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October 21, 2014

Mr. Scott Yon
Chief, Vehicle Integrity Division
Office of Defects Investigation
National Highway Traffic Safety Administration
1200 New Jersey Avenue, SE
Washington, D.C. 20590

RE: Supplemental information: NVS-212eer, PE14-023

Dear Mr. Yon:

As stated in Hyundai's September 12, 2014 response to the above referenced Information Request ("IR"), additional evaluation of the subject vehicles' seat belt buckle pretensioner circuitry was conducted to better understand the cause of the seat belt buckle pretensioner circuit resistance values observed during an August 2014 field survey. This field survey was referenced by Hyundai in Response to questions 8-9 of the IR response. The following summarizes the evaluations that were conducted after the field survey. As requested, copies of documents related to the additional evaluation are provided as attachments.

Request 8

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, Hyundai. 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.

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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.

Request 9.

Provide or discuss the following information regarding the functionality of the Supplemental Restraints System Control Module (SRSCM) and certain diagnostic trouble codes (DTCs) that pertain to the subject components:

a. Provide the requirements or conditions for setting DTCs B1701 and B1706, and how the detection of these DTCs affects the function of the SRSCM, and/or the actuation (deployment) of the effected seat belt pretensioner;
b. State whether or not the SRSCM will attempt to actuate (fire) the seat belt pretensioner, if warranted by conditions incurred during a crash, when DTC B1701 and/or B1706 have been detected and set in the SRSCM;
c. Discuss how increased resistance levels in the pretensioner circuit affects whether or not the pretensioner will actuate (deploy) when commanded by the SRSCM, and state the minimum resistance that will result in a non-deployment when commanded;
d. Provide the requirements or conditions for setting DTCs Bl5l5,B1516, B1517 and B1518, and how the detection of these DTCs affects the function of the SRSCM, the deployment or deployment timing of the seat belt pretensioner, and/or the deployment or deployment timing of either frontal air bag;
e. State whether or not frontal air bag deployment, frontal air bag deployment timing, or the SRSCM's decision on whether to deploy one or both stages of either frontal air bag, is in any way dependent on, or affected by, whether or not an occupant is wearing a seat belt, and if so, discuss the effect(s);
f. State whether or not there is any scenario where a fault in the subject component(s) can result in, or cause the frontal air bag to not deploy, to deploy at a different time, or to incorrectly deploy one versus both stages, then if the fault was not present.

Responses to Requests 8 and 9:

1. On September 16-18, 2014, Hyundai Motor Company (HMC) and Takata conducted two evaluations. In the first evaluation, the resistance values of the seat belt buckle pretensioner circuit in five sample parts were measured before and after the connector and seat belt buckle assembly were exposed to four hours of mechanical vibration. There were no significant differences noted between pre and post vibration exposure. In the second evaluation, additional resistance was added to the seat belt buckle pretensioner circuit to establish the maximum level of circuit resistance which could be present and still allow firing of the seat belt buckle pretensioner device. Five sample parts that were not exposed to vibration and three samples that were exposed to vibration were evaluated. Testing indicates the pretensioner circuit will fire with as much as 32 ohms of additional resistance added to the

circuit. Refer to Attachment 1 for a summary of this evaluation.

2. On August 28 through September 23, 2014 the following evaluations were conducted on field sample parts:

   a. To confirm the proper attachment of the circuit's wire strands to the connector pin crimp, pins were evaluated using computed tomography (CT) analysis. Proper attachment was confirmed in each of the samples evaluated. Refer to Attachment 2 for a summary of this evaluation.

   b. Terminal pins were inspected using Scanning Electron Microscopy (SEM) to identify any connector pin surface irregularities that could be related to increased circuit resistance (voids, corrosion, etc.). There were no indications of surface irregularities with the connector pin surfaces. Refer to Attachment 3 for a summary of this evaluation.

   c. Testing was subsequently conducted to observe the circuit resistance during sample component vibration. Each sample was exposed to 40 hours of vibration along 3 perpendicular (+/- x, y and z) axes. There appeared to be a minimal effect to the connection integrity during vibration testing. Refer to Attachment 4 for a summary of the connector vibration testing.

   d. The effect of moving the seat fore and aft along the seat track upon the seat belt buckle pretensioner circuit resistance was evaluated. The circuit resistance remained within the normal range (1.6 – 4.7 ohms) over a series of 12,000 fore/aft movement cycles. Refer to Attachment 5 for a summary of the seat movement testing.

   e. The seat belt buckle pretensioner circuit resistance was monitored while a complete seat assembly (with the seat belt buckle wiring harness and connector attached) was exposed to a six axis (+/- x, y, and z) vibration evaluation. The circuit resistance remained within an acceptable range over a series of eight 15 minute vibration evaluations. Refer to Attachment 6 for a summary of this evaluation.

3. On August 29 through October 1, 2014, additional testing was conducted to observe the circuit resistance during component vibration. As an experiment, the connector lock tabs on four seat belt buckle pretensioner connectors were removed. It is believed the relative motion between the connector pin contact surfaces over time could result in the minor increases in circuit resistance. Each sample was exposed to 40 hours of vibration along 3 perpendicular (+/- x, y and z) axes. Testing revealed that while there appeared to be minimal effect to the connection integrity during vibration along the "x" and "y" axes, there were increases over the normal resistance range observed during "z" axis vibration.

The connector halves were then stabilized to prevent relative motion between the two connector halves using a cable tie, and the vibration testing was repeated. Resistance values during these tests remained in the normal range. Refer to Attachment 7 for additional detail.

When the seat belt buckle pretensioner circuit resistance exceeds 6.1 ohms, related diagnostic codes are stored, and the airbag light illuminates informing the owner the system should be checked. As stated in Hyundai's September 12, 2014 response, the presence of these stored diagnostic codes does not affect the ability of the SRSCM to detect a collision and command deployment of the pretensioners and airbags when warranted. Testing was conducted to determine the maximum resistance before the pretensioner may not actuate, and that resistance value is 2-3 times higher than any resistance value found in the field survey or during laboratory testing. Based on the results of the field survey and subsequent laboratory testing, Hyundai does not believe the increased resistance of the seat belt buckle pretensioner circuit and corresponding diagnostic codes present a safety risk.

Sincerely,

Steve Johnson

Steve Johnson
Director, Engineering and Design Analysis

Attachments:

Attachment 1 – HMC/Takata evaluation
Attachment 2 – CT Analysis
Attachment 3 – SEM analysis
Attachment 4 – Connector vibration evaluation
Attachment 5 – Seat sliding evaluation
Attachment 6 – Seat and buckle evaluation
Attachment 7 - Vibration evaluation with modified connector body