



Pseudo-Energy Editing Method

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. The purpose of this procedure is to describe the Pseudo-Energy Calculation Method for acceleration data.

1.2 Applicability. This procedure is only applicable to acceleration data.

1.3 Remarks. This procedure is typically used as a criterion for checking editing quality of wheel spindle acceleration data for the 4/5/6-Post Laboratory Vertical Simulation Test or inertially-reacted Hot Exhaust tests. The technique can also be used to check the editing quality of any acceleration data.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW15224

GMW15232

GMW15243

2.3 Additional References.

SAE Paper 911051: "Combining Accelerated Laboratory Durability with Squeak and Rattle Evaluation", Aaron Hurd, 1991.

3 Resources

3.1 Facilities.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment. Not applicable.

3.3 Test Vehicle/Test Piece. Not applicable.

3.4 Test Time. Dependent on size of data set, typically 4 h to 8 h

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Test technician familiar with test facilities, equipment and acceleration data editing.

4 Procedure

4.1 Preparation. Not applicable.

4.2 Conditions.

4.2.1 Environmental Conditions. Not applicable.

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October 2017

Page 1 of 6

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.3 Instructions. The term “**Pseudo-Energy Calculation**” is sometimes referred to as Energy Editing. This is a misnomer in that energy is not edited, but rather, used as a criterion for checking the editing quality. Specifically, Pseudo-Energy is calculated prior to editing data or developing a test, and then recalculated after editing data or developing a test. The amount of Pseudo-Energy retained after editing or test development can then be used to determine whether the resultant edited dataset or drive file set sufficiently meets objectives, or if action such as re-editing, new drive development, or road schedule multiplier adjustments should be made to bring the Pseudo-Energy level back to the baseline level.

Note: The mathematics behind the calculations is reviewed in Appendix A.

4.3.1 Verify the Data. Verify the data prior to calculating Pseudo-Energy. The input files must conform to GMW15243 and contain acceleration data. Channel number, channel descriptors, units, sample rate, points/frame and points/group, must be the same for every input file for a given channel.

Note: The typical sample rate and frame size should be such that a frequency resolution of 0.25 Hz or better is achieved.

4.3.1.1 The equations for Pseudo-Energy calculation assume units of m/s/s. Conversion from other units, e.g., g's, must happen before following the rest of the process.

4.3.2 Taper. The beginnings and ends of files must taper to zero. A typical taper time of approximately 0.5 s is used.

4.3.3 Filtering. The data must be filtered using a high-pass filter created such that it passes data above at least the first spectral line.

The filter is applied to the tapered files to assure that there is no static offset prior to integration.

4.3.4 Integration. The filtered acceleration files are integrated to get velocity data.

4.3.5 Filter Velocity Files. The velocity files are filtered using the same filter as used for filtering the accelerations.

4.3.6 Statistics. Statistics are calculated from the filtered acceleration and velocity files for error checking and to determine full-scale values for the Pseudo-Power files.

4.3.7 Pseudo-Power Time-Histories. Pseudo-Power files are created by multiplying the absolute values of the filtered acceleration and velocity.

4.3.8 Integrate Pseudo-Power Files. The Pseudo-Power files are integrated to get the cumulative Pseudo-Energy files. Statistics are calculated for the Pseudo-Energy. The Pseudo-Energy statistics are used to generate statistical summaries in the following step:

4.4 Summarize Results. Create a baseline data summary spreadsheet, using the “Energy” files, summarizing their maximum amplitudes, weighted by the repetitions of a given road surface, and summed to obtain the total Pseudo-Energy.

4.4.1 Review Results Summary. Using the summary, it is then possible to see which files can be eliminated from the test because they contribute very little Pseudo-Energy.

4.4.1.1 Files with less than 1% Pseudo-Energy are typically eliminated. Warning: transient events (i.e. potholes) have low Pseudo-Energy percentages. Acceleration is not a good indicator of the damage imparted by these events. Do not remove these files from the test.

4.4.1.2 Low frequency twist events are typically not included in the Pseudo-Energy calculation and are usually synthetically created.

4.4.1.3 It is also possible to examine duplicate laps of a given road segment and eliminate redundant laps. The lap with the highest Pseudo-Energy may be kept and the remaining laps eliminated. The eliminated laps are later accounted for by increasing the number of repeats of the remaining lap. The advantage is a reduction in the total number of files that need to be developed on the test rig and potentially a shorter drive file.

4.5 Data Editing. The remaining data can then be edited to remove low Pseudo-Energy segments from each file. Various techniques are used to edit the data depending on the type of data. Some of the more common editing methods include: graphically editing the acceleration data while overlaying the Pseudo-Power data as a

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October 2017

Page 2 of 6



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