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Kathleen C. DeMeter, Director
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National Highway Traffic Safety Administration
400 Seventh St., S.W.
Washington, D.C. 20590

NHTSA WASHINGTON DC 20590
2003 MAY -5 P 4: 10
OFFICE OF CHIEF COUNSEL

Re: ODI Identification Number EA02-031

Dear Ms. DeMeter:

This letter is submitted on behalf of our client Honeywell Sensing and Control ("Honeywell") in response to the National Highway Traffic Safety Administration ("NHTSA"), Office of Defects Investigation ("ODI") inquiry, dated February 5, 2003, relating to ODI's investigation of MY 1997-2001 Chevrolet Corvette vehicles, ODI EA #02-031.

I. BACKGROUND

Honeywell Sensing and Control is the successor of Invensys Sensor Systems and Fasco Controls Corporation, and is located in Shelby, North Carolina. Since all these corporate entities were involved to varying degrees with the electronic column lock of the subject vehicles, for ease of reference the term "Shelby Facility" will be used in this response.

The Shelby Facility was a second tier supplier of electric column lock ("ECL") units for the electronic steering column lock system used in the Subject Vehicles. Delphi Corporation contracted with the Shelby Facility to design, manufacture and supply ECLs for use in certain steering systems that Delphi supplied to General Motors for use in the Subject Vehicles.

A. ECL Package and Function

The ECL is a single sub-component within the antitheft system of the Subject Vehicles. The ECL is designed to reduce vehicle theft by electro-mechanically locking the steering shaft when the ignition switch is in the locked position and the key is removed from the ignition.

The ECL is a sealed, self-contained unit that includes an electric motor, feedback switch assembly, lock bolt, and related gear train inside a die cast zinc housing. An exploded view of the ECL is provided at Tab 1. The unit is assembled and sealed with a plastic rear cover that is heat crimped to the housing on the assembly line. There are three externally accessible parts to an assembled ECL: 1) the lock bolt which projects out of the die cast zinc housing when the unit is activated, 2) an up-stop adjustment screw adjacent to the lock bolt; and 3) a wiring harness exiting through the plastic rear cover. Three ECL units have been provided with this submission as discussed below, including: a completely assembled unit with an access window to view the internal workings (see box labeled "Response to Request # 11"), an uncrimped assembly with access to internal components, and a complete set of subcomponents in individually labeled bags (see box labeled "Sample Part # 1740-0002"). The ECL unit is the only portion of the steering system, or column-locking system designed, manufactured or supplied by the Shelby Facility.

The ECL unit is mounted in the steering column on the lower right side of the steering shaft and positioned so that the ECL lock bolt will engage in a lock plate disc mounted on the steering shaft. The lock plate disc was not designed, manufactured, or supplied by the Shelby Facility. The ECL works by extending its lock bolt into detents on the lock plate to lock the wheel. The lock bolt is retracted from the lock plate to unlock the steering wheel. The ECL unit has a limited and discrete set of mechanical and electrical functions. Mechanically, when the electric motor is activated by current from the vehicle's electrical system, it drives the gear train, lock bolt carrier and the lock bolt into one of two positions: 1) fully extended (locked); or 2) fully retracted (unlocked). The polarity of the current supplied to the ECL by the vehicle determines the direction of lock bolt travel. Electrically, the ECL contains a feedback switch, which allows the vehicle's electronic systems to monitor the position of the lock bolt. The feedback switch can be toggled to one of two positions by the movement of the lock bolt carrier: 1) "open" circuit; or 2) "closed" circuit.

The feedback switch does not actually control or "switch" the polarity of current supplied to the ECL, or otherwise control the direction of the electric motor or lock bolt carrier movement. Likewise, the switch does not in any way control the flow of current to the electric motor. The feedback switch's sole function is to indicate the resting position of the lock bolt carrier by presenting either an open or closed circuit to the vehicle's body control module ("BCM"), which continuously monitors the ECL feedback switch. The ECL is a passive device, operating only in direct response to electric currents generated by the vehicle's electrical system. Thus, the ECL does not independently initiate any lock bolt movements on its own, it only responds to electrical current supplied by the vehicle. When the polarity of the current supplied is reversed, the motor runs in the opposite direction and moves the lock bolt accordingly.

Finally, The Shelby Facility is not aware of any case in which the lock bolt has moved to the point of engagement in the absence of electric current supplied to the motor. In fact, the lock bolt cannot move unless the gear train is operated by the electric motor rotating the worm gear mounted on the motor shaft. The gear train includes a helical and worm gear set that provides a 15 to 1 reduction gearing and is resistant to being back-driven. Moreover, the ECL is mounted in such a way that any gravity induced movement of the lock bolt is towards the unlocked position. This gear train, and the ECL's mounting orientation effectively prevent the lock bolt carrier from moving as the result of vibration or shock events while driving. This is confirmed by the vibration testing discussed in the response to information Request #3.

B. Potential Failure Modes

As described in ODI's February 5, 2003 information request, ODI's prior analysis identified the potential for two theoretical failure modes in the subject vehicles: 1) Failure of the steering column to unlock during initial key-in and start-up; and 2) locking of the steering column while the vehicle is in motion.

The Shelby Facility is not aware of any problem or malfunction of the ECL alone, which could result in a locking of the steering wheel while driving. As discussed in more detail below in response to Request # 4, three potential failure modes specific to the ECL have been identified by the Shelby Facility during product validation and subsequent testing and development: 1) Hardstop; 2) Intermittent or Failed Feedback Switch; and 3) Rebound. Each of these potential ECL-specific failure modes could theoretically result in the failure of the steering column to unlock at vehicle start-up, or the failure of the steering column to lock at key-off and removal as discussed below, but they cannot result in the steering wheel becoming locked while driving.

1. **Hardstop**

As discussed in more detail below, the principal design challenge in developing the ECL was to develop a unit that was capable of pulling the mechanical loads required to unlock the steering shaft under worst case loading, and to accomplish this within the limited package size specified for this application. The limited space required the selection of a relatively small motor. The motor selected had the highest torque available in its package size and high RPMs (12,000). The high RPMs increase the energy that must be dissipated at the end of travel. These design factors combine to create a failure mode known as "Hardstop" which has been identified during both product validation and in field return testing and analysis.

"Hardstop" is the term used to describe the ECL condition when the unit is driven in either the lock or unlock direction and cannot, on its own power, drive the lock bolt in the opposite direction when powered appropriately. The lack of lock bolt movement is the effect; the root cause is high frictional loading of the gear train aggravated by high energies driving the carrier assembly into the end of travel stops within the ECL.

In this failure mode, the lock bolt becomes jammed in either the locked or unlocked position. The effect of a jammed lock bolt is to either prevent the steering column from unlocking at vehicle start-up or to prevent the column from locking at shutdown and key removal. As concluded by ODI in PE99-066, neither of these consequences constitutes a safety related defect.

Hardstop is a customer convenience and continuous improvement issue that the Shelby Facility has worked to eliminate since early in the design and development of the ECL. These efforts are detailed below in response to Requests # 2 and #3. Ultimately, it was determined that the hardstop occurrences that were revealed in the advanced stages of durability testing were related to the use of the zinc housing as the bearing for one end of the motor shaft. Hardstop failures in durability testing typically occurred at around 40,000 cycles; the minimum life cycle durability test specification requires failure free operation through 50,000 cycles. In the original design, as the shaft/housing interface wore over time, zinc was deposited onto the end of the motor shaft, which in turn increased the frictional loads. Eventually, these increased frictional loads on the motor-shaft/housing bearing interface can, in certain cases, exceed the power capability of the motor to move it, and a hardstop condition will occur in those units. The improved design that was launched into production in January 2003 incorporated a precision ball bearing on the end of the motor shaft and has eliminated this hardstop phenomenon.

There were a number of other design and manufacturing changes investigated and implemented before and after product launch which were focused on eliminating hardstop occurrences and were a part of the Shelby Facility's commitment to continuous product improvement. These are discussed in detail in the information and documents supplied in response to Request # 2 and #3.

2. Intermittent or Failed Feedback Switch

As explained above, the ECL contains a switch actuator and feedback switch whose sole function is to indicate the position of the lock bolt carrier. The feedback switch is attached to the plastic rear cover, which holds the switch and spring-metal actuator near the wall of the housing, adjacent to the lock bolt carrier and parallel to its axis of travel. As the carrier moves past the feedback switch, it "wipes" across the spring-metal actuator. The central leg of the actuator in turn deflects towards the feedback switch and depresses the plastic switch button as the lock bolt carrier moves across the actuator switch point. Each time the switch button is depressed, electrical contacts inside the switch are toggled between either the "open" or "closed" circuit positions. The vehicle's BCM continuously monitors the status of the ECL feedback switch.

A "Failed Switch" is a switch that experiences some sort of short or permanent electrical malfunction. In the case of a failed switch, the switch would indicate either "open" or "closed" continuously (depending on its status when the failure occurred) and would never change its state in response to carrier movements. "Intermittent switch" is a switch that momentarily changes its status in the absence of any carrier movement. In this situation, the feedback switch changes its status from open to closed, or closed to open, and in some cases, back to the original correct status, in the absence of an additional carrier movement. Intermittent switching can result in an inaccurate feedback switch indication. The purpose of the feedback switch is to enable the vehicle's BCM to confirm that the ECL lock bolt is unlocked before allowing the vehicle to be driven normally. In an intermittent or failed switch situation, the BCM recognizes the that the feedback switch or ECL is not functioning normally because the switch state changes when it should have remained the same, or remained the same when it should have changed in response to a lock bolt carrier movement. In this situation the BCM is unable to confirm that the ECL is unlocked and the BCM responds by activating one of the vehicle's two failure modes, either "fail enabled" or "walk home." This malfunction would be triggered only at vehicle start-up or vehicle shutdown At vehicle start-up the feedback switch intermittency or failure could result in a signal that the ECL was either unlocked when it in fact remained locked, or that the ECL remained locked while actually unlocked. Upon vehicle shut down, a faulty feedback switch could enable the key to be removed when the wheel was not in fact locked.

A number of product improvements and production process changes have been implemented to improve the reliability and performance of the actuator and feedback switch in the field. These actions include those relating to the misformed actuator production quality spill that was experienced between July 1998 and January 1999, and is discussed in more detail in the response to Request #10. These changes and related events are described in detail in the documents provided in response to Request #s 7, 8, and 10.

In no case could a faulty or intermittent feedback switch or actuator cause the steering wheel to lock while driving.

3. Rebound

"Rebound" is the term used to describe the fact that the lock bolt carrier assembly bounces back from the end of travel in the opposite direction from which it was being driven by the electric motor. The energy acquired during the travel of the carrier/gear train during actuation (lock or unlock) causes the carrier assembly to bounce or "rebound" after impacting the end-of-travel stops. Rebound effects the final resting position of the lock bolt and carrier, and can have one, and theoretically two potential operating consequences, depending on precisely how far the lock bolt carrier travels in the opposite direction during rebound. These two potential consequences, electric feedback switch rebound, and mechanical rebound are discussed below.

a. Electric Feedback Switch Rebound

Where the amount of rebound is sufficient to move the lock bolt carrier back past the feedback switch actuator's switch-point, the rebound will result in a change in the status reading of the feedback switch which monitors the position of the lock bolt. The feedback switch signal provided to the vehicle's BCM will indicate the ECL to be in opposite of its actual position. Specifically, the body control module would read the ECL to be in the locked position when this degree of rebound occurs during unlocking. Rebound sufficient to cause re-actuation of the feedback switch has been found in both validation testing, and field return analysis.

This electric switch rebound at vehicle start-up can cause the feedback switch to indicate a failure to unlock after actual lock bolt retraction because of the partial movement back in the extending direction. According to our understanding of the vehicle's BCM system programming, this will cause an audible chime and fuel will be cut off to the engine once the vehicle reaches a speed of 1.5 MPH in either forward or reverse.

This electrical switch rebound is the only type of rebound that has been observed by the Shelby Facility in validation testing and field returns. The facility has worked to continuously improve the performance of the ECL with respect to eliminating electric feedback switch rebound. The principal design changes relating to these improvements have been focused on adjusting the switch point location and insuring that it is set consistently during assembly through production quality control improvements. These issues are discussed in more detail below.

b. Mechanical Rebound

More severe rebound could theoretically also result in the lock bolt carrier moving to the point where the lock bolt could mechanically re-engage in the lock plate and relock the steering column at vehicle start-up. Likewise, the lock bolt could mechanically disengage from the lock plate upon attempted locking at vehicle shutdown if it rebounded out of the lock plate. This type of more extensive rebound could be described as "mechanical rebound." This malfunction could only occur at vehicle start-up or shutdown when the ECL is activated by electrical currents directed from the vehicle's ignition and electrical system. The consequences of this failure mode would manifest at the instant of start-up or shut down.

There were a number of design and manufacturing changes made after product launch which were focused on eliminating electric feedback switch rebound occurrences and were a part of a commitment by the Shelby Facility's to continuous product improvement.

As found by ODI in its July 21, 2000 closing resume for PE 99-066 these failure modes, which could result in the failure of the wheel to lock or unlock at vehicle start-up or shut-down, do not compromise motor vehicle safety and do not constitute a safety related defect.

II. INFORMATION REQUEST

1. *State the number of subject components, by manufacturer assembly plant and production month and year, which Honeywell has manufactured for sale in the United States.*

   Provide the table in Microsoft Access 2000, or a compatible format, entitled "PRODUCTION DATA." See Enclosure 1, EA02-031 Honeywell Data Collection Disc. For a pre-formatted table which provides further details regarding this submission.

The Shelby Facility produced a total of 182,424 subject components from March 1996 through September 2001 (MY 97 – MY 01). A single manufacturing site in Shelby, NC, produced the subject components. (See attachment 1A.)

2. *Describe all assessments, analyses, tests, test results, studies, surveys, simulations, investigations, inquiries and/or evaluations (collectively, "actions"), including any Failure Mode*

and Effect Analyses (FMEAs), that relate to, or may relate to, the subject component or the alleged defect in the subject vehicle that have been conducted, are being conducted, are planned, or are being planned by, or for, Honeywell. For each such action, provide the following information:

a. Vehicle make, model, and model year for which the subject component is used;

The Subject Components are used in MY 1997.5 through MY 2003 Corvettes with manual transmissions, and MY 1997.5 through MY 2001 Corvettes with automatic transmissions.

b. Action title or identifier;
c. The actual or planned start date;
d. The actual or expected end date;
e. Brief summary of the subject and objective of the action;
f. Engineering group(s)/supplier(s) responsible for designing and for conducting the action;
g. A brief description of the procedure used to complete the action, including testing or survey sample sizes, where applicable; and,
h. 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.

As described below, documents responsive to this request are included as attachments 2A – 2I.

Design and Development Actions

The Shelby Facility was responsible for the internal workings of the device. Delphi communicated functional requirements as well as packaging limitations. Numerous challenges had to be overcome in order to provide a product that would perform the required work in the available space and survive the minimum number of cycles. The following are the "actions" taken during design and development:

A. <u>Comprehensive Gear Train Analysis</u>
Initial design and development required designing a gear train that couples the power available from the motor into a system that minimizes frictional and efficiency losses while maintaining the ability to perform the necessary work in the required time. An outside gear consultant was utilized to confirm internal work performed on the gear set. UTS provided a comprehensive gear train analysis (see attachment "2A"), which was utilized in conjunction with the empirical data generated. (See attachment "2B.")

B. <u>Durability Testing and Analysis</u>
Initial product design work also focused on providing reliable actuation over time, temperature, and load extremes. The unit must work 100% of the time over a minimum of 50,000 cycles. Efforts were made to improve the strength, lubrication, and robustness of internal components to survive extreme mechanical loads required. (See FEAs --Finite Element Analysis & Thermal Strain Analysis -- attachments "2C" and "2D", Lubrication/Material Wear study attachment "2E", and the empirical evolution in attachment "2B") Once internal components demonstrated sufficient strengths, final gear ratios were optimized for improved efficiencies with a focus on eliminating "hardstops". Thread pitches on the leadscrew and lubricants were optimized to improve efficiencies and to reduce frictional loading on the gear sets (see Lubrication/Material Wear study attachment "2E").

C. Elimination of Hardstop

Efforts to eliminate "hardstops" were the dominant focus of the design team; it was seen as the issue preventing PPAP approval. "Hardstop" failures typically appeared in the Durability Test after approximately 40k cycles as shown in the graphs (see attachment "2F"). Switch intermittencies and related issues were seen as quality spills that were quickly addressed.

Post Product Launch Actions

After the original PPAP Durability Test failure (see Question # 4), attempts to complete the durability portion of the test specification continued. These attempts addressed material selections of, but not limited to, the bearing, leadscrew, carrier, and the cover. Additional work was also conducted attempting to reduce the impact energy of the gear train by various methods. Results of several of these tests are shown (see attachment "2G"). Also included are notes from the Concept Review meeting held on 03/24/00 portraying numerous mechanical proposals, which were being considered (see attachment "2 I"). It was not until the root cause of zinc impregnation onto the motor shaft was identified that "Hardstops" were eliminated permitting successful completion of the Durability Test Specification in 4th Quarter of 02.

An analytical review was undertaken in April 2002 to summarize the warranty data of failed systems in the field relative to returned ECL's. Attachment 2J is provided as an internal communication document summarizing and assessing operation/function of the ECL within the vehicle system. Included are graphs depicting cause and effect analysis of changes made to the ECL and vehicle system as it relates to warranty trends.

3. *State the GM and/or Delphi Automotive requirement specifications, including any part marking and a description of each marking, for the subject component used in the subject vehicle. Provide copies of all documents, organized chronologically, related to the requirement specifications.*

I) ***Component markings consist of the following:***
   a) Permanently molded Delphi part # "26050960" on the top of each unit
   b) The manufacturing date code is ink stamped on the side of each unit. It is communicated in Month/Day/Year format. The Delphi drawing provides additional clarification. This ink stamp is also used to confirm that the device successfully passed the End Of Line Tester at the Shelby Facility.
   c) Permanently molded "FASCO" name
   d) Permanently molded "SAE PET" for plastic part recycling identification

II) ***Included as attachments 3A-3G are the following:***
   a) Delphi Product Test Specification # A-002266 -- ***Pre-production***
   b) Delphi drawing # C-018758 M/P -- ***Pre-production***
   c) Delphi Passenger Compartment Environmental Test Spec. # 98ETS-1141
   d) Delphi Product Test Specification # 21053015 -- ***Production Release***
   e) Delphi Drawing # 21020960 -- ***Production Release***
   f) Honeywell Test Interpretation Matrix -- ***Design Validation***
   g) Honeywell Test Interpretation Matrix -- ***Product Validation***

4. *Describe each and every component validation (pre-production) testing requirement specified by GM and/or Delphi Automotive Systems, including all ECL durability requirements, and explain the testing procedures Honeywell employed to validate that the subject component met all requirement specifications stated in Request No. 3. For each testing requirement, provide the date each requirement was met and the test results that indicate Honeywell met the specification.*

   State any requirement specification that Honeywell did not meet prior to vehicle production start-up or has not met since vehicle production start-up. Provide a chronological description of each action that Honeywell has taken to meet the requirement specification.

Summary Of Testing

The Shelby Facility was required to design to the performance requirements described in the Delphi Test Specification # A-002266 (attachment 3A) and Drawing # C-018758 M/P. (attachment 3B) these documents were later revised to Test Specification # 21053015 (attachment 3D) and Drawing #21020960 (attachment 3E) at production release. The test specifications define four distinct test legs, which are:

a) **Test Leg #1 – (44 units)**
   i. **Functional Tests**
   ii. Humidity
   iii. Thermal Storage
   iv. Dust
   v. Pull force
   vi. **Functional Tests** (to verify performance after above tests are completed)
   vii. Visual inspection

b) **Test Leg #2 –(44 units)**
   i. **Functional Tests**
   ii. Salt Fog
   iii. Thermal Shock
   iv. Pullout Force
   v. **Functional Tests** (to verify performance after above tests are completed)
   vi. Visual inspection

c) **Test Leg #3 – (44 units)**
   i. **Functional Tests**
   ii. Vibration
   iii. Drop Test
   iv. Pullout Force
   v. **Functional Tests** (to verify performance after above tests are completed)
   vi. Visual Inspection

d) **Test Leg #4 – 44 units**

i. **Functional Tests**
ii. Durability tests (1x life -- 50K cycles)
iii. **Functional Tests**
iv. Durability tests (2x life -- 50K cycles)
v. **Functional Tests**
vi. Durability tests (3x life -- 50K cycles)
vii. **Functional Tests**
viii. Visual Inspection

The Shelby Facility originally reported that the Product Validation testing based on the above test legs had been successfully completed and submitted the appropriate PPAP package to Delphi. After an initial Start of Production quality spill regarding the beryllium copper actuator at the Bowling Green Assembly plant, it was determined that the test sequence for verification was not adequate to detect intermittent switching in the feedback switch. The original testing protocol sampled ECL units on a periodic rather than continuous basis. Based on the quality spill discovered at the Bowling Green facility, the Product Validation Test System was upgraded to continuously monitor the feedback switch at every test cycle. It was after this tester upgrade implementation that the Shelby Facility discovered that a hardstop potential still existed within the design of the ECL. Delphi was notified and issued engineering permits for continued production while development of a solution to these durability-testing issues was ongoing. These engineering permits are included in the attachments provided in response to Request # 8.

This initiated a long review process of potential design changes and the testing of these proposed changes for verification. During this process root cause could not be ascertained even though major efforts were made to identify. Consultants were hired, Taguchi studies were made, and consultants were utilized as well as Shainin methods and consultants. It was not until May 2001 that root cause was identified as zinc impregnation onto the motor shaft allowing Delphi & Honeywell to resolve the hardstop phenomenon. This improved design was launched into production in January 2003 after having fully met the Product Validation Test requirements. Until then every attempt to validate had demonstrated this anomaly. Test results from numerous development validation attempts are in the attachments included in response to information Request #s 2 and 3.

5. *Describe the manufacturing process, including any statistical process control (SPC) check and quality assurance testing, that Honeywell uses to manufacture the subject component in the subject vehicle. For each SPC check and quality assurance test performed, state the test frequency and sample size. For all ECL sub-components, where Honeywell is not the manufacturer, provide the following:*

   a. *Component name and part number,*
   b. *Component supplier(s);*
   c. *Supplier contact name, address, and telephone number, and*
   d. *Date(s) for which each supplier has provided the product.*

The process, SPC checks and QA testing, quantity and frequency of the checks are included in the Control Plan are attached in response attachment binder # 5. All subcomponents not manufactured by The Shelby Facility are itemized for requests A through D.

6. *Provide a chronological summary of the results of all The Shelby Facility SPC checks and quality assurance tests that relate to the subject component in the subject vehicles. Provide a separate summary, in either graphical or tabular form, for each SPC check and/or quality assurance test. For each summary provided, identify the check or test performed, the entity that performed the check or test, the specific equipment from which the check or test samples was taken, the dates each check or test was performed, and the results of each check or test. Identify any problems, non-conformance to technical requirements, or other exceptions contained within this data, including a description of the problem, non-conformance or exception, the date(s) the problem, non-conformance or exception occurred, and a description of the corrective action taken.*

The SPC/Audit Summary is attached in the binders provided in response to Request # 6. The identity and control of the checks provided are found in the Control Plan supplied in response to Request # 5. Also included are the checks, identification, entity performing the check Problems and Actions noted as well as the Preventative Maintenance Logs.

7. *Provide a chronological description of all modifications or changes made by, or on behalf of, Honeywell in the design, material composition, manufacturing process, quality assurance/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 production.*

A chronological summary of all engineering changes with known dates is included as attachment "7A".

b. *The Honeywell assembly (plant(s) in which the modification or change was made;*

The Honeywell (formerly Fasco) plant manufacturing the device is located in Shelby, N.C. This is the only assembly plant that does and has manufactured the subject component.

c. *A detailed description of the modification or change;*

A detailed description for the modification or change -- these are stated on the actual engineering changes which have been included in this package (ref. Attachment "7B".

d. *The reason(s) for the modification or change;*
See "c" above.

> e. *The part numbers (service and engineering) of the original component;*

The part number of the original component was Honeywell # 1740-0002, Delphi # 26050960. Units were built with no manufacturing distinction between service and original equipment.

> f. *The part number (service and engineering) of the modified component;*

Honeywell and Delphi maintained the same part numbers until the latest unit was introduced in Jan. 2003. The new numbers are Honeywell # 1740-0014 & Delphi # 26089807.

> g. *Whether the original unmodified component was withdrawn from production and/or sale, and if so, when;*

Units were available to be distributed at our customer's discretion.

> h. *When the modified component can be interchanged with earlier production components.*

All versions are interchangeable with no known modifications to the system required.

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

Honeywell is not aware of any modifications or design changes that can be incorporated within 120 days.

> 8. *Provide copies of all of the following relating to the subject component and/or the alleged defect in the subject vehicle:*
>
> a. *All communications within Honeywell;*
>
> b. *All communications between Honeywell and Delphi; and*

c. *All communications between Honeywell and GM.*

Organize the documents within each of subparts "a" through "c" chronologically. 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.

All communications are provided from current employees and files available. Some files were lost during system conversion in late 1999.

Files include:

Rick Garlock	Customer Account Manager
Dick Norris	Director of Sales and Marketing
Van Flamion	Director of Engineering
Wade Landis	Engineering Program Manager
Steve Davis	Design Engineer
Sarah (Fiala) Weist	Quality Control Manager
Sandy Elmore	Purchasing Manager
Tim Willette	Former Quality Control Manager
Dan Thurber	Quality/Manufacturing Engineer

9. *Provide the following information in tabular form:*

   a. *The make, model and model year, of any other vehicles of which Honeywell is aware that contain the subject component, whether installed in production or in service, the applicable dates of production or service usage for the subject component in each vehicle, and the volume of components supplied for each vehicle; and*

   b. *The manufacturer, assembly plant, component part number (service and engineering), and vehicle for all other ECLs, including kits for use in service repairs to ECL assemblies, which have been release, manufactured, or developed, by Honeywell.*

The Shelby Facility does not sell the subject component to any other customer other than Delphi and is unaware of any other vehicles applications.

A single manufacturing site in Shelby, NC, produced the components. There is no other ECL. Honeywell does sell the same device to Delphi for supplying the GM Parts and Service Division. The Shelby Facility did sell the same device as part of a Customer Satisfaction Campaign (CSC) in mid-2001.

10. *Provide a description of each of the following conditions as it applies to the alleged defect in the subject vehicle and a chronological summary of the actions Honeywell has taken to rectify this condition in the subject component:*

    a. *A misformed condition in the actuator die, which can lead to a rebound of the lock bolt causing a potential for failure of the ECL to unlock during the vehicle start up;*

The misformed condition was on the component not the tooling die. A misformed actuator cannot cause rebound. It creates an intermittent actuation of the feedback switch. This switch confirms that the lock bolt has retracted by closing the electrical contacts upon full retraction of the lock bolt. An intermittent or open signal from the switch signals the BCM that the lock bolt CANNOT be confirmed to be retracted. Corrective Action Report (CAR)# 0703 addressed this issue. See the documents included in response to Request #7.

> b. *A bowing condition on the ECL hardware cover which can lead to binding of the ECL gears;*

The bowing of the cover causes an intermittent feedback switch as stated in "a" above. The switch and its assembly are attached to the cover. The bowing of this cover can cause the actuator to rub on the carrier as it traverses from lock to unlock (or unlock to lock) momentarily causing a false actuation of the switch. This does not cause a binding of the gears and does not contribute to rebound.

> c. *Improper heat treatment of the casting, crimp nest resulting in a potential for improper seating, which lead to either the binding of the ECL gears or the rebound of the ECL lock bolt; and*

Improper crimping of the subject component was the issue. It was not related to heat treatment of the nest. Again, the improper crimp contributes to an intermittent or low switch point due to two possible failure modes: 1) Loose crimp -- switch assembly attached to the cover is further away from the datum surface used for switch point tolerance causing a low or intermittent switch; and 2) Crimp too tight -- causes a bowing of the cover as described in "b" above. Neither condition will cause a binding of the gears. Corrective Action Report (CAR)# 0723 addressed this issue in detail. See attachment included in response to Request #7.

> d. *Any other condition in the subject component that relates to the alleged defect in the subject vehicle.*

The alleged failure in the vehicle is the "lock up of the steering column while the vehicle is in motion." As previously described, the other known or theoretical failure modes cannot cause the ECL to lock while driving.

11. Produce each of the following:

a. One exemplar sample of each design version of the subject component; and,

b. Field return samples of the subject component exhibiting each of the following conditions:

i. A misformed condition in the actuator die, which can lead to a rebound of the lock bolt causing a potential for failure of the ECL to unlock during the vehicle start-up;

ii. A bowing condition on the ECL hardware cover, which can lead to binding of the ECL gears;

iii. Improper heat treatment of the casting crimp nest resulting in a potential for improper seating, which can lead to either the binding of the ECL gears or the rebound of the ECL lock bolt; and

iv. Any other condition in the subject component that relates to the alleged defect in the subject vehicle.

a) Enclosed in the box labeled "Response to Request # 11" is a sample ECL from a subject vehicle. With the exception of the design launched in Jan. 2003, the attached unit represents design of the units manufactured from 1996 to 2002. Minor enhancements were incorporated -- (see attachment "7A" -- Engineering Change Chronology)

b) The enclosed unit is a "Field Return" manufactured on Sept. 2nd, 1998. It represents a "Rebound -- Electrical Switch." This unit has been machined to show the inter-workings of the carrier/actuator/switch assembly. An Oscilloscope graph is included (see attachment "11A"), it portraits electrically what the feedback switch is communicating to the control module. The default mode for the switch is "open" signally the controller that the lock bolt is "Locked". Unless the switch closes and remains closed, the lockbolt CANNOT be assumed to be unlocked.

i) No sample available -- see clarification in Question #10a
ii) No sample available -- see clarification in Question #10b
iii) No sample available -- see clarification in Question #10b
iv) There are no known samples or conditions of the ECLs, which could induce the alleged defect.

12. *Furnish Honeywell'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; and

e. *What warnings, of any, the operator and the other person both inside and outside the vehicle would have that the alleged defect was occurring or subject component was malfunctioning.*

See responses to previous questions.

Respectfully submitted,

Patrick M. Raher

Attachments