



## GMW14201 Mirror Vibration Evaluation Procedure

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V-Note # 0011

### Abstract

The GMW14201 specification (Mirror Vibration Evaluation Procedure) is described.

### Question

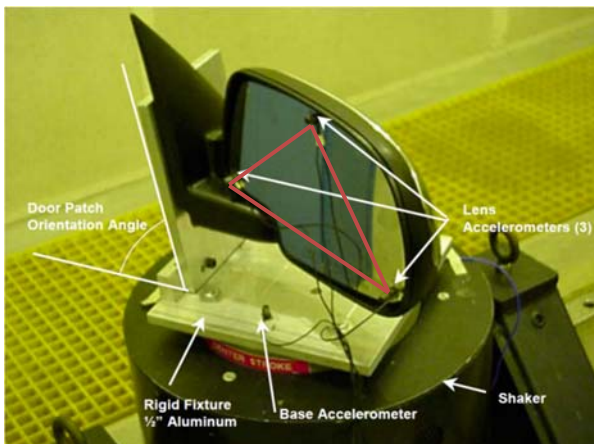
Many people have asked what the GMW14201 specification is and what is needed to perform a test that matches this specification.

### Answer

The GMW14201 specification is a rotational vibration measurement test implemented on inside and outside automotive rear view mirrors. It is designed to measure the rotational response of a mirror when subjected to vertical input vibration.

### Test Setup Method

Accelerometers are placed on the reflective surface of an inside or outside rearview mirror in a triangular pattern. This triangular pattern is highlighted in red in [Figure 1](#) below.



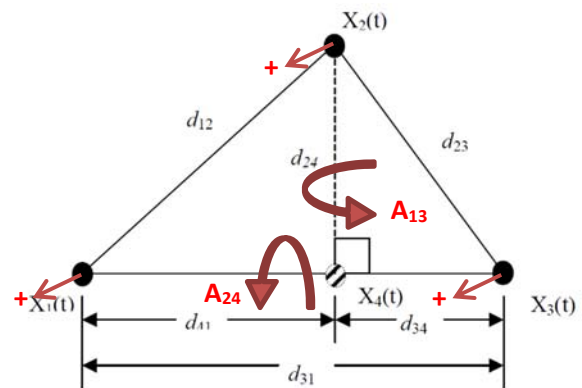
[Figure 1](#) - Test Setup.

The distance between each of the accelerometers is entered into a form in VibrationVIEW for later calculations.

The mirror assembly is then mounted to a rigid fixture which is mounted to the head of a shaker. The mirror is then shaken vertically by using a random vibration profile specified by the GMW14201 specification. While the test is conducted, VibrationVIEW records the values of each of the input and response accelerometers at a high sample rate. Note: recording waveform data requires the RecorderVIEW option on the VR controller conducting the test.

### Post Processing Method

After the test has completed, a MATLAB script computes the remaining calculations. The accelerometers are arranged in a way that the difference in acceleration between two accelerometers divided by the distance between them determines the angular acceleration between them. [Figure 2](#), below, is a 2-D representation of the triangular array shown mounted on a mirror in [Figure 1](#).



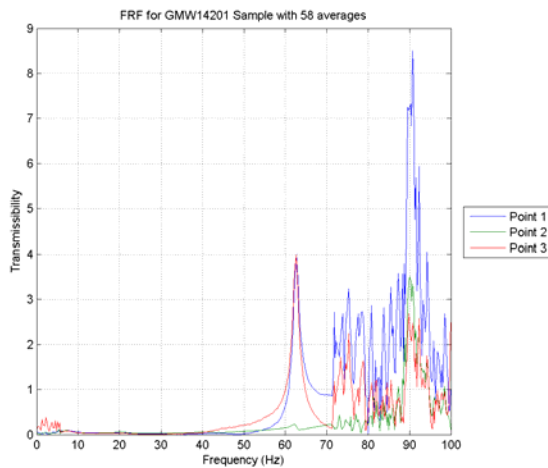
[Figure 2](#) - Mirror Rotation Setup Schematic.

$X_1$ ,  $X_2$ , and  $X_3$  in [Figure 2](#) represent the readings of the three physical accelerometers shown in [Figure 1](#).  $X_4$  is a “virtual”, calculated accelerometer.

$A_{13}$  and  $A_{24}$ , shown in [Figure 2](#), denote the angular acceleration that is calculated between points 1 and 3, and 2 and 4 respectively.  $A_{13}$  represents the “yaw” of the mirror, while  $A_{24}$  represents the “pitch” of the mirror.

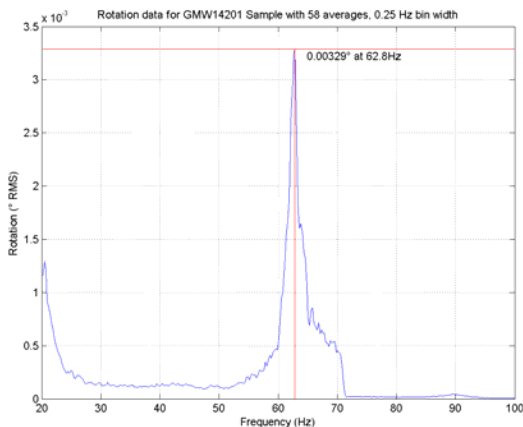
### Test Results

The MATLAB script mentioned before outputs a series of graphs. One is “Transmissibility vs. Frequency”:



[Figure 3 - Transmissibility vs. Frequency.](#)

And another is “Rotation vs. Frequency”:



[Figure 4 - Rotation vs. Frequency.](#)

### Tools Required

The GMW14201 specification can be conducted with any capable hardware and software combination by following the details of the

specification. However, it is much easier to carry out the test by using VR’s hardware, software, and custom MATLAB script. The following list includes the recommended tools for conducting the test:

1. GMW14201 Specification from General Motors Corporation.
2. VR9500 or VR8500 Vibration Controller.
3. RandomVIEW Test Module.
4. RecorderVIEW waveform recording option.
5. GMW14201 MATLAB script.
6. MATLAB 7(r14) or newer.
7. Three light-weight single-axis matched 100 mV/g accelerometers with low transverse sensitivity.
8. One shaker control accelerometer.
9. A shaker with fixturing capable of running this specification.

If you are interested in running the GMW14201 specification with the recommended tools listed above, please contact Vibration Research Corporation’s sales department:

Phone: 616-669-3028

Email: [vrsales@vibrationresearch.com](mailto:vrsales@vibrationresearch.com)

Note: [Figure 1](#) and [Figure 2](#) used in this document were found in the GMW14201 specification.