aug 98 through Jan 99 is approx. 39.0 IPTV.

Root Cause	IPTV Impact (@ 180 days)	Containment	Corrective Action	Verification
1. Floating A-pillar Ground				
2. Bouncy ECL feedback actuator (Nov-98)	+ 7.0 (20%)		Correct tooling, add end of line test 13JA99	
3. ECL microswitch back-off (Sep-99)	+ 1.6 (4%)			
4. Binding in ECL geartrain (Sep-99)	+ 14.8 (38%) Under Worst Case Temp & Voltage			
5. Unknown – unconfirmed	+ > 14.8 (+38%)			

OPEN ISSUES

ECL - Warranty Parts Analysis

Fasco reported on the analysis of the first batch of warranty returned parts.

(24) parts have completed durability testing (at 85°, +14V, and +2,000 cycles). (9) of these parts failed due to binding in the ECL geartrain. These testing conditions are considered to be severe.

12 parts completed Thermal Shock testing. No failures were found

The Fasco end of line tester was modified (week of Sep 6th?) to monitor the feedback switch for a duration after the ECL cycle (allowing the end of line test to catch the ECL 'bounceback' condition). After the modification, all 8 rebound conditions found on the Oscilloscope which were originally NTFs on the end of line tester are now detected as failures. No production failures have been found at this time with the modified EOL tester.

3 ECLs were removed from Milford Proving Ground vehicles for various column lock faults and returned to Fasco for analysis. Vince Latoski had reported an intermittent condition on one of the 3 vehicles (#

1XY62654) where the vehicle failed in the lock mode and 10 minutes later, as the vehicle was to be towed into the garage, the fail to unlock condition went away and the vehicle became driveable. The ECL from this vehicle was confirmed to have a 'bounceback' condition on the Fasco EOL tester at 13V and a bouncy feedback switch . The ECLs from the other 2 Milford vehicles were also tested, one ECL was found to have a bouncy feedback actuator while there was NTF on the other.

To correct the 'bounceback' condition, Fasco will be looking at energy absorbing bearings and a housing support to absorb the ECL motor energy. Analytical models have been used to predict the amount of bounceback in the geartrain.

To correct the geartrain binding condition, Fasco will be looking at high torque motors and material changes in the gears.

ACTION:
1) Provide permanent corrective action plan for 'bounceback condition' – Fasco
2) Provide permanent corrective action plan for geartrain 'binding' condition – Fasco
3) Review Fasco control plan for back drive and binding conditions – Sag Qual

ECL – Design

The ECL geartrain uses covered bearing (NMB) - not sealed. A NYE teflon impregnated grease is used to reduce geartrain wear.

Tom Grace, EICC switch expert, recommends using a rubber encapsulated microswitch to reduce sensitivity to component tolerances.

Dynamic braking cannot be used with the ECL relay. The ECLs creep with > 2V , that's why the relay was added.

ACTION:
1) How are the Omron Switches purchased – distributor or manufacturer? - Fasco
2) Locate GM/MLCG motor expert(s) for involvement/root cause – Al Adams

Vehicle System Root Cause Testing

Due to the high amount of no-trouble-founds in the ECLs returned from warranty, it appears that there are additional system level failures occuring unknown at this time.

A meeting was held on September 9th at MPG involving Al Adams, Vince Letosky, Jim Rousseau, and Dave Lach discussing the options with instrumenting MPG vehicles to detect ECL system level failures.

One vehicle which is currently being driven by Scott Hallopeter will be instrumented with a data logger to record vehicle BCM system states for a hundred + cycles before and after a ECL fault. The ECL from warranty vehicle #27 (NTF) has been re-installed into this vehicle.

A second vehicle will also be fully instrumented to monitor system states under a MPG special test.

Also, the electrical test lab's bench equipment will be used to set-up for a special bench test involving the BCM, ECL, cockpit wiring, and relay. This test will also monitor full system states. (4) of the (7) ECLs from the 2nd batch of warranty parts which all were NTF on the Fasco end of line tester were given to Al Adams for bench testing. The 1st part tested (#201) repeatably exhibited a rebound condition between 550 and 800 cycles within a temperature range of 20°- 40° C. (There is 13 seconds between actuation cycles in the bench set-up.) The remainder of the parts are still to be tested.

Typical ECL voltage is 12.8 V which is indicative of 80% SOC for the vehicle.

ACTION:
1) Set-up MPG vehicle with warranty part #27 with Data Logger – Letosky
2) Provide Saginaw's lab ECL test program for duplication at MLCG – Rouleau
3) Test ECL parts 202-204 to establish failure mode – Ben Lee
4) Set-up MPG special vehicle test – Latoski/Adams/Lach

ECL Relay

Al Adams reported (through Jagir Sooch) that a dealership in Atlanta root caused a vehicle to have a relay failure.

Th relay was introduced during the first week of April 98.

The relay is and Omron relay spec'd at 40 msec before actuation, however, typical actuation occurs at 4-6 msec. The relay used for the ECL is identical to the start enable relay and is located at a similar zone in the vehicle.

ACTION:
1) What are the current, voltage, temperature specs on the relay? – Sooch
2) What is the warranty on the ECL relay? – Finn

Dealership Feedback

Dave Peacy has given the OK to have engineering contacted by the dealership whenever an ECL fault occurs to expedite the root causing efforts. Don Begin will be the primary contact. Jim Rouleau will be the secondary contact on ECL.

ACTION:
1) Provide feedback from dealership service calls/root causing. - Begin

NEXT MEETING: Tuesday, Sept. 28th, 3-5 pm, MLHQ Conf Room 201-25D, Meet Me Line 810-575-1777.

Y-Car ECL Task Team Minutes – 6/27/00

Next Meeting
Tues, July 25th, 3-4, Meet-me-line #888-422-7124; pass code 644250 (NEW #)

Team Members: (* indicates participation in the 6/27/00 meeting)

*Jeremy Mattson (D-S)	*Al Adams (GM)	Dave Peacy (GM)	Jim Danahy (GM)
Shilpan Amin (GM)	*Alan Hinkle (GM)	*Jim Rouleau (D-S)	Surya Chinimilli (GM)
Ricardo Pastor (D-S)	Ben Lee (GM)	Eric Finn (GM)	*Steve Davis (Invensys)
Bob Larsen (D-S)	Steve Loche (D-D)	Tim Willette (Invensys)	*Andy Brenna (GM)
*Dave Lach (D-S)			

ECL Component Issues

1) ECL Rebound

6/27/00: The test report for the SPST relay vs. the SPDT relay has not been submitted to Saginaw, yet.

Action: Provide formal test report for SPST relay versus SPDT relay– S. Davis 6/27 (late)

2) ECL Durability Binding

6/27/00: BCM timing for the ECL in the lock direction is hard coded and would require a software change and validation. Al Adams is pursuing cost and timing. . . . . The ECL Gen II component DFMEA should be submitted to GM after shutdown. . . . . Initial softtool parts of the Gen II design are available but exhibit low quality. The carrier and leadscrew threads exhibit a poor match and the prototype castings require 1 day of machining to make functional.

Provide DV level ECL to GM for noise level review – Rouleau 6/27 (late)
Investigate the impact of reducing the ECL lock direction drive time – S. Loche/Adams 7/25
Determine the ECL GEN II locking "run time" at –40°C – Davis 7/25
Provide the status of the ECL Gen II design development – J. Rouleau 7/25
Provide 16 DV level ECL Gen II parts for GM vehicle level evaluation – S. Davis 7/25
Provide updates to ECL Gen II timeline – J. Rouleau 7/25

- Detail Design with FEA & Stacks	10AP00 – 31MY00	original
	15JN00	complete
- ECL (redesign) DFMEA / PFMEA	04MY00 - 26MY00	original
	- 27JL00	95% complete
- Customer Sample for Noise Eval	02JN00	original
	27JL00	revised
- Production Tooling	25AP00 – 15AU00	????
- DV Testing with full stack variances	15JN00 – 15JL00	
- PV Testing	15AU00 – 25SE00	
- PPAP of New ECL	27SE00	

[redacted]

6) ECL Microswitch Actuator Retention

6/27/00: Implementation status is unknown.

Action: When will the heat staking operation be PPAP'd? – T. Willette 7/27

GM Electrical

[redacted]

9) SPDT Relay

6/13/00: Dennis Gonzalez, Electrical Director, has reviewed the ECL DFMEA and recommended minor modifications.

Action:
Complete SPDT relay vehicle level DFMEA – Brenz/Quality Group 7/27
Track progress of electrical retrofit of development vehicles with SPDT relays – Brenz on-going

[redacted]

Service / Dealership interface

11) Service repair procedures

6/13/00: The exact service action is TBD at this point. The SPDT relay may not be introduced as a service fix. The team is awaiting platform decision on any service action for the summer '00.

Action: Provide ECL service 'action plan' for summer '00 – Brenz/Peacy/Hinkle/Team 7/27
Who would be responsible for writing a service EWO for addition of the SPDT relay–Hinkle 7/27

Warranty

12) Latest (as of 7/1) Month of build IPTV

Action: Provide the latest month of build warranty data – Finn – 8/1

[redacted]

14) Warranty returns

Action: Update warranty chart for the latest returns- Willette 7/27
Provide status of Delphi S warranty evaluations – Larsen 7/27

[redacted]

Misc

[redacted]

Thanks for everyone's participation.

Regards,
Dave Lach
810-756-7762 (8-333-7762)
david.r.lach@gm.com

Y-Car ECL Task Team Minutes – 5/16/00

Next Meeting
Tues, May 30th, 2-3, Meet-me-line #888-221-0133 ; pass code 420832

Team Members: (* indicates participation in the 5/16/00 meeting)

*David Lach (D-S)	Al Adams (GM)	Dave Peacy (GM)	Jim Danahy (GM)
Shilpan Amin (GM)	Service Readiness	*Jim Rouleau (D-S)	Surya Chinimilli (GM)
Ricardo Pastor (D-S)	Ben Lee (GM)	Eric Finn (GM)	*Steve Davis (Invensys)
* Bob Larsen (D-S)	Steve Loche (D-D)	Tim Willette (Invensys)	*Andy Brenna (GM)

ECL Component Issues

1) ECL Rebound

5/23/00: Testing has been completed. File was sent out electronically for reference. The SPDT did lower the mean rebound as well as tighten the distribution of rebound. Testing compared 6 SPDT relay parts with SPST. Parts had gone through 50,000 cycles of testing.

The platform has asked for help in identying the warranty improvements expected with the planned changes. The latest warranty call back analysis indicates that 50% of the warranty vehicles exhibit a 'fail enable' condition, allowing the vehicles to be driven into the dealerships. The rebound occurrence are expected to be a large portion of the 'fail enable' faults. From the testing at Invensys, a rebound% improvement will be calculated for the SPDT relay which then will be compared against the warranty callback analysis to predict an IPTV improvement. Dave and Jim will provide estimates to the team next week.

Action: Provide additional detail for results of SPST relay versus SPDT relay– S. Davis 5/30
Provide IPTV estimate for SPDT relay/loctite screw improvements – Lach/Rouleau 5/30

2) ECL Durability Binding

5/23/00: ECL re-design is on schedule. The remaining detail drawings will be completed by 5/24. Invensys will submit the GEN II ECL DFMEA to Delphi next week for review and approval (along with GM Quality engineering review!).

Noise testing is being scheduled to measure the noise generated by the GEN II ECL during the lock cycle. The noise needs to be evaluated by the platform team as soon as possible (5/2). If the noise is too objectionable, the team could possibly look at lowering the 600 msec BCM cycle time. Possibly 300 msec? However, risks of changing the BCM software need to be considered. ECL testing will need to occur at –40° C to assure that the ECL will always meet the time requirements. Typical production cycle time is 180-200 msec. Cold testing would best come right off of DV testing or a special soak test? However, DV level parts (15JN00) are needed to evaluate design feasability due to the change in thread form.

The typical ECL scope traces were provided to Andy Brenz.

How many DV level ECL parts are req'd for MPG vehicles, early July time frame – 5/30
Provide status of alternate design development (ECL Gen II) – J. Rouleau 5/30
Provide updates to ECL re-design timeline – J. Rouleau 5/30

- Detail Design with FEA & Stacks 10AP00 – 31MY00
- ECL (redesign) DFMEA / PFMEA 04MY00 - 26MY00

- Customer Sample for Noise Eval 02JN00
- Production Tooling 25AP00 – 15AU00
- DV Testing with full stack variances 15JN00 – 15JL00
- PV Testing 15AU00 – 25SE00
- PPAP of New ECL 27SE00

3) Analytical Modeling

5/23/00: The FEA analysis is on hold waiting for the threads to be modeled. The carrier and leadscrew models were sent out to tool shop with the thread form indicated, but the threads weren't modeled, yet.

Action: Complete FEA for Gen II redesign – J. Roulean 6/5/00

[redacted]

7) ECL Microswitch Actuator Retention

5/16/00: Per Andy Brenz, the electrical group will not buy off on the use of loctite inside the ECL. Invensys will investigate heat staking techniques as an alternative.

Action: Continue evaluation of heat staking techniques for securing microswitch – S. Davis 5/30

GM Electrical

[redacted]

9) SPDT Relay

5/16/00: The SPDT relay DFMEA is 95% complete, awaiting Dennis Gonzalez review. In addition, the SPDT will be evaluated electrically in 4 development cars. The Invensys test set-up will be modified to accept all SPDT relays. The SPST relay will still be able to evaluated on bench set-ups at Invensys as needed.

Action:
Complete SPDT relay DFMEA – Brenz/Quality Group 5/30
Set-up electrical evaluation of (4) development vehicles with SPDT relays – 6/5

[redacted]

Service / Dealership Interface

11) Service repair procedures

5/23/00: Service manuals for 2001 have been modified to show SPDT relay. The following (3) service procedures need to be evaluated for best overall customer effectiveness:

1) Replace SPST relays with SPDT relays in '99 + vehicles
2) ECL Gen II Redesign retrofit – October '00
3) Eliminate on ECL on automatic transmission vehicles for service '97 – 00

Action: Develop service procedure for SPDT relay retrofit – Brenz 6/5

Warranty

12) Latest (as of 12/1) Month of build IPTV

Action: Provide the latest month of build warranty data – Finn – 6/1

[redacted]

14) Warranty returns

Action: Update warranty chart for the latest returns- Willette 5/30

[redacted]

Misc

[redacted]

[redacted]

Thanks for everyone's participation.

Regards,
Dave Lach
810-756-7762 (8-333-7762)
david.r.lach@gm.com

Rouleau, Jim

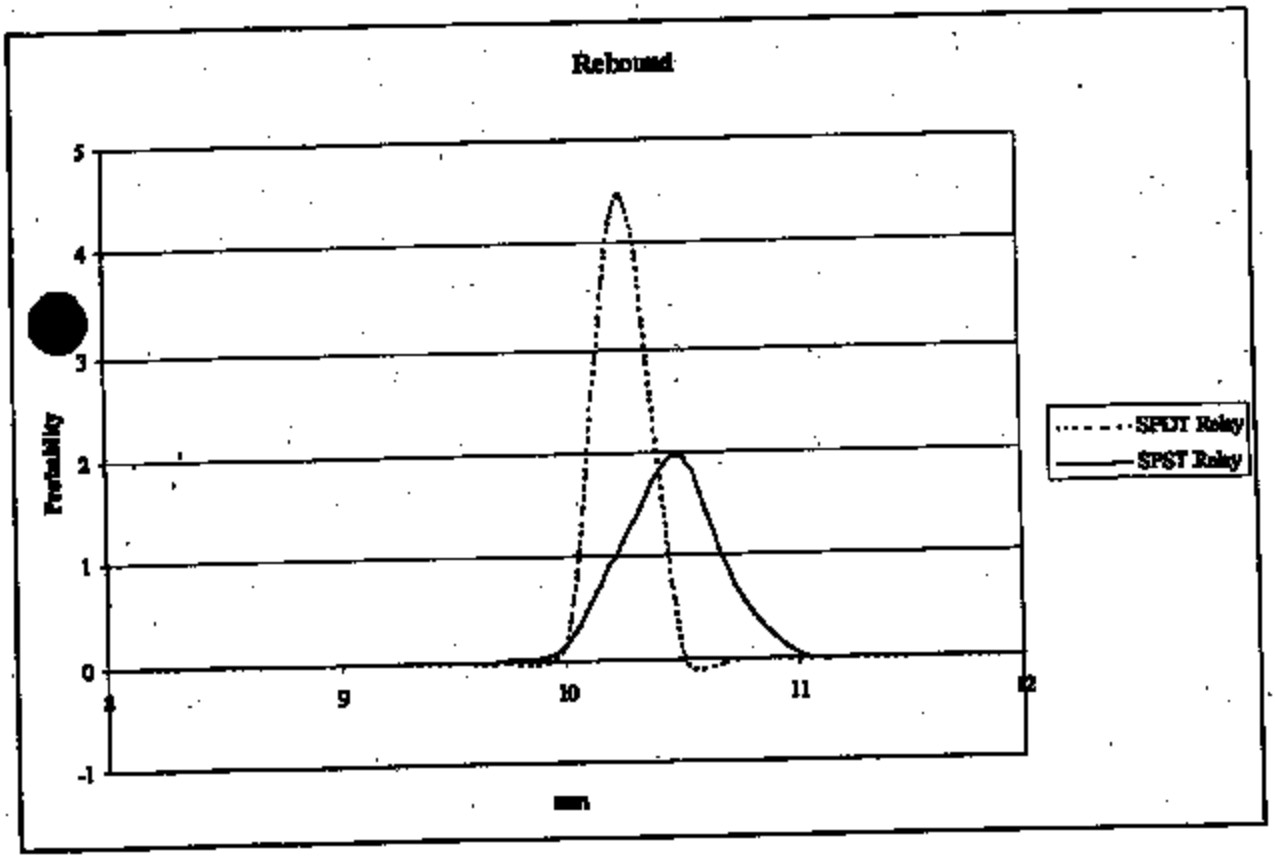
Fr[redacted]
Se[redacted]
To:
Subject:

David R. Lach/US/GM/GMC
Tuesday, May 23, 2000 2:42 PM
Y-car ECL task team
ECL SPDT vs SPST

---------- Forwarded by David R. Lach/US/GM/GMC on 05/23/2000 02:47 PM ----------

To: David R. Lach@US_GM_WRN_MTC01
cc:
Subject: ECL SPDT vs SPST

Attached is a curve taken from 6 pc SPDT and 6 pc SPST. 3 trials each sample. Note that the Standard Deviation of the SPDT
is smaller and the mean is also smaller...
Call with any questions.



CL03-004b-065

Y-Car ECL Task Team Minutes – 4/25/00

Next Meeting
Tues, May 9th, 3-4, Meet-me-line #888-221-0133 ; pass code 420832

Team Members: (* indicates participation in the 4/4/00 meeting)

*David Lach (D-S)	*Al Adams (GM)	Dave Peacy (GM)	Jim Danahy (GM)
Shilpan Amin (GM)	Service Readiness	*Jim Rouleau (D-S)	Surya Chinimilli (GM)
Ricardo Pastor (D-S)	Ben Lee (GM)	Eric Finn (GM)	*Steve Davis (Invensys)
Bob Larsen (D-S)	Steve Loche (D-D)	Tim Willette (Invensys)	*Andy Breese (GM)

ECL Component Issues

1) ECL Rebound

4/25/00: Test is running.
4/18/00: Delphi is working on test methods to propogate failures quickly. The test scheduled to use 4 parts without grease in the geartrain.

Action: Provide findings for 'making' a rebound part – J. Rouleau/S. Davis 5/9

2) ECL Durability Binding

4/25/00: All proof-of-concept parts of new design skipped cycles during a portion of their testing due to not having the lost motion feature. Development parts out of solid with new design will incorporate this feature, timing TBD. The material used in the proof-of-concept parts was not the production material, Carbon Filled Teflon LCP. . . . . All components of the new design have been completed except for the cover and housing – model completed today, 1 day of detailing, approx 2 days behind original timing.

Provide typical ECL scope traces to Andy Breese (ideal vs. non-ideal) – Davis – 3/14 LATE
Provide status of alternate design development (cam-follower) – J. Rouleau 5/9
Provide updates to ECL re-design timeline – J. Rouleau 5/9

- Development samples (machined from solid)
- ECL (redesign) DFMEA
- Customer sample – for review of end-of-travel ratcheting

3) Analytical Modeling

4/18/00: CAD stacks complete for production. Statistical stacks underway based on detail drawings due May 8th.

Action: Provide statistical stack results of current design to Shilpan – J. Rouleau 5/8/00

[redacted]

6) ECL Upstop Screw

4/18/00: Upstop screw loctite is in production starting 4/11/00 - - Service stock should be reworked to use new screw.

Action: Provide status of loctite implementation–estimated BRK PT at Bowling Green -Roulean 5/9

7) ECL Microswitch Actuator Retention

4/25/00: NACG materials group recommends either using hot-melt or loctite (401, Spec 9985976 or 414, Spec 9985337). Z

dasf
4/4/00: Invensys is developing a glue application which would secure the switch actuator (with over molded disc) to the ECL cover. A few warranty parts were found with minor movement of the switch. Outgasing tests were complete with no problems found. There was no affect to the contact resistance. The application area is ¾" away from the switch contact, so with careful application, contamination should not be a problem. Other methods of securing the switch were considered - - - ultrasonic welding has concerns over the focusing of energy, mold changes would be costly and untimely. Zero clamp load is felt to be required for functionality of the ECL – just no lash.

Action: Continue evaluation of glue application to secure the micro-switch to the cover – S. Davis 4/11
Inquire with Electrical TIE about any ill-affects of using glue in ECL – Brenz – 4/11
Inquire with GM Materials group as to any ill-affects of using glue in ECL – Lach 4/11

<u>GM Electrical</u>

8) ESD Lab testing

4/18/00: No updates since last time.
4/4/00: No report at this meeting. Testing is continuing with pre-April 98 parts.

Action:
Set-up time/date for a system level DFMEA analysis of SPDT relay – A. Brenz 4/4
Provide status of testing on MPG pre-April '98 parts # 2-4 – B. Lee 4/4
Perform SIMICAR testing on NTF warranty parts – B. Lee – May 00

9) SPDT Relay

4/25/00: Wiring info to Invensys
4/18/00: 4 relays mailed Friday – 7 on Monday - - when can we get - - - schematic to Invensys - - for technician to wire – power supply in from California - - - KG662 - - timing URGNT / SSF 2001
4/4/00: A DFMEA will be scheduled shortly by the NAO Quality Engineering group to evaluate the SPDT relay, as well as update the DFMEA based upon the lastest lessons learned. . . . Delphi Packard is still in the process of developing a design and quote package for the SPDT relay.

Action: Schedule SPDT relay DFMEA – Brenz/Quality Group 4/11
Provide status on SPDT relay release – Brenz 4/18

[redacted]

Service / Dealership interface

11) Dealership calls to Service Readiness

Action: Who is Don Begin's replacement - D. Peacy 2/1

Warranty

12) Latest (as of 12/1) Month of build IPTV

Action: Provide the latest month of build warranty data – Finn – 4/4

[redacted]

[redacted]

14) Warranty returns

4/18/00: Updated warranty report – summarizes what they have found - - - - a small portion had a switch overmolded movement, all had retention bolt below torque spec, 1/3 –1/4 scuffing of teeth on housing bore - -

Action: Update warranty chart for the latest returns- Willette 4/4

[redacted]

Misc

[redacted]

17) Bowling Green BCL Failures

Action: Provide results of Bowling Green NTF part on data acquisition set-up (with relay) – Willette- 3/14

Thanks for everyone's participation.

Regards,
Dave Lach
810-756-7762 (8-333-7762)
david.r.lach@gm.com

Y-Car ECL Task Team Minutes – 4/18/00

Next Meeting
Tues, April 25th, 3-4, Meet-me-line #888-221-0133 ; pass code 420832

Team Members: (* indicates participation in the 4/4/00 meeting)

*David Lach (D-S)	*Al Adams (GM)	*Dave Peacy (GM)	Jim Danahy (GM)
*Shilpan Amin (GM)	Service Readiness	*Jim Rouleau (D-S)	Surya Chinimilli (GM)
Ricardo Pastor (D-S)	*Ben Lee (GM)	Eric Finn (GM)	*Steve Davis (Invensys)
Bob Larsen (D-S)	Steve Loche (D-D)	Tim Willette (Invensys)	*Andy Brenna (GM)

ECL Component Issues

1) ECL Rebound

4/18/00: Working on testing to propogate failures quickly – test scheduled - - 4 parts without grease
4/04/00: Andy Brenz has asked that efforts be made to make a rebound part by altering the friction of the leadscrew to carrier – partially for validation of the SPDT relay, and partially for a better understanding of root cause.

Action: Provide findings for 'making' a rebound part – J. Rouleau / S. Davis 4/18

2) ECL Durability Binding

4/18/00: scope traces still being worked on - - - - - stacks underway – leadscrew done, lock bolt and carrier complete – now adding in microswitch - looking to make switchpoint clean - - still on target for the 25th to complete stacks - - no feedback from Invensys on testing, on taking apart concept parts, didn't have lost motion in parts – if stack condition , hitting lockplate – can't overcome lockbolt spring - - verify theory, verify failure mode – somewhat anticipated - -
4/04/00: The scope traces had been sent by Invensys, but were not received by Andy Brenz . . . According to the motor suppliers, a ½ speed – high torque motor is not available in the current motor frame size. A two frame size increase need to be package inside the column in order to achieve the desired spec per Craig Huber, Application engineer at Mabuchi. The bigger magnets required to increase the torque would take up the space required to inc . . . . . The cam-follower concept has been followed to design an ECL geartrain which will loose torque at the end of travel (both lock and unlock). The concept requires spring loading the carrier back to re-engage the leadscrew after reversal of torque. Parts could be available for production by august. The goal will be to complete the design work and stacks within a month .... Jim Rouleau and Steve Davis attend a class the past week focusing on cross-axis helical gear geometry. Based upon the information from the seminar, they are confident that the worm-worm gear interface is not causing the problems.

Provide typical ECL scope traces to Andy Brenz (ideal vs. non-ideal) – Davis – 3/14 LATE
Provide status of alternate design development (cam-follower) – J. Rouleau 4/11

3) Analytical Modeling

4/18/00: CAD stacks complete for production, max-min, nominal - - close to nominal - - - statistical stacks underway based on detail drawings – May 8th
4/04/00: Not covered at this meeting

Action: Provide results for parametric analysis of switch event – J. Rouleau 4/4/00

[redacted]

6) ECL Upstop Screw

4/18/00: Upstop screw - - service, rework the service stock - - prevents catastrophic failure - - -

4/04/00: Testing has been completed looking at the testing of upstop screw with loctite. One set of parts was tested without zinc "annealing" operation showing a 28 in-oz retention torque with a st dev of about 3. A second set of parts were tested with "annealing" showing a 22 in-oz retention torque with a st dev of 3. Baseline parts were also evaluated with showed a 22 in-oz retention torque with a 7.18 st dev. No loose parts were found on test. The loctite should be in production by 4/11.

Action: Provide customer approval documents for loctite implementation – Lach 4/11
Provide status of loctite implementation – Willette 4/11

7) ECL Microswitch Actuator Retention

4/4/00: Invensys is developing a glue application which would secure the switch actuator (with over molded disc) to the ECL cover. A few warranty parts were found with minor movement of the switch. Outgasing tests were complete with no problems found. There was no affect to the contact resistance. The application area is ¼" away from the switch contact, so with careful application, contamination should not be a problem. Other methods of securing the switch were considered - - - ultrasonic welding has concerns over the focusing of energy, mold changes would be costly and untimely. Zero clamp load is felt to be required for functionality of the ECL – just no lash.

Action: Continue evaluation of glue application to secure the micro-switch to the cover – S. Davis 4/11
Inquire with Electrical TIE about any ill-affects of using glue in ECL – Brenz – 4/11
Inquire with GM Materials group as to any ill-affects of using glue in ECL – Lach 4/11

<u>GM Electrical</u>

8) ESD Lab testing

4/18/00: No updates since last time.
4/4/00: No report at this meeting. Testing is continuing with pre-April 98 parts.

Action:
Set-up time/date for a system level DFMEA analysis of SPDT relay – A. Brenz 4/4
Provide status of testing on MPG pre-April '98 parts # 2-4 – B. Lee 4/4
Perform SIMICAR testing on NTF warranty parts – B. Lee – May 00

9) SPDT Relay

4/18/00: 4 relays mailed Friday – 7 on Monday - - when can we get - - - schematic to Invensys - - for technician to wire – power supply in from California - - - KG662 - - timing URGNT / SSF 2001
4/4/00: A DFMEA will be scheduled shortly by the NAO Quality Engineering group to evaluate the SPDT relay, as well as update the DFMEA based upon the lastest lessons learned. . . . Delphi Packard is still in the process of developing a design and quote package for the SPDT relay.

Action: Schedule SPDT relay DFMEA – Brenz/Quality Group 4/11
Provide status on SPDT relay release – Brenz 4/18

[redacted]

<u>Service / Dealership interface</u>

11) Dealership calls to Service Readiness

Action: Who is Don Begin's replacement - D. Peacy 2/1

<u>Warranty</u>

12) Latest (as of 12/1) Month of build IPTV

Action: Provide the latest month of build warranty data – Finn – 4/4

[redacted]

[redacted]

14) Warranty returns

4/18/00: Updated warranty report – summarizes what they have found - - - - a small portion had a switch overmolded movement, all had retention bolt below torque spec, 1/3 –1/4 scuffing of teeth on housing bore - -

Action: Update warranty chart for the latest returns- Willette 4/4

[redacted]

<u>Misc</u>

[redacted]

17) Bowling Green ECL Failures

Action: Provide results of Bowling Green NTF part on data acquisition set-up (with relay) – Willette- 3/14

Thanks for everyone's participation.

Regards,
Dave Lach
810-756-7762 (8-333-7762)
david.r.lach@gm.com

Y-Car ECL Task Team Minutes – 4/04/00

Next Meeting
Tues, April 11th, 3-4, Meet-me-line #888-221-0133 ; pass code 420832

Team Members: (* indicates participation in the 4/4/00 meeting)

*David Lach (D-S)	*Al Adams (GM)	*Dave Peacy (GM)	Jim Danahy (GM)
*Shilpan Amin (GM)	Service Readiness	*Jim Rouleau (D-S)	Surya Chinimilli (GM)
Ricardo Pastor (D-S)	*Ben Lee (GM)	Eric Finn (GM)	*Steve Davis (Invensys)
Bob Larsen (D-S)	Steve Locke (D-D)	Tim Willette (Invensys)	*Andy Brenz (GM)

ECL Component Issues

1) ECL Rebound

4/04/00: Andy Brenz has asked that efforts be made to make a rebound part by altering the friction of the leadscrew to carrier – partially for validation of the SPDT relay, and partially for a better understanding of root cause.

Action: Provide findings for 'making' a rebound part – J. Rouleau / S. Davis 4/18

2) ECL Durability Binding

4/04/00: The scope traces had been sent by Invensys, but were not received by Andy Brenz . . . .According to the motor suppliers, a ½ speed – high torque motor is not available in the current motor frame size. A two frame size increase would need to be package inside the column in order to achieve the desired spec per Craig Huber, Application engineer at Maboochi. The bigger magnets required to increase the torque would take up the space required to inc . . . . . The cam-follower concept has been followed to design an ECL geartrain which will loose torque at the end of travel (both lock and unlock). The concept requires spring loading the carrier back to re-engage the leadscrew after reversal of torque. Parts could be available for production by august. The goal will be to complete the design work and stacks within a month …. Jim Rouleau and Steve Davis attend a class the past week focusing on cross-axis helical gear geometry. Based upon the information from the seminar, they are confident that the worm-worm gear interface is not causing the problems.

Provide typical ECL scope traces to Andy Brenz (ideal vs. non-ideal) – Davis – 3/14 LATE
Provide status of alternate design development (cam-follower) – J. Rouleau 4/11

3) Analytical Modeling

4/04/00: Not covered at this meeting

Action: Provide results for parametric analysis of switch event – J. Rouleau 4/4/00

[redacted]

6) ECL Uptop Screw

4/04/00: Testing has been completed looking at the testing of upstop screw with loctite. One set of parts was tested without zinc "annealing" operation showing a 28 in-oz retention torque with a st dev of about 3. A second set of parts were tested with "annealing" showing a 22 in-oz retention torque with a st dev of 3. Baseline parts were also evaluated with showed a 22 in-oz retention torque with a 7.18 st dev. No loose parts were found on test. The loctite should be in production by 4/11.

Action: Provide customer approval documents for loctite implementation – Lach 4/11
Provide status of loctite implementation – Willette 4/11

7) ECL Microswitch Actuator Retention

4/4/00: Invensys is developing a glue application which would secure the switch actuator (with over molded disc) to the ECL cover. A few warranty parts were found with minor movement of the switch. Outgasing tests were complete with no problems found. There was no affect to the contact resistance. The application area is ¼" away from the switch contact, so with careful application, contamination should not be a problem. Other methods of securing the switch were considered - - - ultrasonic welding has concerns over the focusing of energy, mold changes would be costly and untimely. Zero clamp load is felt to be required for functionality of the ECL – just no lash.

Action: Continue evaluation of glue application to secure the micro-switch to the cover – S. Davis 4/11
Inquire with Electrical TIE about any ill-affects of using glue in ECL – Brenz – 4/11
Inquire with GM Materials group as to any ill-affects of using glue in ECL – Lach 4/11

<u>GM Electrical</u>

8) SIMICAR testing

4/4/00: No report at this meeting. Testing is continuing with pre-April 98 parts.

Action:
Set-up time/date for a system level DFMEA analysis of SPDT relay – A. Brenz 4/4
Provide status of testing on MPG pre-April '98 parts # 2-4 – B. Lee 4/4
Perform SIMICAR testing on NTF warranty parts – B. Lee – May 00

9) SPDT Relay

4/4/00: A DFMEA will be scheduled shortly by the NAO Quality Engineering group to evaluate the SPDT relay, as well as update the DFMEA based upon the lastest lessons learned. . . . Delphi Packard is still in the process of developing a design and quote package for the SPDT relay.

Action: Schedule SPDT relay DFMEA – Brenz/Quality Group 4/11
Provide status on SPDT relay release – Brenz 4/18

[redacted]

<u>Service / Dealership Interface</u>

11) Dealership calls to Service Readiness

Action: Who is Don Begin's replacement - D. Peacy 2/1

Warranty

12) Latest (as of 12/1) Month of build IPTV

Action: Provide the latest month of build warranty data – Finn – 4/4

[redacted]

[redacted]

14) Warranty returns

Action: Update warranty chart for the latest returns- Willette 4/4

[redacted]

Misc

[redacted]

17) Bowling Green ECL Failures

Action: Provide results of Bowling Green NTF part on data acquisition set-up (with relay) – Willette- 3/14

Thanks for everyone's participation.

Regards,
Dave Lach
810-756-7762 (8-333-7762)
david.r.lach@gm.com

Jim Rouleau - 4/27/00

F.Y.I

RICARDO

DELPHI
Automotive Systems

memo

Date: April 19, 2000

To: Ann Ried
GM NACG Purchasing

Subject: GMX-215/245/295 Steering Column ECL IPTV Commitments

I am writing to summarize the GMX-215/245/295 steering Column ECL IPTV commitments. IPTV commitments, for the content as sourced, were previously agreed to as part of the original sourcing agreement with GM WWP. The baseline IPTV commitments include the Delphi Steering Systems content only and do not include directed buy components such as the intermediate shaft. The ECL IPTV commitments listed below are in addition to the baseline IPTV as sourced. ECL IPTV commitments throughout the program life are listed below:

Exposure	ECL IPTV
360 Days	5
720 Days	16
1080 Days	28
1440 Days	40

Please contact me on 8-357-4864 if additional information is required.

Mark J. Riepenhoff

Mark J. Riepenhoff
GM NACG Steering Column Program Manager
Delphi Steering Systems

cc: William Jackson
Ricardo Pastor
Dave Vican

CL03-004b-077

Y-Car ECL Task Team Minutes – 3/28/00

Next Meeting
Tues, April 4th, 3-4, Meet-me-line #888-221-0133 ; pass code 420832

Team Members: (* indicates participation in the 3/28/00 meeting)

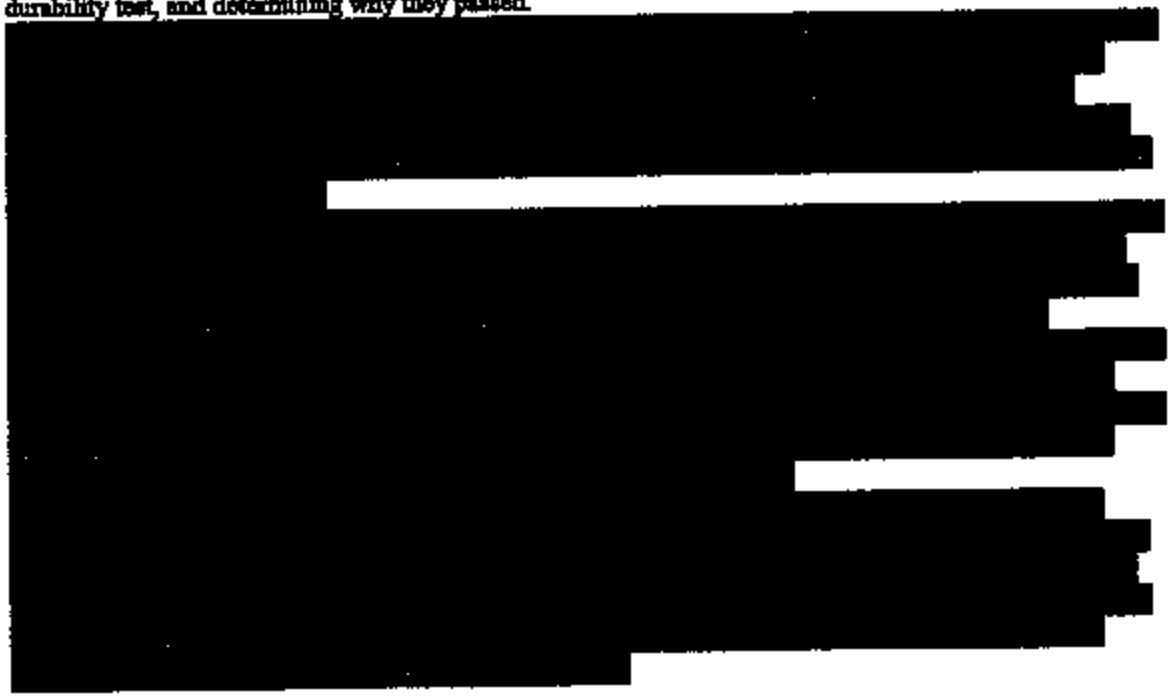
*David Lach (D-S)	Al Adams (GM)	Dave Peacy (GM)	Jim Danahy (GM)
*Shilpan Amin (GM)	Service Readiness TBD	Jim Rouleau (D-S)	Surya Chinimilli (GM)
*Ricardo Pastor (D-S)	Ben Lee (GM)	Eric Finn (GM)	Steve Davis (Invensys)
Bob Larsen (D-S)	Steve Loche (D-D)	Tim Willette (Invensys)	*Andy Brenna (GM)

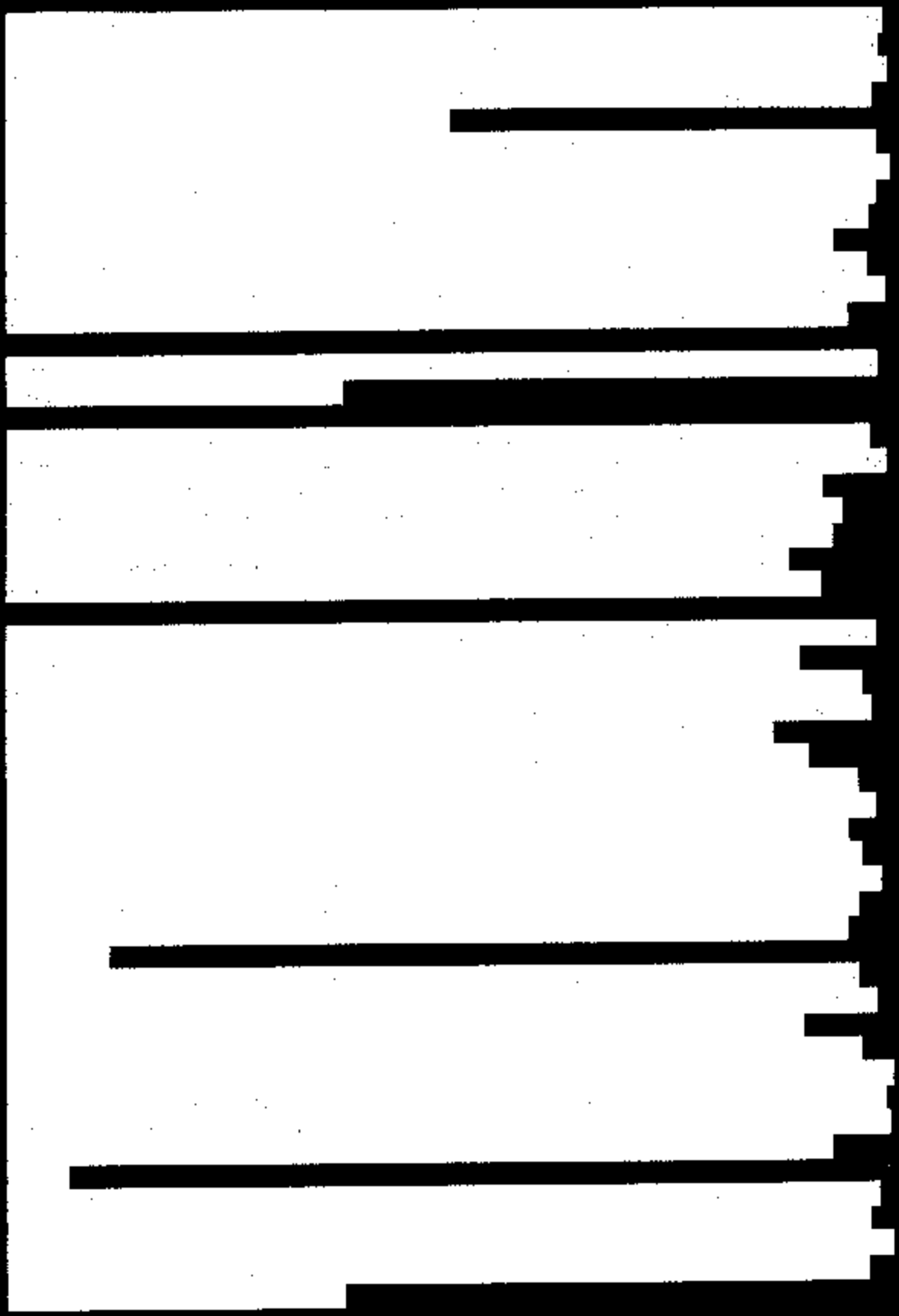
ECL Issues

1) ECL Rebound

8/22/00: Action: Provide formal test report for SPST relay versus SPDT relay– S. Davis 6/27 Complete
-A 3-page test report was distributed to Delphi Saginaw that showed the SPDT did not cause rebounds.

3/28/00: Upstop screw torque tests and change documentation are due by 4/4. VME update is required by the end of the week as to validation test status. Again, the locktite will only prevent the screw from falling out, it will not allow for high clamp force due to creep of the zinc housing. . . . 3/21/00: Upstop screws with loctite are late for MRD of 18MR, but should be available any day to start screw torque manufacturing validation tests. . . . . Gluing of the microswitch actuator to the ELECTRIC COLUMN LOCK cover is being looked at to better prevent the microswitch from moving from it's snapped in position (as seen in a few of the warranty returns). Tests have shown that the microswitch retention force is approximately 2 lbs with the current production design, compared to 27 lbs with adhesive. Out-gasing tests are required to assure that fumes/vapors will not affect switch function. Application of the adhesive would be ½" from the switch contact and would be applied manually at one of the Invensys sub-assembly stations. . . . . John Reimann, Corvette Quality Program Manager, has recommended looking at BOB parts from 24-station durability test, and determining why they passed.





Action: Provide test results for upstop screw (with loctite) and change form – T. Willette / S. Davis 4/4
How much clamp load is required on upstop screw for functionality? - S. Davis 3/14
Provide results of out-gasing tests for microswitch casing glue – S. Davis 4/4

2) ECL Durability Binding:

8/01/00: New ideas to reduce/eliminate noise: 1. Add dampener over springs (hard to find small enough dampeners), 2. Add isolation bushing under screw bearings, 3. Add a switch in lock direction to tell BCM when to shut-off motor.
7/26/00: Gen II ECL noise levels: unlock ~55dB, lock ~60dB, ratcheting ~70dB. Looking into reducing the locking time to 250-300msec instead of 650msec. This is a calibration change. A reduced locking time value would need to be determined.
6/27/00: BCM timing for the ECL in the lock direction is hard coded and would require a software change and validation. Al Adams is pursuing cost and timing. . . . . The ECL Gen II component DFMEA should be submitted to GM after shutdown. . . . . Initial softtool parts of the Gen II design are available but exhibit low quality. The carrier and leadscrew threads exhibit a poor match and the prototype castings require 1 day of machining to make functional.

Investigate reducing the ECL lock direction drive time – S. Loche/Adams 9/27 cancel

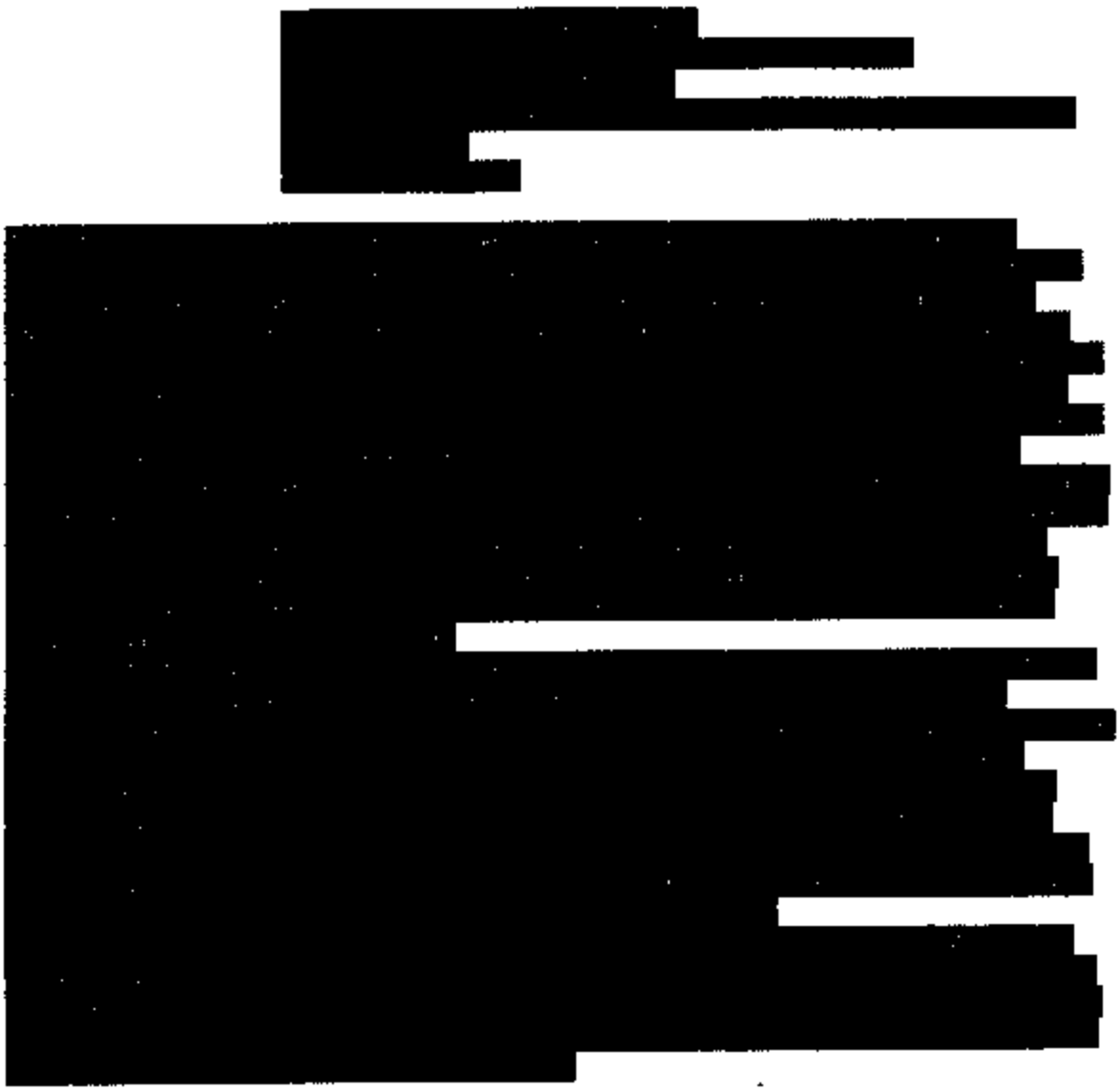
[redacted]

3/21/00: (20) different cam/follower alternate designs have been concepted and evaluated (Pugh Analysis). The cam/follower would replace the worm/worm drive. The cam/follower would allowing varying of speed for the ELECTRIC COLUMN LOCK carrier based upon lock/unlock position and toggle the cam at end of travel, not allowing axial force transmission. A spring would re-engage the follower once motor direction is changed. (2) designs have been chosen for additional study, and are in the process of being detailed and developed.

3/14/00: see below
3/7/00: The high speed camera analysis was completed. The time between 10,000 rpm and 0 rpm - moving with no load to when it hits the wall is 3-4 msec. Further use of the high speed camera will be considered in the future. ..... The load cell has been completed. Better understanding of gear separation force is anticipated next week. . . . The initial 24 parts completed testing with the data acquisition system, 3 did survive, 3 in question, the majority of parts did not pass test, more detailed information will be available next week . . . . . A test order has been written for evaluation of rebound with the elastomeric bumper - - - Viscous clutch development showed to much variability in fluid used . . . . . Other clutch designs show problems (packaging, variablity) which cannot be resolved at this time . . . Centrifugal brake is still understudy – looking for a design company with an expertise . . . . A development test is running at Saginw to add in resistance to motor power circuit at 50% travel – switch trips a relay which adds resistance of 8.2 Ohms) reduces volatge by 5.4 volts - - testing to completed by 3/13. Test being run at 14V in both directions at ambient temperature. Remember, if we decrease the velocity by half, the energy is reduced by $1/4^{th}$. The circuit is set up as a 50/50 split between lock and unlock, so an additional switch needs to be added to the ECL to make the set-up functional . . . . Additional resistor ideas being looked ,

also a zenor diode being looked at - - - A durability test is being run at Invensys at a fixed 9 V (with a voltage regulator) ..... Dave Hill has asked that we re-look at rewinding the motor at an attempt to reduce motor speed . . Mabuchi Motors not interested in business at any price, a quote package will be put together with the motor engineering "wish list"

[redacted]



Action: Provide findings from (24) parts tested with new data acquisition system – Davis – 3/14
Parts evaluation ongoing. Voltage and temperature affects functionality. Data to be complete next week. Controller to 9V does not prevent problem. Clutch slip design would not survive with 9V design. Requires electrical solution to lower power below 9V at impact. 9V required for startup energy. Mechanical design changes within lead screw design eliminates need to limit V. Mechanical design fix would be a long term fix.. Possible implement by end of this year. Possible a system level review of DFMEA with new design to ensure system impact.

Provide typical ECL scope traces to Andy Brenz (ideal vs. non-ideal) – Davis – 3/14
Needs to occur.

Provide test results measuring impact force of leadscrew carrier on ECL bearings – Davis 3/14
200lbs holding with peak impact within 10ms. Seperation force at 6-7lbs.

Provide findings for the measurements of rebound with the elastomeric bumper – Davis – 3/21

Provide findings for centrifugal brake packaging and development testing – Davis – 3/28

Provide findings from external dynamic braking development testing in Saginaw – Rouleau – 3/21

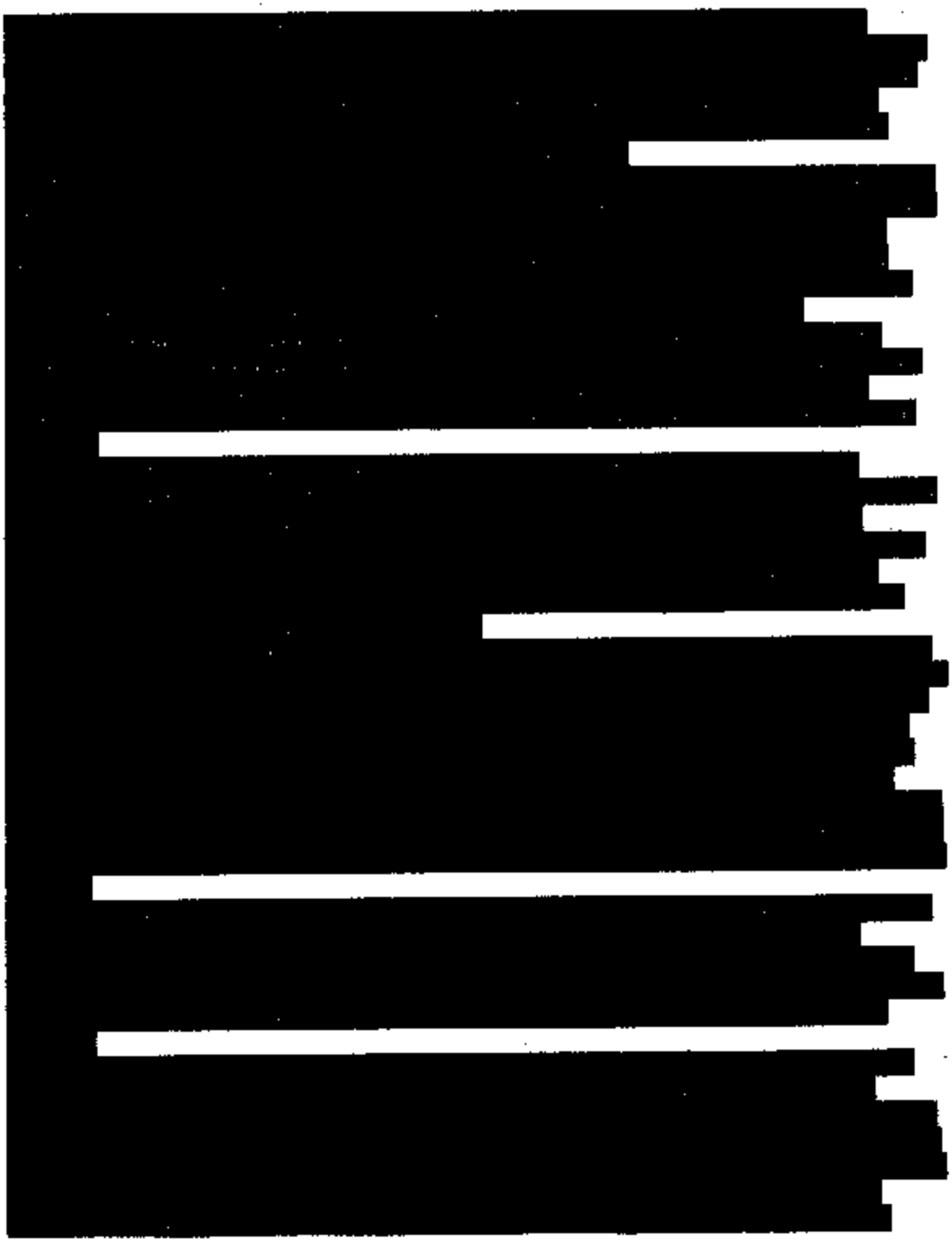
Provide findings from motor testing at a constant 9V – Davis – 3/14
Not feasible. Voltage is not issue, speed has to much impact due to V^2. Requires dramatic reduction to aid module.

- Complete design package for re-winding ECL motor (or re-sourcing with lower speed r'qt) – 3/21

Provide status of alternate design development (cam-follower) – J. Rouleau 4/4

3) Analytical Modeling

3/7/00: Parametric analysis is still on hold - - - The solid model was corrected last week, no FEA results, yet.



[redacted]

Action: Provide findings for parametric analysis of switch event – J. Rouleau 3/21/00
Provide findings of the ECL geartrain analytical vector analysis – J. Rouleau 3/14/00
Studies complete and correlate with measures system. Indicates linear increase with increase torque. Peak torque required. FEA analysis complete. Energy causes overstress of acetyl. More rigid materials causes (i.e. brass) bearing and binding condition transfer.

[redacted]

6) ECL Microswitch Actuator Retention

6/27/00: Implementation status is unknown. Once the Gen II design is validated, this issue will not be necessary or pursued further.

Action: When will the heat staking operation be PPAP'd? – T. Willette 7/27 (On hold)

GM Electrical Lab Testing

6) SIMICAR testing

3/7 Before the SPDT relay goes into production, a full (peer review type) DFMEA needs to be completed, as well as vehicle evaluations and measurements .. . ~~A SPDT relay is in a car now, a higher transient seen, which leads to high AM EMC. Resistive wire to be considered to fine tune braking event.~~ EMC needs to be evaluated versus C5. Torque measurements on ECLs were completed, and all torque values were finger tight low, as expected.

[redacted]

Action: Provide findings of tests comparing a SPST relay to a SPDT relay (rebound parts) – B.Lee 3/14
Part sticks with production relay and would not rebound with new relay with (1) parts. Other parts (2) testing ongoing. Need to find rebound units and verify new relay fixes.

Provide findings from vehicle installation of SPDT relay – A. Brenz 3/14
To be complete next week. Need to quantifiy and radio interference.
Set-up time/date for a system level DFMEA analysis of SPDT relay – A. Brenz 3/14
Participants list required. DFMEA to occur **march 28, 00 from 8-12**
Provide status of testing on MPG pre-April '98 parts # 2-4 – B. Lee April 00
Perform SIMICAR testing on NTF warranty parts – B. Lee – April 00

[redacted]

[redacted]

Service / Dealership interface

[redacted]

[redacted]

Warranty

8) Latest (as of 12/1) Month of build IPTV

[redacted]

Action: Provide the latest month of build warranty data – Finn – Complete

9) [redacted]

[redacted]

[redacted]

[redacted]

Service / Dealership Interface

11) Service repair procedures

6/13/00: The exact service action is TBD at this point. The SPDT relay may not be introduced as a service fix. The team is awaiting platform decision on any service action for the summer '00.

Action: Provide BCL service 'action plan' for summer '00 – Brenz/Peacy/Hinkle/Team 7/27
Who would be responsible for writing a service EWO for addition of the SPDT relay–Hinkle 7/27

11) Warranty returns

2/22/00 – [redacted]

[redacted]

Action: Update warranty chart for the latest returns- Willette 3/21
Describe manufacturing plans to improve micro-switch positioning – Willette 3/21
Determine root cause for switch backing out of cover for small # of warranty parts – Willette 3/21
Parts from Bob Larson to be tracked down with VIN – Rouleau 3/21

12) Vehicle Analysis

[redacted]

Misc

13) Vehicle level Shainin study

[redacted]

Action: Close-out

14) Bowling Green ECL Failures

[redacted]

Action: Provide results of Bowling Green NTF part on data acquisition set-up (with relay) – Willette- 3/14

Thanks for everyone's participation.

Regards,
Dave Lach
810-756-7762 (8-333-7762)
david.r.lach@gm.com

Y-Car ECL Task Team Minutes – 3/7/00

Next Meeting
Tues, Mar 14th, 3-4, Meet-me-line #888-221-0133 ; pass code 420832

(The same meet-me-line has been established for each Tuesday from 3-4 p.m. through June, 2000 – so put it in your planners!)

Team Members: (* indicates participation in the 3/7/00 meeting)

* David Lach (D-S)	* Al Adams (GM)	Dave Peacy (GM)	Jim Danahy (GM)
Shilpan Amin (GM)	Service Readiness TBD	* Jim Roulean (D-S)	Surya Chinimilli (GM)
Ricardo Pastor (D-S)	* Ben Lee (GM)	Eric Finn (GM)	* Steve Davis (Invensys)
Bob Larsen (D-S)	Steve Loche (D-D)	Tim Willette (Invensys)	Andy Brems (GM)

ECL Issues

1) ECL Rebound

3/21/00: 2,000 parts are here this week – just the right thing to do - - carrier for the switch had moved out of position on some unit – loctite testing on the parts – moved under 2 lbs - - 27 lbs after glue, - outgasing test – fumes /vapors affect switch function- low odor glue, normal glue - - application area ½" from switch itself – applied to cover - - - thermal aging - - - - BOB and WOW, why did the good part pass

3/7/00: The BOB and WOW parts have been sectioned . . . . But root cause has been found to be in ACME screw thread back drive equations. According to lead screw designs, anything with coeff friction .28 or less will backdrive – if you get more than .28, you will not be backdrivable – teflon coated carrier, acetal screw, coeff .2 or less. The force that can be held increases as coeff of friction increases. . . . No information of loctite being added to upstop screw. Parts even with loctite will normalize at 300 psi in zinc casting. The loctite will prevent the part from getting looser than 300 psi pressure. Parts with a loctite patch will be expedited – validation plans will include a manufacturing process evaluation of screw torques and capability. . . . . A bank of parts is now running looking at # of cycles to rebound – then the bolt torque to be checked - - - if rebound, tighten back up to see if it rebounds
2/29/00: To complete the BOB / WOW study, the parts with epoxy will be sectioned in an attempt to locate differences. . . . Due to the material properties of zinc, the housing is unable to hold a constant load under the applied upstop screw torque. Zinc will tend to normalize stress at 300 psi. This normalization process typically will take 3-4 days, but can be sped up with heat. 100% of the warranty returns ended up finger tight. An adhesive patch is needed to maintain torque. Also, the question remains, how much clamp force does the component require for functionality.
2/22/00: BOB and WOW parts have been completed – both screw torques were well below spec 50-60 lbs backoff of 25 – 16 in lbs BOB 9 inlbs WOW, no results, Shainin input - - - parts are still on test, humidity and temp, and once backed off to see if zinc creeping....: Per Invensys, calculations have been complete, 2nd set 50% - need ¼" washer to - verify calculated - - - rebound vs # of cycles, as bolt becomes loose, upper bearing is allowed to move, lash additional movement
2/15/00: Torque of upstop bolt is not to spec on the recent batch of warranty returns. In the past, we have seen that looseness of bolt could cause rebound or bind. Root cause is unknown at this time - unsure if zinc casting is creeping or the bolt is just backing off it's torques. Parts are on durability test to help determine root cause. In addition, calculations will be made to determine if the joint torque was designed correctly. Thi s issue hasn't been noticed before in other warranty returns, however, the bolt torque hasn't been measured in previous returns, either. 100% of last warranty returns, 70 out of 70, below bottom of spec,

approximately 20 were considered loose..... BOB and WOW Shainin parts have been verified. A hole will be made in the casting of both the BOB and WOW parts in order for epoxy to be injected into the unit.

2/8/00: (3) WOW parts are available – Jim to take to (1) BOB and WOW verify rebound – fill with liquid epoxy – then tear apart – FE22 for report

2/1/00: Dave Lach will pick up the rebounding ECL from Ben Lee to deliver to Jim Rouleau for use as a WOW part..... Tim Willette has also sent 2 rebound parts from warranty to Saginaw (2/1) for BOB/WOW studies. Ten other rebound parts are available, if needed (out of warranty returns)..... Steve Davis presented the results of the Fasco rebound studies varying current hold time. From the tests, rebound seems to be affected by wear. There was only a very subtle relationship between rebound and pulse length. Also, during testing, it was noted that most rebound occurred at room temp, at elevated temperatures, the rebounding did not repeat. This is contrary to testing in the GM electrical lab.....

1/25/00: Jim Rouleau has requested the two rebound parts from warranty, found by Ben Lee (later sent to Fasco for analysis) be sent from Fasco to Saginaw for use as WOW parts. In addition, 2 of the 3 production units found by Ben Lee to rebound will be delivered to Saginaw for use in the Shainin study. Once the WOW parts are received, the plan is to inject epoxy into one WOW and one BOB part, this will secure the internal ECL components in place, not allowing movement during the disassembly process..... A production run found no difference in rebound among 18 parts..... During disassembly of some of the warranty returns (noted to have rebound), it was noted that some of the lead screws have excessive porosity. To understand the effects of porosity on rebound (and torsional rigidity), Fasco is going to compare leadscrew weight of new, worn, and "warranty returned" leadscrews. Once measurements are complete, the parts will be sectioned to look for porosity..... As mentioned in the minutes last week, testing has been completed comparing rebound versus pulse time. The findings will be summarized in a report by the end of the week. It appears that the new production parts are tighter than parts with cycles on them, possibly explaining a difference in rebound. All parts were all run at room temperature.

1/18/00: Focus will be to look for WOW rebound parts through the latest warranty returns. The design stacks of the ECL microswitch actuator are being re-done. Steve Davis is working through Mark Abby at Delphi S to detail out the stack limits of the microswitch events. In addition, a Omron lever type microswitch is being packaged inside the current ECL housing, which would mount directly to the ECL housing reducing actuator stack-up. The concept is promising, however, needs further development. Fasco has completed testing measuring the variation in ECL lock-bolt rebound height versus electrical 12V pulse length (i.e. 100 ms, 200 ms –current production, 300 ms, 400 ms, 500 ms, and 600 ms). The results will be shared at the 1/25 meeting. SEE GM ELECTRICAL LAB TESTING for vehicle level pulse length studies.

12/7/99: BOB and WOW samples were received, however, not enough variation existed between groups. Green Y is being measured as the difference between bottom out and rebound. Alternate WOW samples will be used from warranty. Review of (2) earlier component search attempts indicates that RED X may be in the crimping operation. Attempts to make a BOB turn into a WOW will be repeated by shimming the upstop - to alter gear tooth engagement.

Action: Provide findings from BOB and WOW sectioned parts - J. Rouleau 3/14
Provide corrective action / timing for housing stop screw loosening – T. Willette / S. Davis 3/14
How much clamp load is required on upstop screw for functionality? - S. Davis 3/14

2) ECL Durability Binding

3/21/00: Involved contract houses to look at cam ideas – trick at end of travel when reversing directions – settle on one by the end of the week – low noise, 50 Hz ratchet, variable thread form – concept selection by the end of the week, design within a month, - - - 188 @ 10v — - finished results of 24 initial parts, do not have any switch failure report - - - - 24 parts analyzed - - -

John Neibold – Lead Reliability Electrical Engineer – column under Doub Berweld, under the current C5 - - DFMEA on c/o vehicles – Dean Matoski- modify DFMEA, fault tree - - maybe next Tues

Package sent out for quote – heard back from Mabocchi – recommended a motor tried before – up two frame sizes to get speed - submit to home office - - - no other sources have responded

Directionally, decreasing the speed will hurt our time to unlock, for 215/245 EZ key, unlocking time latency before starting - - - better sensing of position? Or just switch - - - -

3/7/00: The high speed camera analysis was completed. The time between 10,000 rpm and 0 rpm - moving with no load to when it hits the wall is 3-4 msec. Further use of the high speed camera will be considered in the future. ..... The load cell has been completed. Better understanding of gear separation force is anticipated next week. . . . The initial 24 parts completed testing with the data acquisition system, 3 did survive, 3 in question, the majority of parts did not pass test, more detailed information will be available next week . . . . . A test order has been written for evaluation of rebound with the elastomeric bumper - - - Viscous clutch development showed to much variability in fluid used . . . . . Other clutch designs show problems (packaging, variablity) which cannot be resolved at this time . . . Centrifugal brake is still understudy – looking for a design company with an expertise . . . . A development test is running at Saginw to add in resistance to motor power circuit at 50% travel – switch trips a relay which adds resistance of 8.2 Ohms) reduces volatge by 5.4 volts - - testing to completed by 3/13. Test being run at 14V in both directions at ambient temperature. Remember, if we decrease the velocity by half, the energy is reduced by 1/4th. The circuit is set up as a 50/50 split between lock and unlock, so an additional switch needs to be added to the ECL to make the set-up functional . . . . Additional resistor ideas being looked , also a zenor diode being looked at - - - A durability test is being run at Invensys at a fixed 9 V (with a voltage regulator) ..... Dave Hill has asked that we re-look at rewinding the motor at an attempt to reduce motor speed . . Mabuchi Motors not interested in business at any price, a quote package will be put together with the motor engineering "wish list" - - - - testing with switched off motor didn't pass – 2 out of 2

2/29/0 – The high speed camera will arrive in Saginaw, today. Jim Rouleau will be looking for time duration of impact with the high speed video. . . . . External relays were sent out and received by Invensys. The first set of 24 (mostly) production parts has completed durability testing with the new data acquisition system and are currently being analyzed. Andy Brenz would like to see scope traces. . . . . The load cells (at the bearings) have been received and 80% of the fixture is complete. Load cell data will be available next week. . . . . Engineers USA will not be contracted to develop clutch solutions. UTS will be asked to investigate possibilities instead.

2/22/00: No feedback on high speed camera – Dr. Park could not get any info - - looking primarily for rebound primarily, duration of time from when carrier hits nut to end of travel after rebound — - Data acquisition test set-up complete, 20 relays sent out from Saginaw 2/21 to Invensys – full vehicle logic should be now available - - some failures have occurred with set-up - - -testing both software and new wiring, small programming problems to be solved by today - - - Engineers USA to be brought in to work on a centrigual brake or other clutch designs

2/15/00 – Some high speed video has been run (on a trial basis). The camera will be available again next week for further investigation. Little information was taken during the first running as it was hard to tell a whole lot. The part being used for analysis is the ECL that stuck half way during testing at the GM electrical lab .... Some performacne testing has been started with the new data acquisition system. Awaiting relays from Dave Lach to fully complete test set-up. (24) production parts will be put right on test, when the set-up is completed..... Design complete to house a 2-axis load cell to measure carrier lead screw loading on the leadscrew bearings. The load cells have been ordered, but will take some time to get in. Details for the load cell will be completed by 2/16 – load cells TBD.... Bumper rebound parts not yet started, some data will be available by next week....Still have a problem packaging clutch designs, Jim

Rouleau to look at column impact of extending outside of the current ECL packaging envelope … A centrifugal clutch has been built – works - but clutch size won't allow slippage at end of stroke. Viscous clutches also being considered. A centrifugal brake concept is also being developed. - has a more promissing failure mode than clutch designs. An outside design source is being sought after to design clutch…… … As an alternative solution, packaging of an extra switch is being considered with would turn off power to the ECL and slow the motor towards the end of the carrier travel (external to any BCM software). However, before much can be developed in this area, a load measurement system needs to be completed to evaluate effectiveness (load cell).
2/8/00 – New Kodak camera in on 25th – pictures by the 29th – debugs in process – one station in relay to confirm set-up – tryout other abnormalities – non-sealed connector needed – 6 parts to Fasco - - straingage folks have an impressive web-site, strain-gage into part – lab to look at – normal load cell – need concept yet to hold strain gage, load cell - - - rbound with bumper studies co mplere – tight packaging – concept complete with centrifugal clutch looks good – fine balance point between de-coupling to reduce impact and stall torque – drawings in CAD – viscous coupling - —— mainstream clutch design TBD – need force measurement to quantify improvement
2/1/00: ECL carrier/leadscrew impact force measurements will occur at Fasco. Saginaw/Fasco are dual pathing the building of a fixture to hold the force gage…..The test equipment data acquisition system has been installed and is in the process of being de-bugged…….The high speed camera has not been repaired in Saginaw…….The elastomeric bumper concept has been somewhat dismissed (for solving binding), some improvement were seen in the limited testing, but nothing substantial. The bumper/rebound tests have not been completed, new housings need to be machined up to accept a molded bumper. Engineering judgement of the team is that the bumper will not help rebound - - - - The prioritized action plan to eliminate the geartrain binding is listed below. Focus is being shifted away from an incremental improvements towards a "big fix". The binding problem has been known and worked on for over two years.

<u>Geartrain Bind Action Plan (Prioritized)</u>

1. Obtain carrier impact measurements
2. Utilize a high speed camera to characterize binding event
3. Complete the geartrain simulation
4. Implement data-acquisition system in durability test set-up (@ Invensys)
5. Clutch design
6. Electrical side, ???

1/25/00: Testing has been completed evaluating the bumper design versus current production. (2) production units bound, while (1) bumper part bound at 45,000 cycles. Jim and Steve are still evaluating the risk factors of a slip clutch design and will present a prioritized development plan at next week's meeting……. A slip clutch part has been made and put on test. Half of the test was run in heat. The part is not entirely design intent, however, does demonstrate functionality. Motor stalling was occurring at 9V after 50,000 cycles, which from a functionality standpoint, is promising. Currently, the part has run over 70,000 cycles……. Saginaw's high speed camera is broken which may affect the timing to receive information form the high speed camera analysis. An outside source will be sought to expedite the photography. In addition, Ben Lee will investigate the possibility of using the GM electrical lab to perform the photography……. A load cell is being set-up by Fasco to measure typical carrier impact force inside the ECL. The information will be used in conjuction with the analytical vector analysis……. Test equipment data acquisition is currently being installed at Fasco and is on target for completion by next week. This equipment will be used to monitor the ECL switch events and states throughout durability cycling, similar to the GM SIMICAR setup.
1/18/99: The elastomeric bumper parts were received and put on test first part of January. Fasco's testing equipment (to date) has not been able to monitor switch state through durability testing, however, equipment is on order which will allow data acquisition throughout the durability cycle – due end of Jan 00. Meanwhile, using the original durability test equipment, a test is underway comparing the (pseudo) durability of (5) ECLs with elastomeric bumpers to (6) current production ECLs. The parts are cycled under a constant temperature of 85° C and a voltage of 12V. To date, two production ECLs out of six

failed due to geartrain binding. One ECL with an elastomeric bumper bound and later restarted at 47,000 cycles. A number of clutch designs are being developed as possible design alternatives. In addition, high speed camera analysis will be set-up at Fasco to "detail" the binding event.
12/7/99: New elastomeric bumpers are due in by 12/17. Machined bumper housings have already been completed. New bumpers utilize an energy absorbing material, which is intended to dissipate high impact energy without allowing geartrain to rebound back. Changes will also be made to Fasco's data acquisition methods (used during validation testing) within 2 weeks – current system uses strip chart recorders, which makes it difficult to monitor switch state during testing.

Action: Provide findings from (24) parts tested with new data acquisition system – Davis – 3/14
Provide typical ECL scope traces to Andy Brenz (ideal vs. non-ideal) – Davis – 3/14
Provide test results measuring impact force of leadscrew carrier on ECL bearings – Davis 3/14
Provide findings for the measurements of rebound with the elastomeric bumper – Davis – 4/1
Provide findings for centrifugal brake packaging and development testing – Davis – 3/28
Provide findings from external dynamic braking development testing in Saginaw – Rouleau – 3/21
Provide findings from motor testing at a constant 9V – Davis – 3/14
Complete design package for re-winding ECL motor (or re-sourcing with lower speed r'qt) – 3/21

3) Analytical Modeling

3/21/00: Because of scrapping of part on cast, still looking at cam model, force vector analysis complete, the more energy – bore has been opened up once, not much more material to removed - - - stresses on acetal say it shouldn't live at all - - - CAD model , looking at incremental improvement in switch operation, not all cases build or function properly, tighten or shift tolerances, system robustness – 2 wks – variation analysis

3/7/00: Parametric analysis is still on hold - - - The solid model was corrected last week, no FEA results, yet.

2/29/00: The parametric modeling studies are on hold, waiting for another qualified designer to be assigned to the project. From the studies completed to date, the worm gear interface has been found to be quite robust, with very little change in pitch angle at tolerance extremes. The studies still will attempt to describe the switch event at max material conditions. . . . A para-solid was completed for the vector analysis, but needs to be sent to an outside firm for re-configuring. The initial work will focus on the leadscrew itself, however, the full screw model may be simulated, later.
2/22/00: All the software is now available to do FEA work – all of the modules have been provided to Dr. Park, load cell data will help - – flex of lead screw pitching nut is causing problem, worm/worm probably not the problems, from parametric analysis, under max/min separation not a problem, pressure angle doesn't change much more than 1-2° under shifting, gear interface not likely to bind , bending screw, bending on one side, pulling apart on the other , stopping on upstop (retract – worst case) or casting - - - max/min switch events just started, looking at max/min switch events- results by next week
2/15/00 – Nominal cases for parametric analysis have been modelled (.108 mm) clearance between leadscrew and carrier pitch diameters at nominal case. (.493 mm) clearance at max case. Minimum and current production combinations are to be completed next. ... Some modelling complete with UTS software. The first predictions will include thermal and loading effects (separation of 2 parts under load and temp).
2/8/00 – model for nominal unit is complete – study during tomorrow's visit – next max-min – all production , samples from each cavity – 100% layout of 1 per cavity complete – pitch line separation to be put into gear analysis – from nominal studies, there are some nominal concerns - - Vector analysis modelling has been turned over to Dr. Sur – going through UTS program (familiar) – looking at forces as geartrain separates – "he doubts that the worm gear is binding, expects acme screw to be binding" – binding of the screw is probably due to bending of the leadscrew – stiffer material should bind up right away - - - rebound a torsional windup of the leadscrew

2/1/00: 3-D parametric modelling is nearly complete. Invensys has supplied dimensional information for all the current productional components except for 2 pieces, the housing and the metal upstop. Mark Abby (Saginaw designer) is compiling all of the data for translation into a parametric analysis (mean, max-min, and current production). The analysis will include both the microswitch timing and geartrain interface. Preliminary results will be available early next week..... Gear geometry modelling is underway, UTS software being loaded onto workstation to help with worm-worm design. The modelling will include looking at the teeth separation force as the pitch diameters move apart, as well as a general vector analysis. (The separating forces should go up as the gears move apart, but is it enough to be detrimental to the part?) – Can we look at changing the resistance across the motor? Part of the input circuitry of BCM – Backdrive efficiency

1/25/00: Solid models have been developed to perform the parametric analysis. Currently the designer is working on developing the max/min conditions. Layouts of production parts (best, worst, current production) have been received and will be incorporated into the parametric analysis. The analysis will analyze both the geartrain and switch function. Part families are to be created early next week..... The vector analysis projects is waiting on the leadscrew impact data from Pasco's testing before it can be completed

1/18/99: P.K Park had been out of the office for an extended period since before Christmas break. The analytical model will be worked on with his return. Calculations for a slip-clutch design have been completed. The slip clutch is not feasible for packaging inside the lead screw due to 50x the motor torque requirements inside the lead screw. Before Christmas, failed parts were analyzed to look for any localized lubrication issues. From initial speed calculations, it was determined that standard lubrication should work for this part. The stiffness of the worm gear lead screw material (Acetal) is reduced by ~50% when temperature is increased from room temperature to 85° C, which might explain the problems passing durability testing at high temperatures. Alternate lead screw materials have been pursued in the past, however, the material is somewhat boxed in between the design requirements of the part (energy absorption, stiffness, efficiency, etc...)

12/7/99: P.K. Park from the Delphi S advanced development group is developing an analytical model which will analyze/optimize the current design for geartrain binding. Increased robustness will be sought by altering geartrain geometry (including overlap positioning) and material.

Action: Provide findings for parametric analysis of switch event – J. Rouleau 3/21/00
Provide findings of the BCL geartrain analytical vector analysis – J. Rouleau 3/14/00

4) Containment Testing

12/7/99: Initial testing of 32 parts under limited thermal exposure produced no failures.

Action: Close-out pending further containment action items

5) ECL Rebound Stack information

12/7/99: The stack information was provided early January to Shilpan Amin for inclusion into NHTSA IR response.

Action: Close-out

GM Electrical Lab Testing

6) SIMICAR testing

3/21: Over the past week, 13,000 - 9k (switch actuator failure) , 6 k no failures - — upstop screw – removed screw broke case at 700 cycles - - -- 2mm proud of face, after 800 cycles – 1.7 mm into face - - - continuing pre-April 98 parts - -

SPDT - - - DFMEA completing with „ looked at vehicle from EMC prospective, scope traces show that voltage transient is 1/3 DT relay vs ST relay, sounds the same, only affects during wrap function – not an issue, traces volage and current from pole side of relay, current from back EMF, good data which shows effect - - - Electrical director, Dennis Gonzalez it is the right thing to do, FMEA at 100% completion before final kickoff - - -voltages were are generating, shorting an inductive load, any durability concerns, destructive to contacts, closing a potential high voltage - - - ? to Packard guys - - - just change a few stations

Once Packard has relay # - to Jim Rouleau, then - - - break in time at data acquisition, get relays and new wiring info to them, wire to run double, reliability #s, without arcing going on, burning alloy,

3/7 Before the SPDT relay goes into production, a full (peer review type) DFMEA needs to be completed, as well as vehicle evaluations and measurements ... A SPDT relay is in a car now, a higher transient seen, which leads to high AM EMC - - Resistive wire to be considered to fine tune braking event. EMC needs to be evaluated versus CS. Torque measurements on BCLs were completed, and all torque values were finger tight low, as expected.

2/29/00: Andy Brenz is analyzing a vehicle with a SPDT relay to understand total vehicle impact - AM noise? . . . . . (3) cronic rebound parts, sent from Invensys, were used for comparison of the SPST relay with the SPDT relay. All three parts when tested with a SPST relay had a rebound occur within 1,300 cycles. The first part tested with the SPDT relay completed 20,000 cycles of testing with no rebound, while the 2nd part has completed 10,000 cycles, so far, with no issues. . . . Screw torques on the 3 parts have not been checked, yet.

2/22/00: Ben's on vacation – electrical continuing aditional vehicle level anayvis – to be done in a vehicle – (10) parts Jason Sumpa production parts —- - With (3) in mail, run in normal system, then check with single pole, double throw —- tighten cap screw on known rebound part, can turn on/off? - - - vehicle level evaluation with current prod ECL just to check feasibility -- - - spike using single pole, double throw – already a thick spick without relay or current production, if anything, could be larger — Al to have lab check peak spikes — no issues if less than current

2/15/00: Testing of the first set of production BCLs has been completed. (1) of the cronic rebound parts was evaluated with normal BCM production software and new relay (single pole double throw relay). No failures occurred with the new relay after 10,000 cycles. The intent is to look at using this relay to add a small level of dynamic braking, similar to the pre-April 98 vehicle hardware set-up. There would be no change to the BCM software, just the addition of a new relay and a wire. Soft transients are being seen with this new set-up after the unlock event. Can we add a resistor in-line to filter noise?..... (1) of (10) new production parts were put on test with the developmental software and no problems occurred through 19,000 cycles..... A portion of the warranty jump in April 98 was due to the differences in the vehicle electrical mechanization, which "un-masked" the rebound issue. The rest is probably attributed to the switch actuator quality spill ..... Invensys will send Ben Lee (6) rebound parts from warranty for testing at the GM electrical lab, comparing the current production with the new single pole, double throw relay..... Until the parts are received, Ben will keep on using the production set up to see how many of (10) rebound. From a GM electrical group standpoint, alternative options to reduce rebound include the single pole, double throw relay as a replacement for any BCM software changes.

2/8/00: 12,250 cycles no failures – next part 7,500 cycles before un-locking failure - - Ben does see a bump on the scope (current) bump - probably a voltage spike on the post 98 part

2/1/00: Ben Lee to resend GM Electrical Lab's test summary (LN problems). . . . . Al Adams and Ben Lee are working on development software that changes the way the relays are actuated. The development software reverses the way the relays are actuated, causing the BCM to command an open/ground instead of

an open/open to the ECL motor for 60 msec (then an open/open). One of the 'cronic' rebound parts has been on test for 10,000+ cycles without seeing a rebound condition. A second 'cronic' rebound part will be put on test this evening (2/1). The feasibility of the change has not been determined at this point. There is a concern with closing the external relay under a no-current condition. Al Adams is seeking Delphi Packard advice on this issue. Maybe a different relay? - - - - Electrically, the difference between an ground/open and an open/open should provide only minimal dynamic braking, since the ground impedance is too high to logically affect the motor's characteristics. However, the parts appear to be telling us that there is a difference. Ben Lee will attempt to zoom in on current differences to pin-point the root cause - - - - - The availability of the high speed camera at GM electrical lab is unknown at this point, TBD. - - - - - - Pre April 98 part testing is on-hold until completion of the developmental test mentioned above.
1/25/00: Ben Lee to send out a recent test summary tomorrow (1/26), which will be passed on to the group..... The first MPG pre-April 98 part was run over the weekend, but lab had a shut down. The part had 19,000 cycles on it but no conclusions should be made from the test. The part was run again on Monday night and the stopped tested after 3,000 cycles due to excessive rebound. The part was restarted and stopped a 2nd time after 213 cycles due to excessive rebound. The 2nd MPG pre-April 98 part was put on test and is currently running with 400+ cycles..... Al, Jim, and Steve, had a conversation a few weeks ago discussing the electrical system differences before and after the April 98 relay change. Prior to April 98, one side of the motor received an open (after the unlocking function) while the other side received a high resistance. With the post April 98 system, both sides of the relay receive an open circuit. Their preliminary conclusion was that the pre-April 98 system does provide a slight amount of electrical damping, however, it is probably not a significant factor in the part function. Further discussion on this topic will occur at next week's meeting, after Fasco's rebound height test summary and Ben Lee's SIMICAR test summary are available.
1/18/99: Testing has been completed evaluating the effects of current hold time on rebound. (3) of (4) new parts out of production were made to rebound under varying hold times between 100 ms and 650 ms. (4) parts taken out of Milford Proving Grounds vehicles with ECL build dates prior to April 98 are currently scheduled for testing in an effort to 'validate' the test procedure. Bob Larsen, Delphi SQA, is sending Ben Lee a number of NTF warranty parts for evaluation on the SIMICAR setup.
12/7/99: Production parts # 1-2 (7) were run on the SIMICAR setup with no failures. Baseline parts #3-6 were misplaced. Next parts on test will be parts #1-#4 which were removed from pre-April 98 MPG vehicles.

Action: Provide findings of tests comparing a SPST relay to a SPDT relay (rebound parts) – B.Lee 3/14
Provide findings from vehicle installation of SPDT relay – A. Brenz 3/14
Set-up time/date for a system level DFMEA analysis of SPDT relay – A. Brenz 3/14
Provide status of testing on MPG pre-April '98 parts # 2-4 – B. Lee April 00
Perform SIMICAR testing on NTF warranty parts – B. Lee – April 00

7) ECL temperatures

12/7: Closed – the C5 Corvette will see 160-165° F at the shroud (71-74° C)

<u>Service / Dealership interface</u>

8) Dealership calls to Service Readiness

Action: Who is Don Begin's replacement - D. Peacy 2/1

<u>Warranty</u>

8) Latest (as of 12/1) Month of build IPTV

2/22/00 – Saginaw dealer calls, 81 calls, customer claimed that steering column lock at low speeds, other customer complained at less than 35 mph, happened two times – - get Vin #s and dates to Al, at low speeds 1-2 mph — 2 people complained that steering wheel lock while driving - - - - - 65% of cars between 0-500 miles 15% 15 500-3000, 15% 3000-6000, remainer 6000-7000 —— 40-50 % at 0 miles - - - Dealer in California - - - - 44% of all cars service light only, 32% said column was locked – wouldn't unlcock, 2% said it wouldn't lock when it was suppoesd to lock, 5% stall when shifted, 4% dead battery, 5% wouldn't start, 6% undetermined 81 calls total on 2000 Corvettes
2/1/00: The latest warranty information was provided prior to the meeting. Early 2000 warranty looks good, however, the short exposure time may be deceiving at this point.
1/25/00: The following is a summary of 2000 MY warranty information, projected to 12 MIS at 60% improvement:

Labor Code E7501:
Frequency: 13.91 IPTV
Cost/Car: $3.39

12/7/00: Complete – warranty data is showing a decline in returns – reasons are unclear at this time

Action: Provide the latest month of build warranty data – Finn – Complete

10) Warranty – problem definition tree

2/8/00: Below is a summary of (150) warranty claims throughout the '99 MY for E7501 – Column Lock, Replacement. This information is similar to Eric Finn's earlier information stating a 50/50 drive-in/tow-in ratio.

Complaint	Occurrences
1. Service Column Light Displayed - Fail Enable	82 (55%)
2. Steering Column Locked, Won't Unlock, Won't Start, or Towed into Displayed	48 (32%)
3. Miscellaneous Column - non ECL related	8 (5%)
4. Unclear from information (mostly either 1 or 2)	7 (5%)
5. Miscellaneous Vehicle - non ECL related	3 (2%)
6. Miscellaneous Vehicle - ECL related	2 (1%)
Total	150

2/1/00: Robin Sich, Delphi S Reliability, will be contacted to provide further information on ECL dealership callbacks.

Action: Understand differences between GM information (50/50 split for drive-in/tow-in) and Delphi information (80/20 split favoring drive-in or fail enable fault) – Team 2/1

11) Warranty returns

2/22/00 – No other trends for warranty teardowns. A few parts were found to have a misplaced switch actuator – backed out?. Invensys is looking at ways to permanently fix switch down, heat stake, epoxy, laser weld ?
2/15/00: Invensys is continuing to analyze warranty. Movement of the terminal disc assemblies was seen on a small (3) % of warranty parts – .008-010" Are they backing out due to cycling? Or is it a production issue? Capability info on current production shows no problem - -
2/1/00: The warranty return chart will be updated prior to next week's meeting to include rebound information for the latest returns. 120 parts next week -
1/25/00: Fasco has just received 24 more warranty parts from Saginaw. These parts will be analyzed and logged into the warranty chart prior to the meeting on 2/8..... Eight NTF ECLs from the last batch of warranty returns are being sent to Ben Lee at the GM electrical lab for testing. In addition, most of the NTF warranty parts to date (that are fully intact) are being torn down and dimensionally inspected, focusing on any switch related issues. The warranty lab at Fasco can process 40 parts per week. Approximately (120) parts have been set aside for teardown at this point..... The following summarizes the preliminary evaluations (from Fasco) of the latest (47) warranty returns:

No Trouble Found	60%
Rebound	30%
Actuator Problem	6%
Switch Point Problem	4%

1/18/00 – An additional 47+ returns have been analyzed through Saginaw and Fasco. The majority of parts were NTF – although 10-15 parts exhibited rebound. SEE ATTACHED WARRANTY CHART
12/7/00: Information has been scarce since NACG project ran out – now, Saginaw project has been pulling all of the returns, but only limited information has been made available on the findings

Action: Update warranty chart for the latest returns- Willette 3/14
Describe manufacturing plans to improve micro-switch positioning – Willette 3/14
Determine root cause for switch backing out of cover for small # of warranty parts – Willette 3/14

12) Vehicle Analysis

Action: Continue to search for a vehicle with repeat ECL replacements for potential buy-back by Delphi engineering. - D. Peacy 2/8/00

Misc

13) Vehicle level Shainin study

2/8/00: One part was returned from Bowling Green – unsure of which part - - -
1/18/00: Items will be closed since project appears to be unfeasible at this time.
12/7: Still attempting to locate WOW vehicles for analysis

Action: Close-out

14) Bowling Green ECL Failures

2/29/00 : One of the Bowling Green returned parts were tested at Invensys on the new data acquisition system. It completed 4,200 cycles with no problems. . . . The part will be re-tested now that the relays have been added into the system.

2/15/00: Contaminants were found in 3 ECLs returned from Bowling Green in Nov 99..... The source of the contaminant, water and oil, is unknown. The current design requires grease, which cannot be eliminated.. The next generation ECL could possibly eliminate the grease, possibly with a wiping type contact..... One NTF was returned from Bowling Green (the vehicle fault was not identified on the part) and will be put on the data acquisition system for analysis.
2/1/00: Suresh, Bowling Green electrical quality engineer, is working on (2) more vehicles with ECL faults. One was found to have an ECL with a lock bolt stuck half-way between lock and un-lock. The 2nd vehicle had a fail enable fault (rebound?). The ECL has not been changed yet. - - - - - -Inversys is still waiting for the final report from Omron, to close out the November 99 Bowling Green issue.
1/25/00: There was a bad internal relay in the BCM returned from Bowling Green causing the BCL failure condition. The D72 relay from the BCM was sent back to Siemens for further testing. The part was found to have excessive epoxy run-in. For corrective action, an attribute gage was added to the process to control terminal alignment..... Of the (3) column ECL returns from Bowling Green, 1 of 3 parts had high resistance (self correcting high resistance where the resistance would drop as the part was cycled). The part was sent to Omron for further analysis. Preliminary analysis stated the part appears to be normal. The other two parts checked to be NTF. Subsequently, the parts (all three) were sent to Japan for further analysis.
12/7/00: Bowling Green has had 6 vehicle with ECL failures during the month of November. 4 vehicles exhibited the fail enable condition (1 suspected wire pinch under shrouds and 3 suspected feedback switch issues), 1 vehicle had a hard fail in the BCM, and 1 vehicle was suspected to have a bad external relay (condition fixed itself when the relay was inadvertently dropped).

Action: Provide results of Bowling Green NTF part on data acquisition set-up (with relay) – Willette- 3/14

Thanks for everyone's participation.

Regards,
Dave Lach
810-756-7762 (8-333-7762)
david.r.lach@gm.com

V-Car ECL Task Team Minutes – 2/29/00

Next Meeting
Tues, Mar 6th, 3-4, Meet-me-line #888-221-0133 ; pass code 420931

(The same meet-me-line has been established for each Tuesday from 3-4 p.m. through March 13th, 2000 – so put it in your planners!)

Team Members: (* indicates participation in the 2/29/00 meeting)

* David Lach (D-S)	* Al Adams (GM)	Dave Peacy (GM)	Jim Danahy (GM)
Shilpan Amin (GM)	Service Readiness TBD	* Jim Rouleau (D-S)	* Surya Chinimilli (GM)
Ricardo Pastor (D-S)	Ben Lee (GM)	Eric Finn (GM)	* Steve Davis (Invensys)
Bob Larsen (D-S)	Steve Loche (D-D)	* Tim Willette (Invensys)	* Andy Brenna (GM)

ECL Issues

1) ECL Rebound

2/29/00: To complete the BOB / WOW study, the parts with epoxy will be sectioned in an attempt to locate differences. . . . Due to the material properties of zinc, the housing is unable to hold a constant load under the applied upstop screw torque. Zinc will tend to normalize stress at 300 psi. This normalization process typically will take 3-4 days, but can be sped up with heat. 100% of the warranty returns ended up finger tight. An adhesive patch is needed to maintain torque. Also, the question remains, how much clamp force does the component require for functionality.

[redacted]

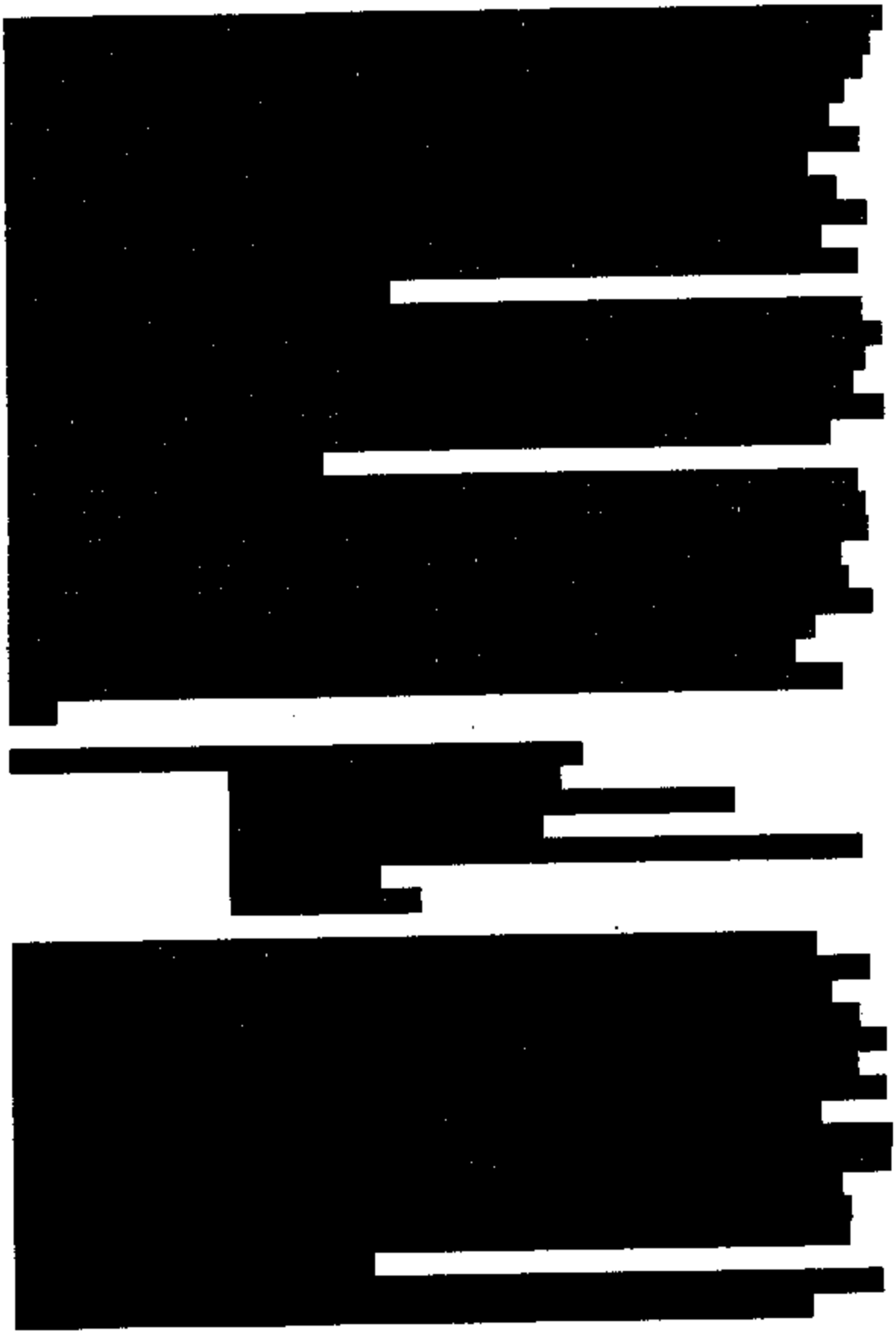
[redacted]

Action: Provide findings from BOB and WOW sectioned parts - J. Rouleau 3/7
Provide corrective action / timing for housing stop screw loosening – T. Willette / S. Davis 3/7
How much clamp load is required on upstop screw for functionality? - S. Davis 3/7
Does a unclamped load help cause a rebound or geartrain bind? – S. Davis 3/14

2) ECL Durability Binding

2/29/0 – The high speed camera will arrive in Saginaw, today. Jim Rouleau will be looking for time duration of impact with the high speed video. . . . . External relays were sent out and received by Invensys. The first set of 24 (mostly) production parts has completed durability testing with the new data acquisition system and are currently being analyzed. Andy Brenz would like to see scope traces. . . . . The load cells (at the bearings) have been received and 80% of the fixture is complete. Load cell data will be available next week. . . . . Engineers USA will not be contracted to develop clutch solutions. UTS will be asked to investigate possibilities instead.

[redacted]



[redacted]

Action: Provide findings from review of parts under "high speed camera" - Rouleau 3/6
Provide findings from (24) parts tested with new data acquisition system – Davis – 3/6
Provide typical ECL scope traces to Andy Brenz (ideal vs. non-ideal) – Davis – 3/6
Provide test results measuring impact force of leadscrew carrier on ECL bearings – Davis 3/6
Provide findings for the measurements of rebound with the elastomeric bumper – Davis – 3/6
Provide findings for clutch packaging and development testing – Davis – 3/6

3) Analytical Modeling

2/29/00: The parametric modeling studies are on hold, waiting for another qualified designer to be assigned to the project. From the studies completed to date, the worm gear interface has been found to be quite robust, with very little change in pitch angle at tolerance extremes. The studies still will attempt to describe the switch event at max material conditions. . . . A pare-solid was completed for the vector analysis, but needs to be sent to an outside firm for re-configuring. The initial work will focus on the leadscrew itself, however, the full screw model may be simulated, later.

[redacted]

[redacted]

Action: Provide findings for parametric analysis of switch event – J. Rouleau 3/13/00
Provide findings of the BCL geartrain analytical vector analysis – J. Rouleau 3/6/00

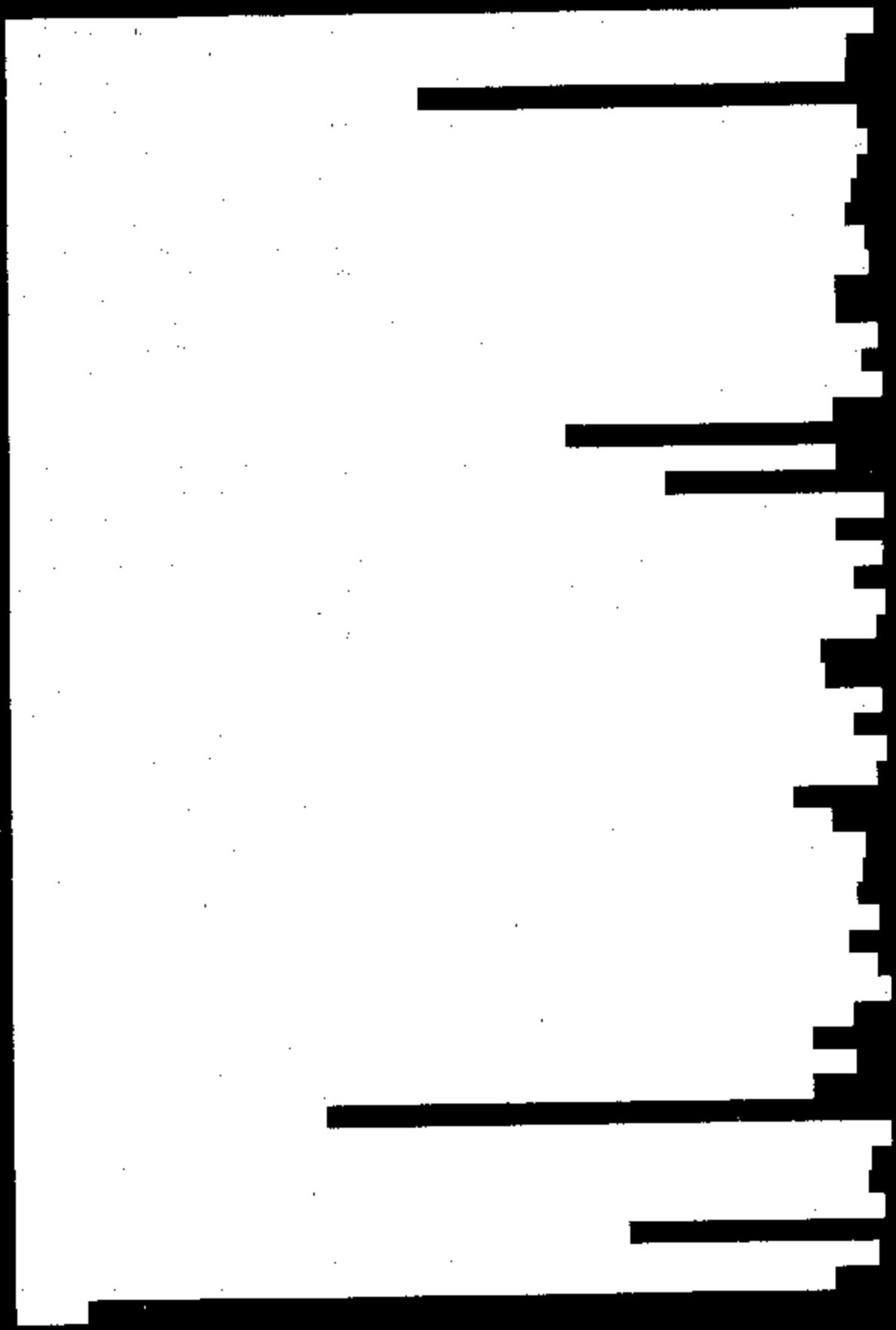
[redacted]

GM Electrical Lab Testing

6) SIMICAR testing

2/29/00: Andy Brenz is analyzing a vehicle with a SPDT relay to understand total vehicle impact - AM noise? . . . . . (3) ozonic rebound parts, sent from Invensys, were used for comparison of the SPST relay with the SPDT relay. All three parts when tested with a SPST relay had a rebound occur within 1,300 cycles. The first part tested with the SPDT relay completed 20,000 cycles of testing with no rebound, while the 2nd part has completed 10,000 cycles, so far, with no issues. . . . Screw torques on the 3 parts have not been checked, yet.

[redacted]



Action: Provide status of tests comparing a SPST relay to a SPDT relay (rebound parts) – B.Lee 3/6
Provide findings from vehicle installation of SPDT relay – A. Brenz 3/6
Measure screw torques on (3) rebound parts (by tightening) – B. Lee 3/6
Provide status of testing on MPG pre-April '98 parts # 2-4 – B. Lee 3/6
Perform SIMICAR testing on NTF warranty parts – B. Lee – 3/13

[redacted]

[redacted]

Service / Dealership Interface

[redacted]

[redacted]

Warranty

8) Latest (as of 12/1) Month of build IPTV

[redacted]

Action: Provide the latest month of build warranty data – Finn – 3/6/00

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

11) Warranty returns

2/22/00 – No other trends for warranty teardowns. A few parts were found to have a misplaced switch actuator – backed out?. Invensys is looking at ways to permanently fix switch down, heat stake, epoxy, laser weld ?

[redacted]

Action: Update warranty chart for the latest returns- Willette 3/6
Describe manufacturing plans to improve micro-switch positioning – Willette 3/6
Determine root cause for switch backing out of cover for small # of warranty parts – Willette 3/6

12) Vehicle Analysis

[redacted]

Misc

13) Vehicle level Shaimin study

[redacted]

Action: Close-out

14) Bowling Green ECL Failures

2/29/00 : One of the Bowling Green returned parts were tested at Invensys on the new data acquisition system. It completed 4,200 cycles with no problems. . . . The part will be re-tested now that the relays have been added into the system.

[redacted]

Action: Provide results of Bowling Green NTF part on data acquisition set-up (with relay) – Willette- 3/6

Thanks for everyone's participation.

Regards,
Dave Lach
810-756-7762 (8-333-7762)
david.r.lach@gm.com

Y-Car ECL Task Team Minutes – 2/22/00

Next Meeting
Tues, Feb 29thd, 3-4, Meet-me-line #888-221-0133 ; pass code 420832

(The same meet-me-line has been established for each Tuesday from 3-4 p.m. through March 14th, 2000 – so put it in your planners!)

Team Members: (* indicates participation in the 2/22/00 meeting)

* David Lach (D-S)	* Al Adams (GM)	Dave Peacy (GM)	Jim Danahy (GM)
Shilpan Amin (GM)	Service Readiness TBD	* Jim Rouleau (D-S)	* Surya Chinimilli (GM)
Ricardo Pastor (D-S)	* Ben Lee (GM)	Eric Finn (GM)	Steve Davis (Invensys)
* Bob Larsen (D-S)	Steve Loche (D-D)	* Tim Willetts (Invensys)	* Andy Brenna (GM)

ECL Issues

1) ECL Rebound

2/22/00: BOB and WOW parts have been completed – both screw torques were well below spec 50-60 lbs backoff of 25 – 16 in lbs BOB 9 inlbs WOW, no results, Shainin input - - - parts are still on test, humidity and temp, and ones backed off to see if zinc creeping…. Per Invensys, calculations have been complete, 2nd set 50% - need ¼" washer to - verify calculated - - - rebound vs # of cycles, as bolt becomes loose, upper bearing is allowed to move, lash additional movement
2/15/00: Torque of upstop bolt is not to spec on the recent batch of warranty returns. In the past, we have seen that looseness of bolt could cause rebound or bind. Root cause is unknown at this time - unsure if zinc casting is creeping or the bolt is just backing off it's torques. Parts are on durability test to help determine root cause. In addition, calculations will be made to determine if the joint torque was designed correctly. Thi s issue hasn't been noticed before in other warranty returns, however, the bolt torque hasn't been measured in previous returns, either. 100% of last warranty returns, 70 out of 70, below bottom of spec, approximately 20 were considered loose….. BOB and WOW Shainin parts have been verified. A hole will be made in the casting of both the BOB and WOW parts in order for epoxy to be injected into the unit.

[redacted]

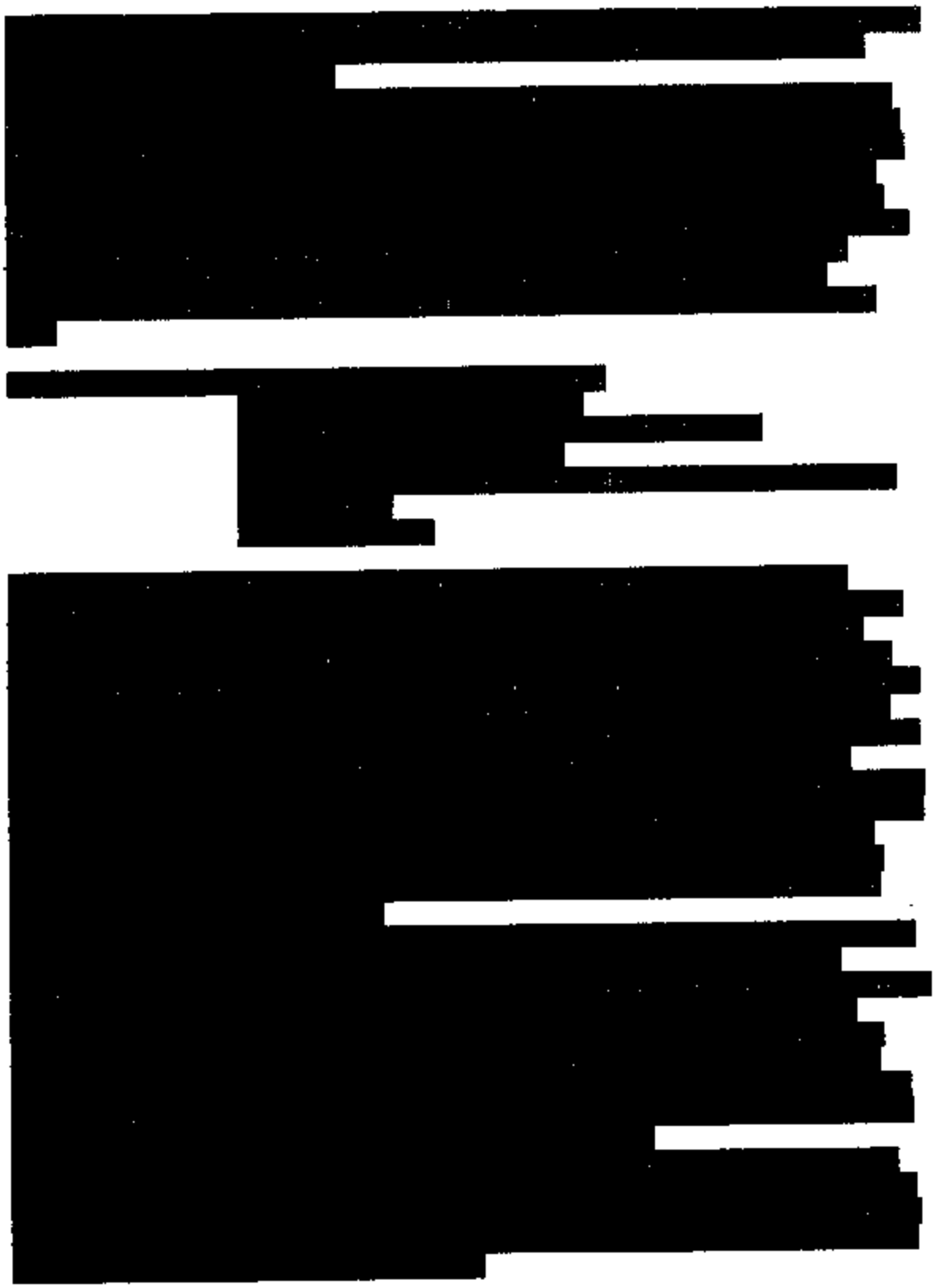
[redacted]

Action: Provide status update of BOB and WOW component search studies - J. Rouleau 2/22
Provide root cause for housing stop screw loosening -- T. Willettes 2/22

2) ECL Durability Binding

2/22/00: No feedback on high speed camera – Dr. Park could not get any info - - looking primarily for rebound primarily, duration of time from when carrier hits nut to end of travel after rebound --- - Data acquisition test et-up complete, 20 relays sent out from Saginaw 2/21 to Invensys – full vehicle logic should be now available - - some failures have occurred with set-up - - -testing both software and new wiring, small programming problems to be solved by today - - - Engineers USA to be brought in to work on a centrigual brake or other clutch designs
2/15/00 – Some high speed video has been run (on a trial basis). The camera will be available again next week for further investigation. Little information was taken during the first running as it was hard to tell a whole lot. The part being used for analysis is the ECL that stuck half way during testing at the GM electrical lab .... Some performacne testing has been started with the new data acquisition system. Awaiting relays from Dave Lach to fully complete test set-up. (24) production parts will be put right on test, when the set-up is completed..... Design complete to house a 2-axis load cell to measure carrier lead screw loading on the leadscrew bearings. The load cells have been ordered, but will take some time to get in. Details for the load cell will be completed by 2/16 – load cells TBD.... Bumper rebound parts not yet started, some data will be available by next week....Still have a problem packaging clutch designs, Jim Rouleau to look at column impact of extending outside of the current ECL packaging envelope ... A centrifugal clutch has been built – works - but clutch size won't allow slippage at end of stroke. Viscous clutches also being considered. A centrifugal brake concept is also being developed. - has a more promising failure mode than clutch designs. An outside design source is being sought after to design clutch..... ... As an alternative solution, packaging of an extra switch is being considered with would turn off power to the ECL and slow the motor towards the end of the carrier travel (external to any BCM software). However, before much can be developed in this area, a load measurement system needs to be completed to evaluate effectiveness (load cell).

[redacted]



Action: Provide findings from review of failed parts under "high speed camera" - Rouleau 2/29
Provide status of data acquisition being added to durability test setup – Davis – 2/22
Provide test results measuring impact force of leadscrew carrier on ECL bearings – Davis 2/29

Provide findings for the measurements of rebound with the elastomeric bumper – Davis – 2/22
Provide/order (30) external relays for testing at Invensys – Lach – 2/22
Provide findings for clutch packaging and development testing – Davis – 2/22

3) Analytical Modeling

2/22/00: All the software is now available to do FEA work – all of the modules have been provided to Dr. Park, load cell data will help - – flex of lead screw pitching nut is causing problem, worm/worm probably not the problems, from parametric analysis, under max/min separation not a problem, pressure angle doesn't change much more thatn 1-2° under shifting, gear interface not likely to bind , bending screw, bending on one side, pulling apart on the other , stopping on upstop (retract – worst case) or casting - - - max/min switch events just started, looking at max/min switch events- results by next week
2/15/00 – Nominal cases for parametric analysis have been modelled (.108 mm) clearance between leadscrew and carrier pitch diameters at nominal case. (.493 mm) clearance at max case. Minimum and current production combinations are to be completed next. ...' Some modelling complete with UTS software. The first predictions will include thermal and loading effects (separation of 2 parts under load and temp).

[redacted]

Action: Provide initial findings from the solid model parametric analysis – J. Rouleau 2/22//00
Provide findings of the BCL geartrain analytical vector analysis – J. Rouleau 2/22/00

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

GM Electrical Lab Testing

6) SIMICAR testing

2/22/00: Ben's on vacation – electrical continuing aditional vehicle level anaysis – to be done in a vehicle – (10) parts Jason Sumpa production parts --- With (3) in mail, run in normal system, then check with single pole, double throw — tighten cap screw on known rebound part, can turn on/off? - - - vehicle level evaluation with current prod ECL just to check feasibility -- - - spike using single pole, double throw – already a thick spick without realy or current production, if anything, could be larger — Al to have lab check peak spikes — no issues if less than current
2/15/00: Testing of the first set of production ECLs has been completed. (1) of the cronic rebound parts was evaluated with normal BCM production software and new relay (single pole double throw relay). No failures occurred with the new relay after 10,000 cycles. The intent is to look at using this relay to add a small level of dynamic braking, similar to the pre-April 98 vehicle hardware set-up. There would be no change to the BCM software, just the addition of a new relay and a wire. Soft transients are being seen with this new set-up after the unlock event. Can we add a resistor in-line to filter noise?..... (1) of (10) new production parts were put on test with the developmental software and no problems occurred through 19,000 cycles..... A portion of the warranty jump in April 98 was due to the differences in the vehicle electrical mechanization, which "un-masked" the rebound issue. The rest is probably attributed to the switch actuator quality spill ..... Invensys will send Ben Lee (6) rebound parts from warranty for testing at the GM electrical lab, comparing the current production with the new single pole, double throw relay..... Until the parts are received, Ben will keep on using the production set up to see how many of (10) rebound. From a GM electrical group standpoint, alternative options to reduce rebound include the single pole, double throw relay as a replacement for any BCM software changes.

[redacted]

[redacted]

Action: Provide test results of current production parts, # of cycles to induce rebound – B.Lee 2/22
Send (6) rebound warranty parts to B. Lee for evaluation of new relay – T. Willette 2/22
Provide status of testing on MPG pre-April '98 parts # 2-4 – B. Lee 3/6
Perform SIMICAR testing on NTF warranty parts – B. Lee – 3/13

[redacted]

[redacted]

Service / Dealership Interface

8) Dealership calls to Service Readiness

Action: Who is Don Begin's replacement - D. Peacy 2/1

Warranty

9) Latest (as of 12/1) Month of build IPTV

[redacted] 65% of cars between 0-500 miles 15% 15 500-3000, 15% 3000-6000, remainer 6000-7000 ----- 40-50 % at 0 miles - - - Dealer in California - - - - 44% of all cars service light only, 32% said column was locked – wouldn't unlock, 2%

said it wouldn't lock when it was supposed to lock, 5% stall when shifted, 4% dead battery, 5% wouldn't start, 6% undetermined 81 calls total on 2000 Corvettes

[redacted]

Action: Provide the latest month of build warranty data – Finn – 3/1/00

[redacted]

11) Warranty returns

2/22/00 – no other trends for warranty teardowns – relaxing into fit or group, manuf looking at ways to permanently fix switch down, heat stake, epoxy, laser weld — -
2/15/00: Inveneys is continuing to analyze warranty. Movement of the terminal disc assemblies was seen on a small (3) % of warranty parts – .008-010" Are they backing out due to cycling? Or is it a production issue? Capability info on current production shows no problem - -

[redacted]

[redacted]

Action: Update warranty chart for the latest returns- Willette 3/6
Provide findings for dimensional layout of NTF warranty parts – Willette 2/22
Determine root cause for switch backing out of cover for small # of warranty parts – Willette 2/22

12) Vehicle Analysis

Action: Continue to search for a vehicle with repeat ECL replacements for potential buy-back by Delphi engineering. - D. Peacy 2/9/00

Misc

13) Vehicle level Shainin study

[redacted]

Action: Can we use the current production "fail enable" car at Bowling Green as a WOW? Swap in and out pre-April 98 components? – Danahy – 2/8

14) Bowling Green ECL Failures

2/22/00 : Bowling Green, 4,200 cycles no problems wait until relays in system
2/15/00: Contaminants were found in 3 ECLs returned from Bowling Green in Nov 99..... The source of the contaminant, water and oil, is unknown. The current design requires grease, which cannot be eliminated. The next generation ECL could possibly eliminate the grease, possibly with a wiping type contact..... One NTF was returned from Bowling Green (the vehicle fault was not identified on the part) and will be put on the data acquisition system for analysis.

[redacted]

[redacted]

Action: Provide status of findings for (2) Jan '00 vehicles at Bowling Green with ECL faults – Danahy 2/8
Provide results of Bowling Green NTF part on data acquisition set-up – Davis 2/29

Thanks for everyone's participation.

Regards,
Dave Lach
810-756-7762 (8-333-7762)
david.r.lach@gm.com

Y-Car ECL Task Team Minutes – 2/15/00

Next Meeting
Tues, Feb 22nd, 3-4, Meet-me-line #888-221-0133 ; pass code 420832

(The same meet-me-line has been established for each Tuesday from 3-4 p.m. through March 14th, 2000 – so put it in your planners!)

Team Members: (* indicates participation in the 2/1/00 meeting)

* David Lach (D-S)	* Al Adams (GM)	Dave Peacy (GM)	Jim Danaby (GM)
Shilpan Amin (GM)	Service Readiness TBD	* Jim Roulean (D-S)	* Surya Chinimilli (GM)
Ricardo Pastor (D-S)	* Ben Lee (GM)	* Eric Finn (GM)	* Steve Davis (Invensys)
Bob Larsen (D-S)	Steve Loche (D-D)	* Tim Willette (Invensys)	

ECL Issues

1) ECL Rebound

2/15/00: Torque of upstop bolt is not to spec on the recent batch of warranty returns. In the past, we have seen that looseness of bolt could cause rebound or bind. Root cause is unknown at this time - unsure if zinc casting is creeping or the bolt is just backing off it's torques. Parts are on durability test to help determine root cause. In addition, calculations will be made to determine if the joint torque was designed correctly. Thi a issue hasn't been noticed before in other warranty returns, however, the bolt torque hasn't been measured in previous returns, either. 100% of last warranty returns, 70 out of 70, below bottom of spec, approximately 20 were considered loose..... BOB and WOW Shimin parts have been verified. A hole will be made in the casting of both the BOB and WOW parts in order for epoxy to be injected into the unit.

[redacted]

[redacted]

Action: Provide status update of BOB and WOW component search studies - J. Rouleau 2/22
Provide root cause for housing stop screw loosening – T. Willettes 2/22

2) ECL Durability Binding

2/15/00 – Some high speed video has been run (on a trial basis). The camera will be available again next week for further investigation. Little information was taken during the first running as it was hard to tell a whole lot. The part being used for analysis is the ECL that stuck half way during testing at the GM electrical lab .... Some performance testing has been started with the new data acquisition system. Awaiting relays from Dave Lach to fully complete test set-up. (24) production parts will be put right on test, when the set-up is completed..... Design complete to house a 2-axis load cell to measure carrier lead screw loading on the leadscrew bearings. The load cells have been ordered, but will take some time to get in. Details for the load cell will be completed by 2/16 – load cells TBD.... Bumper rebound parts not yet started, some data will be available by next week....Still have a problem packaging clutch designs, Jim Rouleau to look at column impact of extending outside of the current ECL packaging envelope ... A centrifugal clutch has been built – works - but clutch size won't allow slippage at end of stroke. Viscous clutches also being considered. A centrifugal brake concept is also being developed. - has a more promising failure mode than clutch designs. An outside design source is being sought after to design clutch.... ... As an alternative solution, packaging of an extra switch is being considered with would turn off power to the ECL and allow the motor towards the end of the carrier travel (external to any BCM software). However, before much can be developed in this area, a load measurement system needs to be completed to evaluate effectiveness (load cell).

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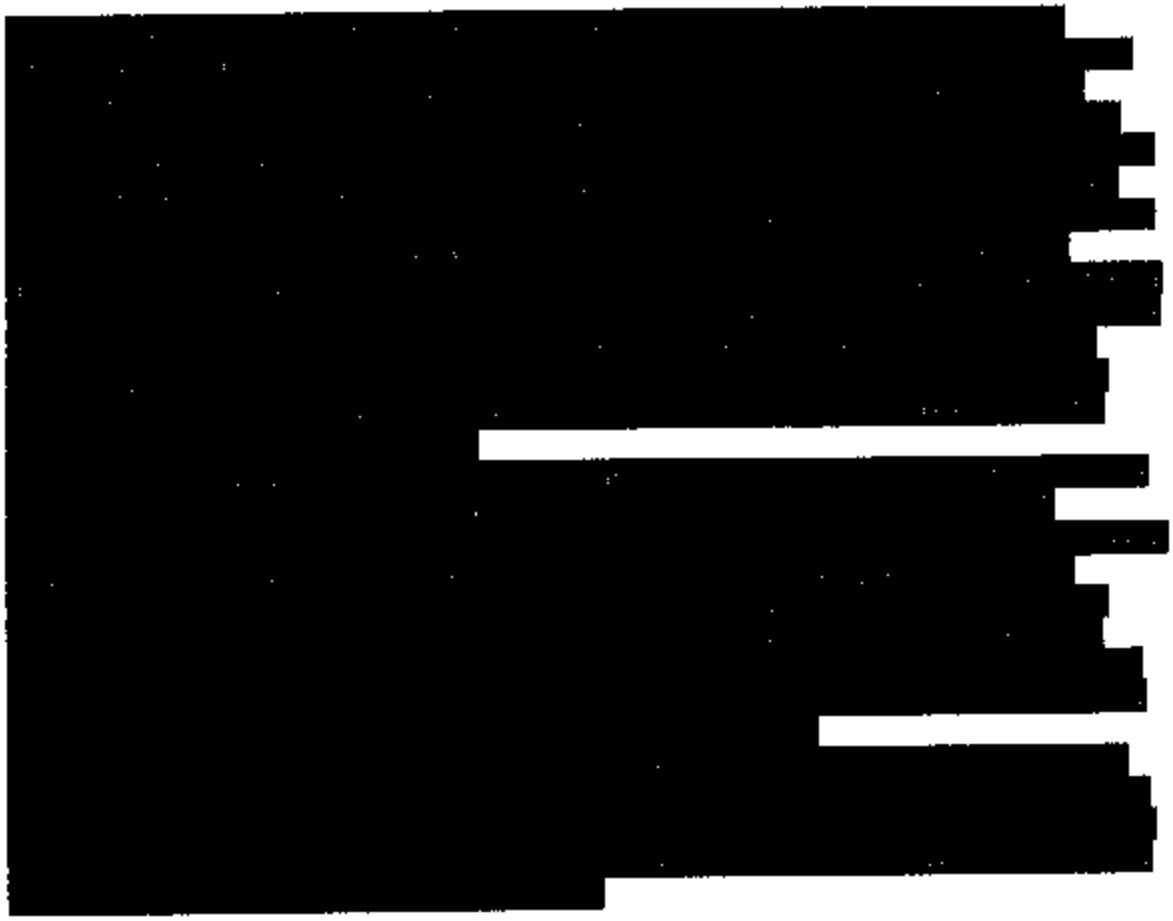

Action: Provide findings from review of failed parts under "high speed camera" - Rouleau 2/29
Provide status of data acquisition being added to durability test setup – Davis – 2/22
Provide test results measuring impact force of leadscrew carrier on ECL bearings – Davis 2/29
Provide findings for the measurements of rebound with the elastomeric bumper – Davis – 2/22
Provide/order (30) external relays for testing at Invensys – Lach – 2/22
Provide findings for clutch packaging and development testing – Davis – 2/22

3) Analytical Modeling

2/15/00 – Nominal cases for parametric analysis have been modelled (.108 mm) clearance between leadscrew and carrier pitch diameters at nominal case. (.493 mm) clearance at max case. Minimum and current production combinations are to be completed next. … Some modelling complete with UTS software. The first predictions will include thermal and loading effects (separation of 2 parts under load and temp).

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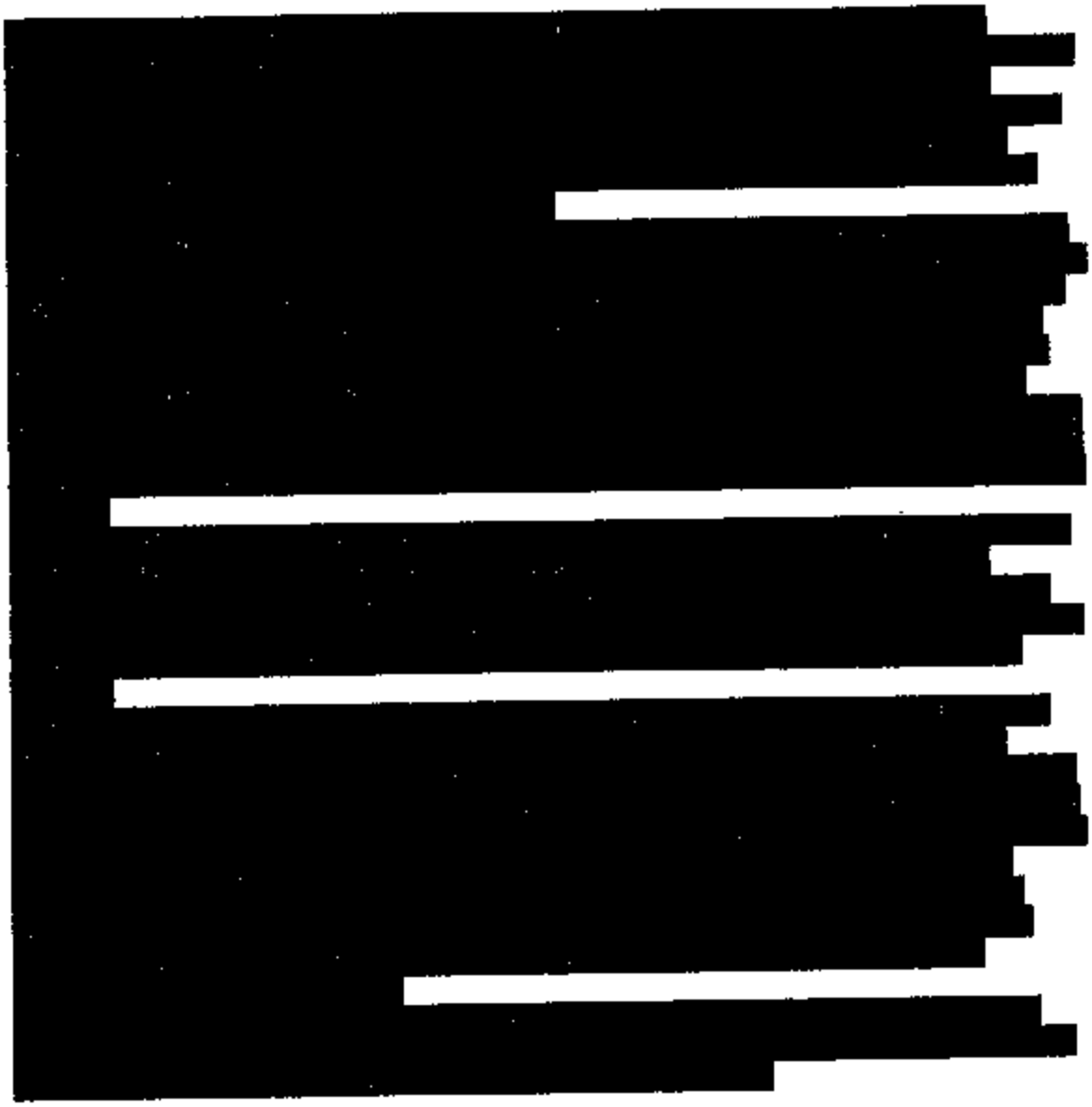


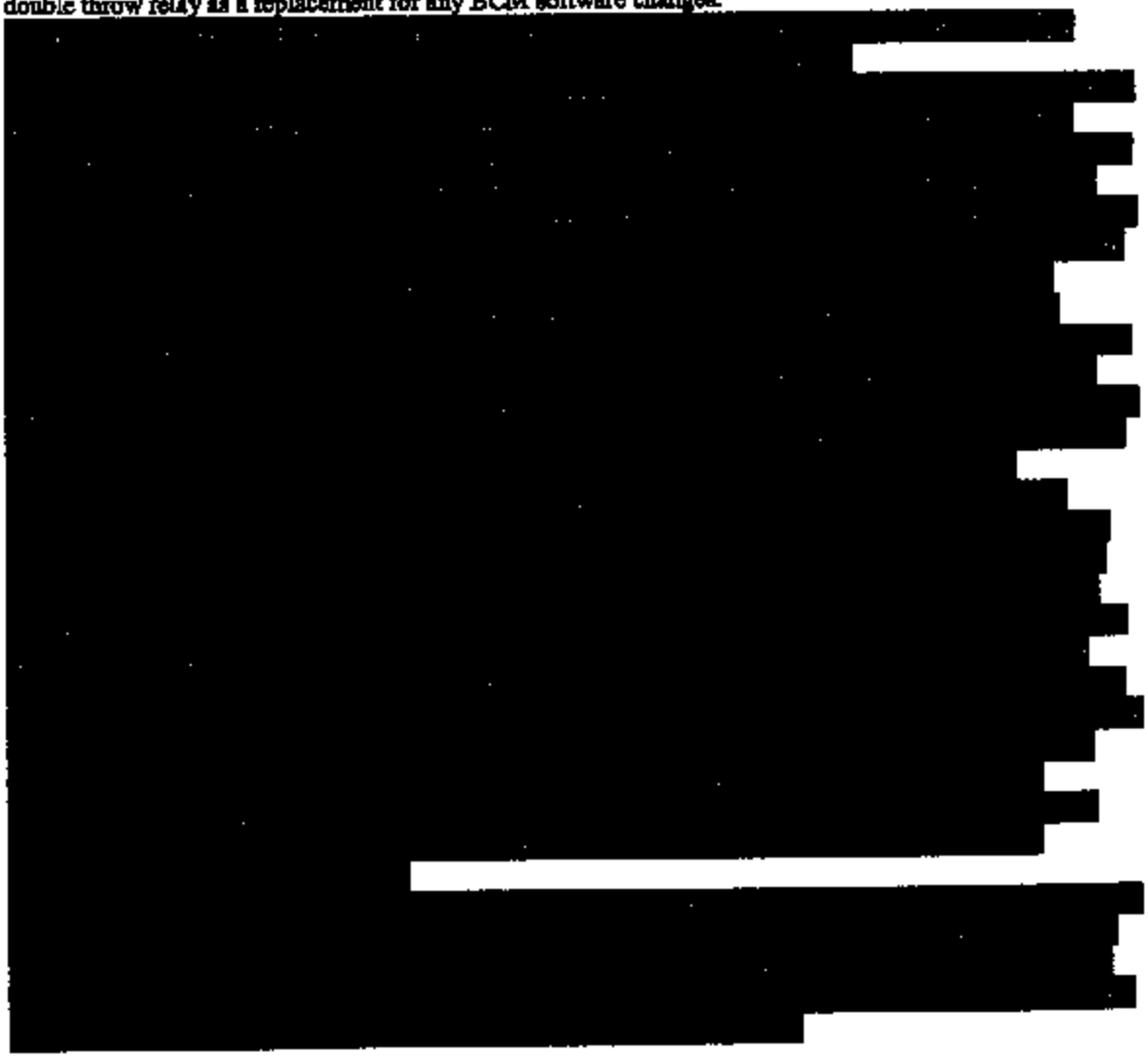
Action: Provide initial findings from the solid model parametric analysis – J. Rouleau 2/22/00
Provide findings of the ECL geartrain analytical vector analysis – J. Rouleau 2/22/00

[redacted]

GM Electrical Lab Testing

6) SIMICAR testing

2/15/00: Testing of the first set of production ECLs has been completed. (1) of the cronic rebound parts was evaluated with normal BCM production software and new relay (single pole double throw relay). No failures occurred with the new relay after 10,000 cycles. The intent is to look at using this relay to add a small level of dynamic braking, similar to the pre-April 98 vehicle hardware set-up. There would be no change to the BCM software, just the addition of a new relay and a wire. Soft transients are being seen with this new set-up after the unlock event. Can we add a resistor in-line to filter noise?..... (1) of (10) new production parts were put on test with the developmental software and no problems occurred through 19,000 cycles..... A portion of the warranty jump in April 98 was due to the differences in the vehicle electrical mechanization, which "un-masked" the rebound issue. The rest is probably attributed to the switch actuator quality spill ..... Invensys will send Ben Lee (6) rebound parts from warranty for testing at the GM electrical lab, comparing the current production with the new single pole, double throw relay..... Until the parts are received, Ben will keep on using the production set up to see how many of (10) rebound. From a GM electrical group standpoint, alternative options to reduce rebound include the single pole, double throw relay as a replacement for any BCM software changes.



[redacted]

Action: Provide test results of current production parts, # of cycles to induce rebound – B.Lee 2/22
Send (6) rebound warranty parts to B. Lee for evaluation of new relay – T. Willette 2/22
Provide status of testing on MPG pre-April '98 parts # 2-4 – B. Lee 3/6
Perform SIMICAR testing on NTF warranty parts – B. Lee – 3/13

[redacted]

Service / Dealership interface

8) Dealership calls to Service Readiness

Action: Who is Don Begin's replacement - D. Peacy 2/1

Warranty

9) Latest (as of 12/1) Month of build IPTV

[redacted]

Action: Provide the latest month of build warranty data – Finn – 3/1/00

[redacted]

[redacted]

11) Warranty returns

2/15/00: Invensys is continuing to analyze warranty. Movement of the terminal disc assemblies was seen on a small (3) % of warranty parts – .008-010" Are they backing out due to cycling? Or is it a production issue? Capability info on current production shows no problem

[redacted]

Action: Update warranty chart for the latest returns- Willette 3/6
Provide findings for dimensional layout of NTF warranty parts – Willette 2/22
Determine root cause for switch backing out of cover for small # of warranty parts – Willette 2/22

12) Vehicle Analysis

Action: Continue to search for a vehicle with repeat ECL replacements for potential buy-back by Delphi engineering. - D. Peacy 2/8/00

Misc

13) Vehicle level Shainin study

[redacted]

Action: Can we use the current production "fail enable" car at Bowling Green as a WOW? Swap in and out pre-April 98 components? – Danahy – 2/8

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2/15/00: Contaminants were found in 3 ECLs returned from Bowling Green in Nov 99….. The source of the contaminant, water and oil, is unknown. The current design requires grease, which cannot be eliminated. The next generation ECL could possibly eliminate the grease, possibly with a wiping type contact….. One NTF was returned from Bowling Green (the vehicle fault was not identified on the part) and will be put on the data acquisition system for analysis.

[redacted]

Action: Provide status of findings for (2) Jan '00 vehicles at Bowling Green with ECL faults – Danahy 2/8
Provide results of Bowling Green NTF part on data acquisition set-up – Davis 2/29

Thanks for everyone's participation.

Regards,
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810-756-7762 (8-333-7762)
david.r.lach@gm.com

Y-Car ECL Task Team Minutes – 2/8/00

Next Meeting
Tues, Feb 8th, 3-4, Meet-me-line #888-221-0133 ; pass code 420832

(The same meet-me-line has been established for each Tuesday from 3-4 p.m. through March 14th, 2000 – so put it in your planners!)

Team Members: (* indicates participation in the 1/25/00 meeting)

* David Lach (D-S)	* Al Adams (GM)	Dave Peacy (GM)	* Jim Danahy (GM)
* Shilpan Amin (GM)	Service Readiness TBD	* Jim Rouleau (D-S)	Surya Chinimilli (GM)
* Ricardo Pastor (D-S)	* Ben Lee (GM)	Eric Finn (GM)	* Steve Davis (Fasco)
* Bob Larsen (D-S)	* Steve Loche (D-D)	* Tim Willette (Fasco)	

ECL Issues

1) ECL Rebound

2/8/00: (3) WOW parts are available – Jim to take to (1) BOB and WOW verify rebound – full of liquid epoxy – then tear apart – FE22 for report
2/1/00: Dave Lach to pick the part from Ben – Tim W sent 2 parts to Sag – 10 others available if needed (out of warranty returens). From the Fasco studies – rebound seems to be affected by wear – very subtle rebound for pulse length – at room temp,m lab stuff rebounded – at temp it did not repeat – warranty chart to be updated with rebound height – this week – by Friday
1/25/00: Jim Rouleau has requested the two rebound parts from warranty, found by Ben Lee (later sent to Fasco for analysis) be sent from Fasco to Saginaw for use as WOW parts. In addition, 2 of the 3 production units found by Ben Lee to rebound will be delivered to Saginaw for use in the Shainin study. Once the WOW parts are received, the plan is to inject epoxy into one WOW and one BOB part, this will secure the internal ECL components in place, not allowing movement during the disassembly process..... A production run found no difference in rebound among 18 parts..... During disassembly of some of the warranty returns (noted to have rebound), it was noted that some of the lead screws have excessive porosity. To understand the effects of porosity on rebound (and torsional rigidity), Fasco is going to compare leadscrew weight of new, worn, and "warranty returned" leadscrews. Once measurements are complete, the parts will be sectioned to look for porosity..... As mentioned in the minutes last week, testing has been completed comparing rebound versus pulse time. The findings will be summarized in a report by the end of the week. It appears that the new production parts are tighter than parts with cycles on them, possibly explaining a difference in rebound. All parts were all run at room temperature.
1/18/00: Focus will be to look for WOW rebound parts through the latest warranty returns. The design stacks of the ECL microswitch actuator are being re-done. Steve Davis is working through Mark Abby at Delphi S to detail out the stack limits of the microswitch events. In addition, a Omron lever type microswitch is being packaged inside the current ECL housing, which would mount directly to the ECL housing reducing actuator stack-up. The concept is promising, however, needs further development. Fasco has completed testing measuring the variation in ECL lock-bolt rebound height versus electrical 12V pulse length (i.e. 100 ms, 200 ms –current production, 300 ms, 400 ms, 500 ms, and 600 ms). The results will be shared at the 1/25 meeting. SEE GM ELECTRICAL LAB TESTING for vehicle level pulse length studies.
12/7/99: BOB and WOW samples were received, however, not enough variation existed between groups. Green Y is being measured as the difference between bottom out and rebound. Alternate WOW samples will be used from warranty. Review of (2) earlier component search attempts indicates that RED X may be

in the crimping operation. Attempts to make a BOB turn into a WOW will be repeated by shimming the upstop - to alter gear tooth engagement.

Action: Provide Status Update of BOB and WOW component search studies - J. Rouleau 2/8
Provide (2) warranty returned BCLs exhibiting rebound to Saginaw for Shainin study–S.Davis 2/1
Provide (2) production BCLs exhibiting rebound to Saginaw for Shainin study – B. Lee/Lach 2/1

2) BCL Durability Binding

2/1/00: Impact force measurements will occur at Fasco, Saginaw/Fasco to build fixture – data acquisition is being de-bugged – high speed camera has not been repaired in Saginaw – elastomeric bumper has been dismissed, some improvement but not substantial, bumper/rebound tests not completed , machined up new parts - - - engineering judgement not to help rebound - - Option # 1 , mechanisms (clutches being added to BCL), high speed , geartrain analysis, force measurements - - - incremental improvements are being ditched – need big fix, and to determine how much

1. Getting impact measurements
2. High speed camera
3. Geartrain simulation
4. Durability testing on-line
5. Clutch design
6. Electrical side, ???

1/25/00: Testing has been completed evaluating the bumper design versus current production. (2) production units bound, while (1) bumper part bound at 45,000 cycles. Jim and Steve are still evaluating the risk factors of a slip clutch design and will present a prioritized development plan at next week's meeting..... A slip clutch part has been made and put on test. Half of the test was run in heat. The part is not entirely design intent, however, does demonstrate functionality. Motor stalling was occurring at 9V after 50,000 cycles, which from a functionality standpoint, is promising. Currently, the part has run over 70,000 cycles..... Saginaw's high speed camera is broken which may affect the timing to receive information form the high speed camera analysis. An outside source will be sought to expedite the photography. In addition, Ben Lee will investigate the possibility of using the GM electrical lab to perform the photography..... A load cell is being set-up by Fasco to measure typical carrier impact force inside the BCL. The information will be used in conjuction with the analytical vector analysis..... Test equipment data acquisition is currently being installed at Fasco and is on target for completion by next week. This equipment will be used to monitor the BCL switch events and states throughout durability cycling, similar to the GM SIMICAR setup.
1/18/99: The elastomeric bumper parts were received and put on test first part of January. Fasco's testing equipment (to date) has not been able to monitor switch state through durability testing, however, equipment is on order which will allow data acquisition throughout the durability cycle – due end of Jan 00. Meanwhile, using the original durability test equipment, a test is underway comparing the (pseudo) durability of (5) BCLs with elastomeric bumpers to (6) current production BCLs. The parts are cycled under a constant temperature of 85° C and a voltage of 12V. To date, two production BCLs out of six failed due to geartrain binding. One BCL with an elastomeric bumper bound and later restarted at 47,000 cycles. A number of clutch designs are being developed as possible design alternatives. In addition, high speed camera analysis will be set-up at Fasco to "detail" the binding event.
12/7/99: New elastomeric bumpers are due in by 12/17. Machined bumper housings have already been completed. New bumpers utilize an energy absorbing material, which is intended to dissipate high impact energy without allowing geartrain to rebound back. Changes will also be made to Fasco's data acquisition methods (used during validation testing) within 2 weeks – current system uses strip chart recorders, which makes it difficult to monitor switch state during testing.

Action: Detail and prioritize geartrain binding corrective action plans – Rouleau/Davis 2/1

Provide findings from review of failed parts under "high speed camera" - Rouleau 2/1
Provide status of data acquisition being added to durability test setup – Davis – 2/1
Provide test results measuring impact force of leadscrew carrier on ECL bearings – Davis 2/1
Provide findings for the measurements of rebound with the elastomeric bumper – Davis – TBD
Provide/order (30) external relays for testing at Fasco – Lach – 2/1

3) Analytical Modeling

2/1/00: 3-D all complete except 2 pieces, hsg and upstop, hsg by this pm, up-stop to an outside lab by next Friday - -max, min, mean, and current production - - - switch timing and geartrain interface - - results early next week, switch actuation times, carrier hits, not deflection but when it presses down on switch – pitch lines of the 2 gears – tight or loose – next two - - —- gear geometry modelling is underway, UTS software being loaded onto workstation, claculating what happens as pitch diameters more apart, what happens to force vector on your teeth – separating forces should go up , detrimental to function of parts
1/25/00: Solid models have been developed to perform the parametric analysis. Currently the designer is working on developing the max/min conditions. Layouts of production parts (best, worst, current production) have been received and will be incorporated into the parametric analysis. The analysis will analyze both the geartrain and switch function. Part families are to be created early next week..... The vector analysis projects is waiting on the leadscrew impact data from Fasco's testing before it can be completed
1/18/99: P.K Park had been out of the office for an extended period since before Christmas break. The analytical model will be worked on with his return. Calculations for a slip-clutch design have been completed. The slip clutch is not feasible for packaging inside the lead screw due to 50x the motor torque requirements inside the lead screw. Before Christmas, failed parts were analyzed to look for any localized lubrication issues. From initial speed calculations, it was determined that standard lubrication should work for this part. The stiffness of the worm gear lead screw material (Acetal) is reduced by ~50% when temperature is increased from room temperature to 85° C, which might explain the problems passing durability testing at high temperatures. Alternate lead screw materials have been pursued in the past, however, the material is somewhat boxed in between the design requirements of the part (energy absorption, stiffness, efficiency, etc...)
12/7/99: P.K. Park from the Delphi S advanced development group is developing an analytical model which will analyze/optimize the current design for geartrain binding. Increased robustness will be sought by altering geartrain geometry (including overlap positioning) and material.

Action: Provide initial findings from the solid model parametric analysis – J. Rouleau 2/8/00
Provide findings of the ECL geartrain analytical vector analysis – J. Rouleau 2/8/00

4) Containment Testing

12/7/99: Initial testing of 32 parts under limited thermal exposure produced no failures.

Action: Close-out pending further containment action items

5) ECL Rebound Stack information

12/7/99: The stack information was provided early January to Shilpan Amin for inclusion into NHTSA IR response.

Action: Close-out

GM Electrical Lab Testing

6) SIMICAR testing

2/1/00: Ben Lee to resend test summary (LN problem) , run part overnight, 5001 cycles no , 5000 cycles no problem - tried to lengthen the time the BCM operates the motor and flip the way the relays flip the - development software deactivates the relay in the BCK=M first, then the external relay 2nd – at the end of the unlock, the BCM sees ground for 60 msec, then open - ---- - new software open for 60 msec - -- electrically it doesn't make sense, -- Ben to really zoom in on current -- corrosion of contacts with not current flowing through external relay – relay being open dry, no current – being engaged, with current - open question to Packard – frictional element? Gears closer together? Inductive effects, closing not much of an in-rush , closer you will create a voltage - - - diffsrent relay??? High speed camera at gm lab — TBD - - -pre April 98 --

1/25/00: Ben Lee to send out a recent test summary tomorrow (1/26), which will be passed on to the group……. The first MPG pre-April 98 part was run over the weekend, but lab had a shut down. The part had 19,000 cycles on it but no conclusions should be made from the test. The part was run again on Monday night and the stopped tested after 3,000 cycles due to excessive rebound. The part was restarted and stopped a 2nd time after 213 cycles due to excessive rebound. The 2nd MPG pre-April 98 part was put on test and is currently running with 400+ cycles……. Al, Jim, and Steve, had a conversation a few weeks ago discussing the electrical system differences before and after the April 98 relay change. Prior to April 98, one side of the motor received an open (after the unlocking function) while the other side received a high resistance. With the post April 98 system, both sides of the relay receive an open circuit. Their preliminary conclusion was that the pre-April 98 system does provide a slight amount of electrical damping, however, it is probably not a significant factor in the part function. Further discussion on this topic will occur at next week's meeting, after Fasco's rebound height test summary and Ben Lee's SIMICAR test summary are available.

1/18/99: Testing has been completed evaluating the effects of current hold time on rebound. (3) of (4) new parts out of production were made to rebound under varying hold times between 100 ms and 650 ms. (4) parts taken out of Milford Proving Grounds vehicles with BCL build dates prior to April 98 are currently scheduled for testing in an effort to 'validate' the test procedure. Bob Larsen, Delphi SQA, is sending Ben Lee a number of NTF warranty parts for evaluation on the SIMICAR setup.

12/7/99: Production parts # 1-2 (?) were run on the SIMICAR setup with no failures. Baseline parts #3-6 were misplaced. Next parts on test will be parts #1-#4 which were removed from pre-April 98 MPG vehicles.

Action: Provide a test summary of varying BCL motor 'hold times' - B. Lee 1/26
Provide status of testing on MPG pre-April '98 parts # 2-4 – B. Lee 2/1
Perform SIMICAR testing on NTF warranty parts – B. Lee – 2/8
Team discussion regarding rebound – "being able to turn rebound on/off in lab" – Adams/Team

7) BCL temperatures

12/7: Closed – the C5 Corvette will see 160-165° F at the shroud (71-74° C)

<u>Service / Dealership interface</u>

8) Provide a listing of recent BCL related dealership calls and root cause findings

Action: Who is Don Begin's replacement - D. Peacy 2/1

<u>Warranty</u>

9) Latest (as of 12/1) Month of build IPTV

1/25/00: The following is a summary of 2000 MY warranty information, projected to 12 MIS at 60% improvement:

Labor Code E7501:
Frequency: 13.91 IPTV
Cost/Car: $3.39

12/7/00: Complete – warranty data is showing a decline in returns – reasons are unclear at this time

Action: Provide lastest month of build warranty data as of Feb 1st – Finn 2/1/00

10) Warranty – problem definition tree

Action: Understand differences between GM information (50/50 split for drive-in/tow-in) and Delphi information (80/20 split favoring drive-in or fail enable fault) – Larsen/Finn 2/1
Note: please contact each other prior to the meeting to resolve this issue –
Bob Larsen, 8-357-5675 ..... Eric Finn, 8-333-6480

11) Warranty returns

2/1/00: Warranty data is attached - 3 month in service for July build – 6 months we usually see a spike close to a 60/30 split NTF /Rebound - - 1 switch intermittent

1/25/00: Fasco has just received 24 more warranty parts from Saginaw. These parts will be analyzed and logged into the warranty chart prior to the meeting on 2/8..... Eight NTF ECLs from the last batch of warranty returns are being sent to Ben Lee at the GM electrical lab for testing. In addition, most of the NTF warranty parts to date (that are fully intact) are being torn down and dimensionally inspected, focusing on any switch related issues. The warranty lab at Fasco can process 40 parts per week. Approximately (120) parts have been set aside for teardown at this point..... The following summarizes the preliminary evaluations (from Fasco) of the latest (47) warranty returns:

No Trouble Found	60%
Rebound	30%
Actuator Problem	6%
Switch Point Problem	4%

1/18/00 – An additional 47+ returns have been analyzed through Saginaw and Fasco. The majority of parts were NTF – although 10-15 parts exhibited rebound. SEE ATTACHED WARRANTY CHART

12/7/00: Information has been scarce since NACG project ran out – now, Saginaw project has been pulling all of the returns, but only limited information has been made available on the findings

Action: Update warranty chart to include rebound height information for the latest - Willette 2/1
Analyze the (24) latest warranty returns and log into the warranty chart – Willette 2/1
Provide findings for dimensional layout of NTF warranty parts – Willette 2/15

12) Vehicle Analysis

Action: Continue to search for a vehicle with repeat ECL replacements for potential buy-back by Delphi engineering. - D. Peacy 2/8/00

Misc

13) Vehicle level Shainin study

1/18/00: Items will be closed since project appears to be unfeasible at this time.
12/7: Still attempting to locate WOW vehicles for analysis

Action: Close-out

14) Bowling Green ECL Failures
2/1/00: Suresh at BG has (2) more fialures – 1 stuck in between – 2nd either an actuator or rebound part – ECL not changed yet - - -still waiting for the final report from Omron, hopefully by this Friday
1/25/00: There was a bad internal relay in the BCM returned from Bowling Green causing the ECL failure condition. The D72 relay from the BCM was sent back to Siemens for further testing. The part was found to have excessive epoxy run-in. For corrective action, an attribute gage was added to the process to control terminal alignment..... Of the (3) column ECL returns from Bowling Green, 1 of 3 parts had high resistance (self correcting high resistance where the resistance would drop as the part was cycled). The part was sent to Omron for further analysis. Preliminary analysis stated the part appears to be normal. The other two parts checked to be NTF. Subsequently, the parts (all three) were sent to Japan for further analysis.
12/7/00: Bowling Green has had 6 vehicls with ECL failures during the month of November. 4 vehicles exhibited the fail enable condition (1 suspected wire pinch under shrouds and 3 suspected feedback switch issues), 1 vehicle had a hard fail in the BCM, and 1 vehicle was suspected to have a bad external relay (condition fixed itself when the relay was inadvertently dropped).

Action: Provide analysis results of 3 ECLs returned to Sag/Fasco for intermittent switch –Willette 2/1 (microswitches sent to Siemens in Japan)

Thanks for everyone's participation.

Regards,

Dave Lach
810-758-7762 (8-333-7762)

Y-Car ECL Task Team Minutes – 2/1/00

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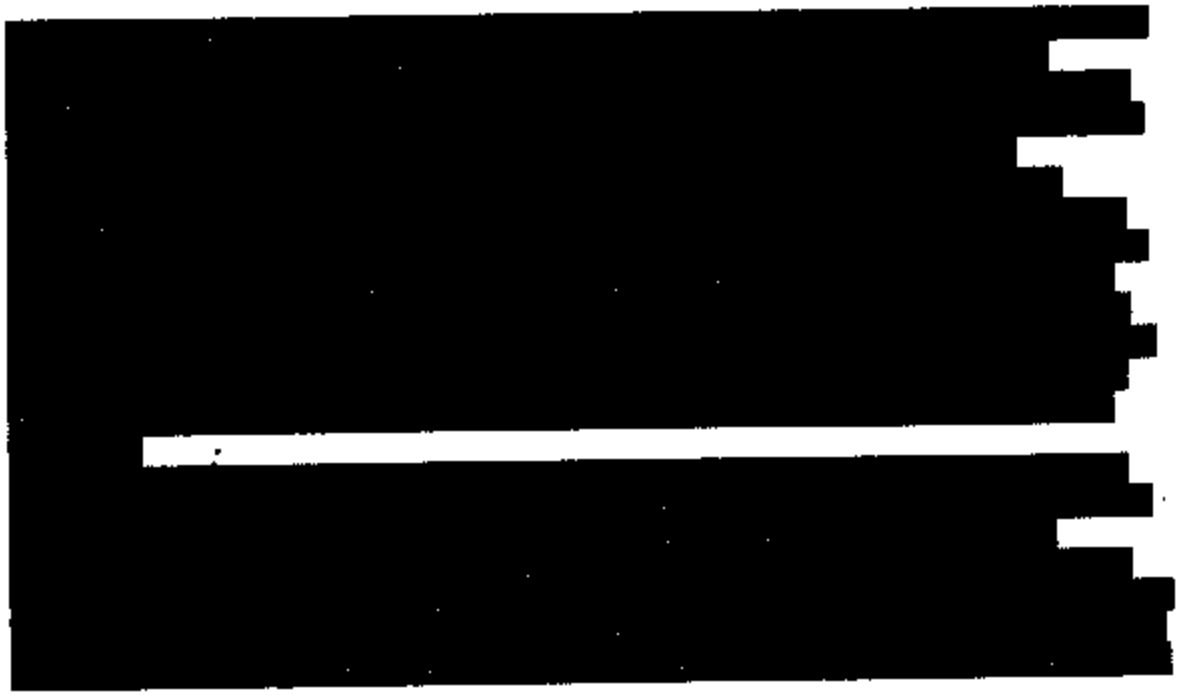
Shilpan Amin (GM)	Service Readiness TBD	* Jim Rouleau (D-S)	Surya Chintmilli (GM)
Ricardo Pastor (D-S)	* Ben Lee (GM)	* Eric Finn (GM)	* Steve Davis (Invensys)
Bob Larsen (D-S)	Steve Loche (D-D)	* Tim Willette (Invensys)	

ECL Issues

1) ECL Rebound

2/8/00: (3) WOW parts are available – Jim to take to (1) BOB and WOW verify rebound – full of liquid epoxy – then tear apart – FE22 for report

2/1/00: Dave Lach will pick up the rebounding ECL from Ben Lee to deliver to Jim Rouleau for use as a WOW part..... Tim Willette has also sent 2 rebound parts from warranty to Saginaw (2/1) for BOB/WOW studies. Ten other rebound parts are available, if needed (out of warranty returns)..... Steve Davis presented the results of the Fasco rebound studies varying current hold time. From the tests, rebound seems to be affected by wear. There was only a very subtle relationship between rebound and pulse length. Also, during testing, it was noted that most rebound occurred at room temp, at elevated temperatures, the rebounding did not repeat. This is contrary to testing in the GM electrical lab.....



[redacted]

Action: Provide status update of BOB and WOW component search studies - J. Rouleau 2/8
Provide (2) warranty returned ECLs exhibiting rebound to Saginaw for Shainin study–S.Davis 2/1
Provide (2) production ECLs exhibiting rebound to Saginaw for Shainin study – B. Lee/Lach 2/1

2) ECL Durability Binding

2/8/00 – New Kodak camera in on 25th – pictures by the 29th – debugs in process – one station in relay to confirm set-up – tryout other abnormalities – non-sealed connector needed – 6 parts to Fasco - - straingage folks have an impressive web-site, strain-gage into part – lab to look at – normal load cell – need concept yet to hold strain gage, load cell - - - rbound with bumper studies co mplete – tight packaging – concept complete with centrifugal clutch looks good – fine balance point between de-coupling to reduce impact and stall torque – drawings in CAD – viscous coupling - — mainstream clutch design TBD – need force measurement to quantify improvement
2/1/00: ECL carrier/leadscrew impact force measurements will occur at Fasco. Saginaw/Fasco are dual pathing the building of a fixture to hold the force gage.....The test equipment data acquisition system has been installed and is in the process of being de-bugged.....The high speed camera has not been repaired in Saginaw.....The elastomeric bumper concept has been somewhat dismissed (for solving binding), some improvement were seen in the limited testing, but nothing substantial. The bumper/rebound tests have not been completed, new housings need to be machined up to accept a molded bumper. Engineering judgement of the team is that the bumper will not help rebound - - - - The prioritized action plan to eliminate the geartrain binding is listed below. Focus is being shifted away from an incremental improvements towards a "big fix". The binding problem has been known and worked on for over two years.

<u>Geartrain Bind Action Plan (Prioritized)</u>

1. Obtain carrier impact measurements
2. Utilize a high speed camera to characterize binding event
3. Complete the geartrain simulation
4. Implement data-acquisition system in durability test set-up (@ Invensys)
5. Clutch design
6. Electrical side, ???

[redacted]

[redacted]

Action: Provide findings from review of failed parts under "high speed camera" - Rouleau 2/8
Provide status of data acquisition being added to durability test setup – Davis – 2/8
Provide test results measuring impact force of leadscrew carrier on ECL bearings – Davis 2/15
Provide findings for the measurements of rebound with the elastomeric bumper – Davis –
Provide/order (30) external relays for testing at Invensys – Lach – 2/8
Provide findings for clutch packaging and development testing – Davis – 2/8

3) Analytical Modeling

2/8/00 – model for nominal unit is complete – study during tomorrow's visit – next max-min – all production , samples from each cavity – 100% layout of 1 per cavity complete – pitch line separation to be put into gear analysis – from nominal studies, there are some nominal concerns - - Vector analysis modelling has been turned over to Dr. Sur – going through UTS program (familiar) – looking at forces as geartrain separates – "he doubts that the worm gear is binding, expects some screw to be binding" – binding of the screw is probably due to bending of the leadscrew – stiffer material should bind up right away - - - rebound a torsional windup of the leadscrew
2/1/00: 3-D parametric modelling is nearly complete. Invensys has supplied dimensional information for all the current productional components except for 2 pieces, the housing and the metal upstop. Mark Abby (Saginaw designer) is compiling all of the data for translation into a parametric analysis (mean, max-min, and current production). The analysis will include both the microswitch timing and geartrain interface. Preliminary results will be available early next week. . . . . Gear geometry modelling is underway, UTS software being loaded onto workstation to help with worm-worm design. The modelling will include looking at the tooth separation force as the pitch diameters move apart, as well as a general vector analysis. (The separating forces should go up as the gears move apart, but is it enough to be detrimental to the part?) – Can we look at changing the resistance across the motor? Part of the input circuitry of BCM – Backdrive efficiency

[redacted]

[redacted]

Action: Provide initial findings from the solid model parametric analysis – J. Rouleau 2/8/00
Provide status of current production measurements on ECL housing – Willette 2/8/00
Provide findings of the ECL geartrain analytical vector analysis – J. Rouleau 2/8/00

[redacted]

GM Electrical Lab Testing

6) SIMICAR testing

2/8/00: 12,250 cycles no failures – next part 7,500 cycles before un-locking failure - - Ben does see a bump on the scope (current) bump - probably a voltage spike on the post 98 part
2/1/00: Ben Lee to resend GM Electrical Lab's test summary (LN problems). . . . . Al Adams and Ben Lee are working on development software that changes the way the relays are actuated. The development software reverses the way the relays are actuated, causing the BCM to command an open/ground instead of an open/open to the ECL motor for 60 msec (then an open/open). One of the 'cronic' rebound parts has been on test for 10,000+ cycles without seeing a rebound condition. A second 'cronic' rebound part will be put on test this evening (2/1). The feasibility of the change has not been determined at this point. There is a concern with closing the external relay under a no-current condition. Al Adams is seeking Delphi Packard advice on this issue. Maybe a different relay? - - - - Electrically, the difference between an ground/open and an open/open should provide only minimal dynamic braking, since the ground impedance is too high to logically affect the motor's characteristics. However, the parts appear to be telling us that there is a difference. Ben Lee will attempt to zoom in on current differences to pin-point the root cause - - - - - The availability of the high speed camera at GM electrical lab is unknown at this point, TBD. - - - - - -
Pre April 98 part testing is on-hold until completion of the developmental test mentioned above.

[redacted]

[redacted]

Action: Provide a test summary of varying ECL motor 'hold times' - B. Lee 2/2
Provide status of testing on MPG pre-April '98 parts # 2-4 – B. Lee 2/15
Perform SIMICAR testing on NTF warranty parts – B. Lee – 2/22
Team discussion regarding rebound – "being able to turn rebound on/off in lab" – Adams/Team

[redacted]

[redacted]

Service / Dealership interface

8) Dealership calls to Service Readiness

Action: Who is Don Begin's replacement - D. Peacy 2/1

Warranty

9) Latest (as of 12/1) Month of build IPTV

2/1/00: The latest warranty information was provided prior to the meeting. Early 2000 warranty looks good, however, the short exposure time may be deceiving at this point.

[redacted]

Action: Provide the latest month of build warranty data – Finn – 3/1/00

10) Warranty – problem definition tree

2/1/00: Robin Sich, Delphi S Reliability, will be contacted to provide further information on ECL dealership callbacks.

Action: Understand differences between GM information (50/50 split for drive-in/tow-in) and Delphi information (80/20 split favoring drive-in or fail enable fault) – Team 2/1

11) Warranty returns

2/1/00: The warranty return chart will be updated prior to next week's meeting to include rebound information for the latest returns. 120 parts next week -

[redacted]

Action: Update warranty chart to include rebound height information for the latest returns- Willette 2/8
Provide findings for dimensional layout of NTF warranty parts – Willette 2/15

12) Vehicle Analysis

Action: Continue to search for a vehicle with repeat ECL replacements for potential buy-back by Delphi engineering. - D. Peacy 2/8/00

Misc

13) Vehicle level Shainin study

2/8/00: One part was returned from Bowling Green – unsure of which part - - -

[redacted]

Action: Can we use the current production "fail enable" car at Bowling Green as a WOW? Swap in and out pre-April 98 components? – Danahy – 2/8

14) Bowling Green ECL Failures

2/1/00: Suresh, Bowling Green electrical quality engineer, is working on (2) more vehicles with ECL faults. One was found to have an ECL with a lock bolt stuck half-way between lock and un-lock. The 2nd vehicle had a fail enable fault (rebound?). The ECL has not been changed yet. - - - - - -Invensys is still waiting for the final report from Omron, to close out the November 99 Bowling Green issue.

[redacted]

Action: Provide analysis results of 3 ECLs returned to Sag/Fasco for intermittent switch –Willette 2/8
(microswitches sent to Siemens in Japan)
Provide status of findings for (2) Jan '00 vehicles at Bowling Green with BCL faults – Danahy 2/8

Thanks for everyone's participation.

Regards,
Dave Lach
810-756-7762 (8-333-7762)
david.r.lach@gm.com

Y-Car ECL Task Team Minutes – 1/25/00

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1) ECL Rebound

1/25/00: Jim Rouleau has requested the two rebound parts from warranty, found by Ben Lee (later sent to Fasco for analysis) be sent from Fasco to Saginaw for use as WOW parts. In addition, 2 of the 3 production units found by Ben Lee to rebound will be delivered to Saginaw for use in the Shainin study. Once the WOW parts are received, the plan is to inject epoxy into one WOW and one BOB part, this will secure the internal ECL components in place, not allowing movement during the disassembly process..... A production run found no difference in rebound among 18 parts..... During disassembly of some of the warranty returns (noted to have rebound), it was noted that some of the lead screws have excessive porosity. To understand the effects of porosity on rebound (and torsional rigidity), Fasco is going to compare leadscrew weight of new, worn, and "warranty returned" leadscrews. Once measurements are complete, the parts will be sectioned to look for porosity..... As mentioned in the minutes last week, testing has been completed comparing rebound versus pulse time. The findings will be summarized in a report by the end of the week. It appears that the new production parts are tighter than parts with cycles on them, possibly explaining a difference in rebound. All parts were all run at room temperature.
1/18/00: Focus will be to look for WOW rebound parts through the latest warranty returns. The design stacks of the ECL microswitch actuator are being re-done. Steve Davis is working through Mark Abby at Delphi S to detail out the stack limits of the microswitch events. In addition, a Omron lever type microswitch is being packaged inside the current ECL housing, which would mount directly to the ECL housing reducing actuator stack-up. The concept is promising, however, needs further development. Fasco has completed testing measuring the variation in ECL lock-bolt rebound height versus electrical 12V pulse length (i.e. 100 ms, 200 ms –current production, 300 ms, 400 ms, 500 ms, and 600 ms). The results will be shared at the 1/25 meeting. SEE GM ELECTRICAL LAB TESTING for vehicle level pulse length studies.
12/7/99: BOB and WOW samples were received, however, not enough variation existed between groups. Green Y is being measured as the difference between bottom out and rebound. Alternate WOW samples will be used from warranty. Review of (2) earlier component search attempts indicates that RED X may be in the crimping operation. Attempts to make a BOB turn into a WOW will be repeated by shimming the upstop - to alter gear tooth engagement.

Action: Provide Status Update of BOB and WOW component search studies - J. Rouleau 2/8
Provide (2) warranty returned ECLs exhibiting rebound to Saginaw for Shainin study–S.Davis 2/1
Provide (2) production ECLs exhibiting rebound to Saginaw for Shainin study – B. Lee/Lach 2/1

Provide test results of ECL rebound height vs. pulse length – S. Davis 1/29

2) ECL Durability Binding

1/25/00: Testing has been completed evaluating the bumper design versus current production. (2) production units bound, while (1) bumper part bound at 45,000 cycles. Jim and Steve are still evaluating the risk factors of a slip clutch design and will present a prioritized development plan at next week's meeting……. A slip clutch part has been made and put on test. Half of the test was run in heat. The part is not entirely design intent, however, does demonstrate functionality. Motor stalling was occurring at 9V after 50,000 cycles, which from a functionality standpoint, is promising. Currently, the part has run over 70,000 cycles……. Saginaw's high speed camera is broken which may affect the timing to receive information form the high speed camera analysis. An outside source will be sought to expedite the photography. In addition, Ben Lee will investigate the possibility of using the GM electrical lab to perform the photography……. A load cell is being set-up by Fasco to measure typical carrier impact force inside the ECL. The information will be used in conjuction with the analytical vector analysis……. Test equipment data acquisition is currently being installed at Fasco and is on target for completion by next week. This equipment will be used to monitor the ECL switch events and states throughout durability cycling, similar to the GM SIMICAR setup.
1/18/99: The elastomeric bumper parts were received and put on test first part of January. Fasco's testing equipment (to date) has not been able to monitor switch state through durability testing, however, equipment is on order which will allow data acquisition throughout the durability cycle – due end of Jan 00. Meanwhile, using the original durability test equipment, a test is underway comparing the (pseudo) durability of (5) ECLs with elastomeric bumpers to (6) current production ECLs. The parts are cycled under a constant temperature of 85° C and a voltage of 12V. To date, two production ECLs out of six failed due to geartrain binding. One ECL with an elastomeric bumper bound and later restarted at 47,000 cycles. A number of clutch designs are being developed as possible design alternatives. In addition, high speed camera analysis will be set-up at Fasco to "detail" the binding event.
12/7/99: New elastomeric bumpers are due in by 12/17. Machined bumper housings have already been completed. New bumpers utilize an energy absorbing material, which is intended to dissipate high impact energy without allowing geartrain to rebound back. Changes will also be made to Fasco's data acquisition methods (used during validation testing) within 2 weeks – current system uses strip chart recorders, which makes it difficult to monitor switch state during testing.

Action: Detail and prioritize geartrain binding corrective action plans – Rouleau/Davis 2/1
Provide findings from review of failed parts under "high speed camera" - Rouleau 2/1
Provide status of data acquisition being added to durability test setup – Davis – 2/1
Provide test results measuring impact force of leadscrew carrier on ECL bearings – Davis 2/1
Provide findings for the measurements of rebound with the elastomeric bumper – Davis – TBD
Provide/order (30) external relays for testing at Fasco – Lach – 2/1

3) Analytical Modeling

1/25/00: Solid models have been developed to perform the parametric analysis. Currently the designer is working on developing the max/min conditions. Layouts of production parts (best, worst, current production) have been received and will be incorporated into the parametric analysis. The analysis will analyze both the geartrain and switch function. Part families are to be created early next week……. The vector analysis projects is waiting on the leadscrew impact data from Fasco's testing before it can be completed
1/18/99: P.K Park had been out of the office for an extended period since before Christmas break. The analytical model will be worked on with his return. Calculations for a slip-clutch design have been completed. The slip clutch is not feasible for packaging inside the lead screw due to 50x the motor torque requirements inside the lead screw. Before Christmas, failed parts were analyzed to look for any localized lubrication issues. From initial speed calculations, it was determined that standard lubrication should work

for this part. The stiffness of the worm gear lead screw material (Acetal) is reduced by ~50% when temperature is increased from room temperature to 85° C, which might explain the problems passing durability testing at high temperatures. Alternate lead screw materials have been pursued in the past, however, the material is somewhat boxed in between the design requirements of the part (energy absorption, stiffness, efficiency, etc…)
12/7/99: P.K. Park from the Delphi S advanced development group is developing an analytical model which will analyze/optimize the current design for geartrain binding. Increased robustness will be sought by altering geartrain geometry (including overlap positioning) and material.

Action: Provide initial findings from the solid model parametric analysis – J. Rouleau 2/8//00
Provide findings of the ECL geartrain analytical vector analysis – J. Rouleau 2/8/00

4) Containment Testing

12/7/99: Initial testing of 32 parts under limited thermal exposure produced no failures.

Action: Close-out pending further containment action items

5) ECL Rebound Stack information

12/7/99: The stack information was provided early January to Shilpan Amin for inclusion into NHTSA IR response.

Action: Close-out

<u>GM Electrical Lab Testing</u>

6) SIMICAR testing

1/25/00: Ben Lee to send out a recent test summary tomorrow (1/26), which will be passed on to the group……. The first MPG pre-April 98 part was run over the weekend, but lab had a shut down. The part had 19,000 cycles on it but no conclusions should be made from the test. The part was run again on Monday night and the stopped tested after 3,000 cycles due to excessive rebound. The part was restarted and stopped a 2nd time after 213 cycles due to excessive rebound. The 2nd MPG pre-April 98 part was put on test and is currently running with 400+ cycles…… Al, Jim, and Steve, had a conversation a few weeks ago discussing the electrical system differences before and after the April 98 relay change. Prior to April 98, one side of the motor received an open (after the unlocking function) while the other side received a high resistance. With the post April 98 system, both sides of the relay receive an open circuit. Their preliminary conclusion was that the pre-April 98 system does provide a slight amount of electrical damping, however, it is probably not a significant factor in the part function. Further discussion on this topic will occur at next week's meeting, after Fusco's rebound height test summary and Ben Lee's SIMICAR test summary are available.
1/18/99: Testing has been completed evaluating the effects of current hold time on rebound. (3) of (4) new parts out of production were made to rebound under varying hold times between 100 ms and 650 ms. (4) parts taken out of Milford Proving Grounds vehicles with ECL build dates prior to April 98 are currently scheduled for testing in an effort to 'validate' the test procedure. Bob Larsen, Delphi SQA, is sending Ben Lee a number of NTF warranty parts for evaluation on the SIMICAR setup.
12/7/99: Production parts # 1-2 (?) were run on the SIMICAR setup with no failures. Baseline parts #3-6 were misplaced. Next parts on test will be parts #1-#4 which were removed from pre-April 98 MPG vehicles.

Action: Provide a test summary of varying ECL motor 'hold times' - B. Lee 1/26
Provide status of testing on MPG pre-April '98 parts # 2-4 – B. Lee 2/1
Perform SIMICAR testing on NTF warranty parts – B. Lee – 2/8
Team discussion regarding rebound – "being able to turn rebound on/off in lab" – Adams/Team

7) ECL temperatures

12/7: Closed – the C5 Corvette will see 160-165° F at the shroud (71-74° C)

Service / Dealership Interface

8) Provide a listing of recent ECL related dealership calls and root cause findings

Action: Who is Don Begin's replacement - D. Peacy 2/1

Warranty

9) Latest (as of 12/1) Month of build IPTV

1/25/00: The following is a summary of 2000 MY warranty information, projected to 12 MIS at 60% improvement:

Labor Code B7501:
Frequency: 13.91 IPTV
Cost/Car: $3.39

12/7/00: Complete – warranty data is showing a decline in returns – reasons are unclear at this time

Action: Provide lastest month of build warranty data as of Feb 1st – Finn 2/1/00

10) Warranty – problem definition tree

Action: Understand differences between GM information (50/50 split for drive-in/tow-in) and Delphi information (80/20 split favoring drive-in or fail enable fault) – Larsen/Finn 2/1
Note: please contact each other prior to the meeting to resolve this issue –
Bob Larsen, 8-357-5675 ..... Eric Finn, 8-333-6480

11) Warranty returns

1/25/00: Fasco has just received 24 more warranty parts from Saginaw. These parts will be analyzed and logged into the warranty chart prior to the meeting on 2/8..... Eight NTF ECLs from the last batch of warranty returns are being sent to Ben Lee at the GM electrical lab for testing. In addition, most of the NTF warranty parts to date (that are fully intact) are being torn down and dimensionally inspected, focusing on any switch related issues. The warranty lab at Fasco can process 40 parts per week. Approximately (120) parts have been set aside for teardown at this point..... The following summarizes the preliminary evaluations (from Fasco) of the latest (47) warranty returns:

No Trouble Found	60%
Rebound	30%
Actuator Problem	6%
Switch Point Problem	4%

1/18/00 – An additional 47+ returns have been analyzed through Saginaw and Fasco. The majority of parts were NTF – although 10-15 parts exhibited rebound. SEE ATTACHED WARRANTY CHART
12/7/00: Information has been scarce since NACG project ran out – now, Saginaw project has been pulling all of the returns, but only limited information has been made available on the findings

Action: Update warranty chart to include rebound height information for the latest - Willette 2/1
Analyze the (24) latest warranty returns and log into the warranty chart – Willette 2/1
Provide findings for dimensional layout of NTF warranty parts – Willette 2/15

12) Vehicle Analysis

Action: Continue to search for a vehicle with repeat ECL replacements for potential buy-back by Delphi engineering. - D. Peacy 2/8/00

Misc

13) Vehicle level Shainin study

1/18/00: Items will be closed since project appears to be unfeasible at this time.
12/7: Still attempting to locate WOW vehicles for analysis

Action: Close-out

14) Bowling Green ECL Failures

1/25/00: There was a bad internal relay in the BCM returned from Bowling Green causing the BCL failure condition. The D72 relay from the BCM was sent back to Siemens for further testing. The part was found to have excessive epoxy run-in. For corrective action, an attribute gage was added to the process to control terminal alignment..... Of the (3) column BCL returns from Bowling Green, 1 of 3 parts had high resistance (self correcting high resistance where the resistance would drop as the part was cycled). The part was sent to Omron for further analysis. Preliminary analysis stated the part appears to be normal. The other two parts checked to be NTF. Subsequently, the parts (all three) were sent to Japan for further analysis.
12/7/00: Bowling Green has had 6 vehicle with ECL failures during the month of November. 4 vehicles exhibited the fail enable condition (1 suspected wire pinch under shrouds and 3 suspected feedback switch issues), 1 vehicle had a hard fail in the BCM, and 1 vehicle was suspected to have a bad external relay (condition fixed itself when the relay was inadvertently dropped).

Action: Provide analysis results of 3 ECLs returned to Sag/Fasco for intermittent switch –Willette 2/1
(microswitches sent to Siemens in Japan)

Thanks for everyone's participation.

Regards,

Dave Lach
810-756-7762 (8-333-7762)

Y-Car ECL Task Team Minutes – 1/18/00

Next Meeting
Tues, Jan 25th, 3-4, Meet-me-line #888-221-0133 ; pass code 420832

(The same meet-me-line has been established for each Tuesday from 3-4 p.m. through March 14th, 2000 – so put it in your planners!)

The following is a summary of items discussed during the meetings from Dec 14th - Jan 18th.

Team Members:

David Lach (D)	Al Adams (GM)	Dave Peacy (GM)	Jim Danahy (GM)
Shilpan Amin (GM)	Service Readiness TBD	Don Begin (GM)	Jim Rouleau (D)
Ricardo Pastor (D)	Ben Lee (GM)	Eric Finn (GM)	Steve Davis (F)
Bob Larsen (D)	Steve Lochs (D)	Tim Willette (F)	Surya Chimmilli (GM)

ECL Issues

1) ECL Rebound Shainin Study Update - Jim Rouleau

1/18/00: Focus will be to look for WOW rebound parts through the latest warranty returns. The design stacks of the ECL microswitch actuator are being re-done. Steve Davis is working through Mark Abby at Delphi S to detail out the stack limits of the microswitch events. In addition, a Omron lever type microswitch is being packaged inside the current ECL housing, which would mount directly to the ECL housing reducing actuator stack-up. The concept is promising, however, needs further development. Fasco has completed testing measuring the variation in ECL lock-bolt rebound height versus electrical 12V pulse length (i.e. 100 ms, 200 ms –current production, 300 ms, 400 ms, 500 ms, and 600 ms). The results will be shared at the 1/25 meeting. SEE GM ELECTRICAL LAB TESTING for vehicle level pulse length studies.
12/7/99: BOB and WOW samples were received, however, not enough variation existed between groups. Green Y is being measured as the difference between bottom out and rebound. Alternate WOW samples will be used from warranty. Review of (2) earlier component search attempts indicates that RED X may be in the crimping operation. Attempts to make a BOB turn into a WOW will be repeated by shimming the upstop - to alter gear tooth engagement.

Action: Provide Status Update of BOB and WOW component search studies - J. Rouleau
Provide test results of ECL rebound height vs. pulse length – S. Davis 1/25

2) ECL Elastomeric Bumper Prototype Status - Jim Rouleau/Steve Davis

1/18/99: The elastomeric bumper parts were received and put on test first part of January. Fasco's testing equipment (to date) has not been able to monitor switch state through durability testing, however, equipment is on order which will allow data acquisition throughout the durability cycle – due end of Jan 00. Meanwhile, using the original durability test equipment, a test is underway comparing the (pseudo) durability of (5) ECLs with elastomeric bumpers to (6) current production ECLs. The parts are cycled under a constant temperature of 85° C and a voltage of 12V. To date, two production ECLs out of six failed due to geartrain binding. One ECL with an elastomeric bumper bound and later restarted at 47,000 cycles. A number of clutch designs are being developed as possible design alternatives. In addition, high speed camera analysis will be set-up at Fasco to "detail" the binding event.

12/7/99: New elastomeric bumpers are due in by 12/17. Machined bumper housings have already been completed. New bumpers utilize an energy absorbing material, which is intended to dissipate high impact energy without allowing geartrain to rebound back. Changes will also be made to Fasco's data acquisition methods (used during validation testing) within 2 weeks – current system uses strip chart recorders, which makes it difficult to monitor switch state during testing.

Action: Provide test summary comparing ECLs with bumpers to production ECLs. - Rouleau/Davis 1/25
Detail future corrective action plans for geartrain binding (bumpers vs. slip clutch) –JR/SD 1/25
Provide findings from review of failed parts under "high speed camera" - Rouleau/Davis 2/1
Provide status of data acquisition being added to durability test setup – Davis – 2/1

3) Analytical Modeling

1/18/99: P.K Park had been out of the office for an extended period since before Christmas break. The analytical model will be worked on with his return. Calculations for a slip-clutch design have been completed. The slip clutch is not feasible for packaging inside the lead screw due to 50x the motor torque requirements inside the lead screw. Before Christmas, failed parts were analyzed to look for any localized lubrication issues. From initial speed calculations, it was determined that standard lubrication should work for this part. The stiffness of the worm gear lead screw material (Acetal) is reduced by ~50% when temperature is increased from room temperature to 85° C, which might explain the problems passing durability testing at high temperatures. Alternate lead screw materials have been pursued in the past, however, the material is somewhat boxed in between the design requirements of the part (energy absorption, stiffness, efficiency, etc...)

12/7/99: P.K. Park from the Delphi S advanced manufacturing development group is developing an analytical model which will analyze/optimize the current design for geartrain binding. Increased robustness will be sought by altering geartrain geometry (including overlap positioning) and material.

Action: Provide findings from the solid model parametric analysis – J. Rouleau 1/4/99
Provide findings of the ECL geartrain analytical vector analysis – J. Rouleau 1/4/99

4) Containment Testing

12/7/99: Initial testing of 32 parts under limited thermal exposure produced no failures.

Action: Close-out pending further containment action items

5) ECL Rebound Stack information

12/7/99: The stack information was provided early January to Shilpan Amin for inclusion into NHTSA IR response.

Action: Close-out

<u>GM Electrical Lab Testing</u>

6) Provide test results for SIMICAR testing - B Lee

1/18/99: Testing has been completed evaluating the effects of current hold time on rebound. (3) of (4) new parts out of production were made to rebound under varying hold times between 100 ms and 650 ms. (4) parts taken out of Milford Proving Grounds vehicles with ECL build dates prior to April 98 are currently

scheduled for testing in an effort to 'validate' the test procedure. Bob Larsen, Delphi SQA, is sending Ben Lee a number of NTF warranty parts for evaluation on the SIMICAR setup.

12/7/99: Production parts # 1-2 (?) were run on the SIMICAR setup with no failures. Baseline parts #3-6 were misplaced. Next parts on test will be parts #1-#4 which were removed from pre-April 98 MPG vehicles.

Action: Provide a test summary of varying ECL motor 'hold times' - B. Lee 1/25
Provide status of testing on MPG pre-April '98 parts # 1-4 – B. Lee 1/25
Perform SIMICAR testing on NTF warranty parts – B. Lee – 2/8

7) ECL temperatures

12/7: Closed – the C5 Corvette will see 160-165° F at the shroud (71-74° C)

Service / Dealership interface

8) Provide a listing of recent ECL related dealership calls and root cause findings - Don Begin

Action: Who is Don Begin's replacement - D. Peacy 1/25

Warranty

9) Latest (as of 12/1) Month of build IPTV

12/7: Complete – warranty data is showing a decline in returns – reasons are unclear at this time

10) Warranty – problem definition tree

Action: Understand differences between GM information (50/50 split for drive-in/tow-in) and Delphi information (80/20 split favoring drive-in or fail enable fault) – Larsen/Finn TBD

11) Warranty returns

1/18/00 – An additional 47+ returns have been analyzed through Saginaw and Fasco. The majority of parts were NTF – although 10-15 parts exhibited rebound. SEE ATTACHED WARRANTY CHART
12/7/00: Information has been scarce since NACG project ran out – now, Saginaw project has been pulling all of the returns, but only limited information has been made available on the findings

Action: Follow-up on warranty return parts (ECLs)- add info to warranty chart - Bob Larson 2/1

12) Vehicle Analysis

Action: Continue to search for a vehicle with repeat ECL replacements for potential buy-back by Delphi engineering. - D. Peacy 2/1/00

Misc

13) Provide status of vehicle level Shainin study - Danahy

1/18/00: Items will be closed since project appears to be unfeasible at this time.
12/7: Still attempting to locate WOW vehicles for analysis

Action: Close-out

14) Bowling Green ECL Failures

12/7: Bowling Green has had 6 vehicle with ECL failures during the month of November. 4 vehicles exhibited the fail enable condition (1 suspected wire pinch under shrouds and 3 suspected feedback switch issues), 1 vehicle had a hard fail in the BCM, and 1 vehicle was suspected to have a bad external relay (condition fixed itself when the relay was inadvertently dropped).

Action: Provide analysis results of 3 ECLs returned to Sag for intermittent switch(bounce?)–Larsen 12/14
Provide analysis results for failed BCM @ Bowling Green – Loche 12/14

Thanks for everyone's participation.

Regards,

Dave Lach
810-756-7762 (8-333-7762)