



## Background and Summary of Evaluations for the Mighty-Tite™ Seat Belt Tightener

### Regulatory Environment

The National Highway Traffic Safety Administration (NHTSA), under the Department of Transportation, is responsible for developing and administering regulations regarding motor vehicle safety. These regulations are identified as Federal Motor Vehicle Safety Standards (FMVSS).

Although NHTSA has promulgated many regulations regarding motor vehicle safety, there are no specific regulations or testing protocols that govern what are usually described as "aftermarket" products. NHTSA's regulations cover vehicles themselves, as well as certain products used in them such as child restraint systems ("car seats"), but do not cover "aftermarket" products such as the Mighty-Tite.

Nevertheless, because the Mighty-Tite's intended usage is in conjunction with both the vehicle lap seat belt and a car seat, there are two regulations that can be used as reference to determine testing of the Mighty-Tite and evaluate its effectiveness for its intended purpose. These regulations are FMVSS 213 for Child Restraint Systems and FMVSS 209 for Seat Belt Assemblies.

### Testing and Protocol

To provide a measure of confidence that the Mighty-Tite is in substantial compliance with the applicable provisions of these regulations, testing was conducted at both the University of Michigan Transportation Research Institute (UMTRI) and at Detroit Testing Laboratory (DTL). The UMTRI testing involved dynamic crash testing using a variety of dummies and car seats to evaluate injury criteria; the DTL testing involved physical testing of the Mighty-Tite to evaluate its functional and physical properties.

In addition to this testing, other tests were also conducted to evaluate the performance of the Mighty-Tite when subjected to multiple installations and adjustments during use, and to comparatively evaluate its performance during the dynamic crash test relative to standard car seat installations.

### Dynamic Crash Testing

The dynamic crash testing per FMVSS 213 utilized the following dummies in their appropriate car seats:

- Newborn in a rear facing infant seat
- 6-month old in a rear facing infant seat
- 12-month old in a forward facing car seat and a forward facing booster
- 3-year old (both with and without a weighted vest attached) in a forward facing car seat
- 6-year old (both with and without a weighted vest attached) in a forward facing car seat

Test results for these tests were the numerical injury criteria measurements specified in the standard, including:

- Head Injury Criteria (HIC)
- Chest Acceleration (Chest G's)
- Head Excursion
- Knee Excursion
- Back Angle (for rear facing seats)

### Physical Properties

Flammability, temperature resistance, compressive forces, and seat belt webbing integrity were evaluated relative to the requirements of FMVSS 209.

### Multiple Installation Cycling

Although not required by a specific safety standard protocol, seat belt webbing was cycled through the Mighty-Tite at various angles to simulate multiple installations and sliding of the product on the webbing. This test was conducted to determine if such action created any adverse effects on the webbing itself.

### **Comparative Tests with Loosely Belted Car Seats**

Again, although not required by any safety standard, dynamic crash testing was conducted per the FMVSS 213 protocol to evaluate the use of the Mighty-Tite on car seat installations relative to these same installations without the Mighty-Tite in place and with loose and normal seat belt tension. Injury criteria as specified above were measured and compared to determine the effectiveness of the Mighty-Tite.

### **Summary of Results**

- Dynamic Crash Testing – all numerically measured injury criteria were well within the established limits of FMVSS 213.
- Physical Properties – all properties evaluated met the requirements of FMVSS 209. Seat belt webbing integrity also met these requirements after dynamic crash testing with the Might-Tite installed.
- Multiple Installation Cycling – no significant damage or deterioration was observed during this test that would affect the performance of the seat belt webbing as specified in FMVSS 209.
- Comparative Testing – all numerically measured injury criteria were reduced through the use of the Mighty-Tite on car seats.

### **Overall Conclusions**

- In all tests performed, the Mighty-Tite complied with the applicable requirements of the FMVSS standards.
- No significant effects of installation and usage were observed on the seat belt webbing.
- Installation of the Mighty-Tite reduced the effects of the dynamic crash test on injury criteria specified in FMVSS 213.

### **The Effects of Seat Belt Tightness on Child Restraint Systems**

As a result of investigation and research into the issue of vehicle seat belt tightness and the potential effect of excessive tightness on a child restraint system (CRS), the following salient points are relevant to this issue:

- In general, CRS design and construction takes into account the tension forces generated on the seat belt during both the manufacturer's recommended CRS installation process and the dynamic crash test.
- Dynamic crash test forces far exceed those placed upon the CRS during recommended installation (by as much as 8 or 10 times), and therefore these extreme forces are generally relied upon to determine design and engineering specifications for the maximum required performance of the CRS.
- During the CRS installation process, typically vehicle seats themselves are initially compressed as the seat belt tension on the CRS increases.
- Empirical testing has shown that with excessive tightening of up to 100 lbs. of seat belt tension force, vehicle seats typically deform and/or are permanently damaged prior to any damage occurring to the CRS itself.
- Even after excessive tightening of the seat belt up to 100 lbs., vehicle seats immediately begin to "relax" into a position that then relieves the seat belt tension over a short period of time, significantly reducing the overall tension force on the CRS to below 40 lbs.
- Complaints and returns of CRS units for structural damage as a result of excessive seat belt tightening are virtually non-existent.

### **Implications for the Mighty-Tite Seat Belt Tightener**

- When the Mighty-Tite is used properly, the tension force applied to the seat belt is comparable to the force on the CRS when it is installed according to the manufacturer's recommendations without the use of the device.
- Even if excessive force is exerted through the use of the Mighty-Tite during CRS installation, due to the dynamics of the vehicle seat and the actual resultant force on the seat belt, there is no indication that CRS performance will be degraded.