



# Memorandum

Subject: **ACTION:** REACT 350 crash cushion

Date: SEP 14 2016

From: Elizabeth Alicandri   
Associate Administrator for Safety

In Reply Refer To:  
HSA-1

To: Division Administrators  
Directors of Field Services  
Federal Lands Highway Division Engineers

## Purpose

The purpose of this memorandum is to share information with you regarding a version of the REACT 350 crash cushion with a 9 cylinder configuration that was manufactured and sold between 1996 and 2007. The information pertains to a recent voluntary disclosure made by Trinity Industries to FHWA regarding a crash test conducted in 2007 that exceeded the allowable limit for Occupant Ridedown Acceleration, one of two performance factors used to assess occupant risk under National Cooperative Highway Research Program (NCHRP) 350 report.

## Background

On April 12, 1995, FHWA issued a letter of “full acceptance” of a crash cushion called the “REACT 350” with various configurations including a 9 cylinder configuration. In late 1996-1997, the inventor modified the 9 cylinder REACT 350 by changing the three rearmost cylinders from 1.4” thickness to 1.8” thickness. Finite Element Analysis (FEA) computer modeling and engineering judgement, but not crash testing, was used by the inventor to evaluate the crashworthiness of the device with this modification. The modified 9 cylinder device was then manufactured and sold to customers by companies including Roadway Safety Services Inc. and Energy Absorption Systems (EAS), Inc. from 1996 to 2007.

In 2007, EAS had crash tests performed of the modified 9 cylinder REACT 350 device with the three rear most cylinders at 1.8” thickness. The Occupant Ridedown Acceleration result of the first crash test was measured at 20.8 G. After these 2007 crash test results, EAS stopped manufacturing and selling the modified 9 cylinder REACT 350 device and reverted back to selling the 9 cylinder REACT 350 device with the three rearmost cylinders with 1.4” thickness. In 2010, Trinity acquired EAS.

Trinity Industries recently voluntarily disclosed to FHWA the results of the 2007 crash test. As of the date of this letter, FHWA has been unable to locate any documentation

showing that we were aware that EAS had performed this 2007 crash test or of its results. NCHRP Report 350 (Report 350) presents criteria used to evaluate the results of crash testing of roadside safety hardware. Between 1993 and 2015, FHWA relied on Report 350 as guidance to determine whether or not a crash test demonstrates that a roadside safety hardware device was eligible for Federal-aid funding. Report 350 states the “the Occupant Ridedown Accelerations should satisfy a maximum limit of 20 G”. We have interpreted the 20 G value to permit up to 20.49 G due to rounding.

FHWA evaluated the significance of the modified 9 cylinder REACT 350 exceeding the Report 350 maximum recommended limit for ORA. FHWA contacted the National Highway Traffic Safety Administration (NHTSA) to gain insight on the risk of serious injury when 20.5 G is exceeded. The NHTSA New Car Assessment Program (NCAP) rates vehicles relative to their crashworthiness. NCAP gathers vehicle data that can be used to show ORA values from crash tests. FHWA reviewed NCAP vehicle data from full frontal, rigid barrier crash testing of 67 recent tests on model year 2013 and 2014 vehicles. Data gathered from these tests show 88 percent of the vehicles were rated 4 or 5 stars and those vehicles had ORA values ranging from 25.6 G up to 58.8 G with an average value of 35.9 G.

After evaluating this information, FHWA has concluded that the existence of an ORA value slightly above 20.49 G during crash testing does not reflect a dramatically increased risk of serious injury in comparison to an ORA value of 20.49 G. FHWA is not aware of any additional information relating to the modified REACT 350 to lead FHWA to a different conclusion. Notwithstanding that conclusion, FHWA notes that the modified 9 cylinder REACT 350 device does not meet the NCHRP 350 recommended ORA maximum value.

### **Action**

Please share this memorandum and the enclosed letter to Trinity with your State DOT and any city, county or municipality in your State with responsibility for the operation and maintenance of their roadways. FHWA has requested that Trinity notify highway agencies of the 2007 test results in a manner reasonably likely to reach all purchasers and users of the modified 9 cylinder REACT 350 device. FHWA has also requested that Trinity develop a plan to offer modification or replacement of any modified 9 cylinder REACT 350 device that an owner or operator identifies. Given the limited ability to visually distinguish between the 1.4” and 1.8” thickness cylinders, FHWA has asked Trinity to provide guidance and assistance with identifying the modified 9 cylinder REACT 350 with 1.8” thickness cylinders.

If you have questions, please contact Michael Griffith at (202) 366-9469 or [mike.griffith@dot.gov](mailto:mike.griffith@dot.gov)

**Enclosure**



U.S. Department  
of Transportation  
**Federal Highway  
Administration**

1200 New Jersey Ave., SE  
Washington, D.C. 20590

September 13, 2016

In Reply Refer To:  
HSST-1

Scott Ewing  
Associate General Counsel  
Trinity Industries, Inc.  
2525 North Stemmons Freeway  
Dallas, TX 75207

Dear Mr. Ewing:

Thank you for your voluntary June 9, 2016 response to the Federal Highway Administration (FHWA) questions about the REACT 350. FHWA has reviewed the materials you provided and made additional searches for records within our control related to the REACT 350. This letter summarizes the REACT 350 history as understood by FHWA and requests that Trinity Industries Inc. (Trinity) make certain additional disclosures and take certain actions described below.

On April 12, 1995, FHWA issued a letter of "full acceptance" of a crash cushion called the "REACT 350" with various configurations including a 9 cylinder configuration. In late 1996-1997, the inventor of the device, Dr. Carney, modified the 9 cylinder REACT 350 by changing the three rearmost cylinders from 1.4" thickness to 1.8" thickness. Dr. Carney used Finite Element Analysis (FEA) computer modeling and engineering judgement, but not crash testing, to evaluate the crashworthiness of the device with this modification. The modified 9 cylinder device was then manufactured and sold to customers by companies including Roadway Safety Services Inc. and Energy Absorption Systems (EAS), Inc. Trinity does not have records of who purchased this device but estimates approximately 900 of these modified 9 cylinder configuration devices were purchased between 1996 and 2007. As of the date of this letter, FHWA has been unable to locate any documentation showing that any FHWA employees received notice or any communications related to this modification to the 9 cylinder REACT 350. Also, FHWA has been unable to locate any documentation showing that our agency issued an eligibility letter, acceptance letter, or any other concurrence for this modification.

In 2007, EAS had crash tests performed of the modified 9 cylinder REACT 350 device with the three rear most cylinders at 1.8" thickness. The Occupant Ridedown Acceleration (ORA) result of the crash test was measured at 20.8 G. As of the date of this letter, FHWA has been unable to locate any documentation showing that FHWA was aware that EAS had performed this 2007 crash test or of its results. After these 2007 crash test results, EAS stopped manufacturing and selling the modified 9 cylinder REACT 350 device. The original REACT 350 device with 1.4" thickness rear cylinders and the Optimized REACT 350 with 1.4" rear cylinders both continue to have valid eligibility letters from FHWA based on results of crash testing. Trinity purchased EAS in 2010.

As you are aware, NCHRP Report 350 (Report 350) is a research report FHWA uses as guidance to evaluate the results of crash testing roadside safety hardware. Between 1993 and 2015, FHWA relied on Report 350 as guidance to determine whether or not a crash test demonstrates that a roadside safety hardware device was eligible for Federal-aid funding. Report 350 states the “recommended limits for occupant impact velocity and ORAs [occupant ridedown accelerations] are given in Table 5.1.” Table 5.1 then states that the ORAs should satisfy a maximum limit of 20 G. FHWA has interpreted the 20 G value to permit up to 20.49 G due to rounding.

FHWA evaluated the significance of the modified 9 cylinder REACT 350 exceeding the Report 350 maximum recommended limit for ORA. FHWA contacted the National Highway Traffic Safety Administration (NHTSA) to gain insight on the risk of serious injury when 20.5 G is exceeded. The NHTSA New Car Assessment Program (NCAP) rates vehicles relative to their crashworthiness. NCAP gathers vehicle data that can be used to show ORA values from crash tests. FHWA reviewed NCAP vehicle data from full frontal, rigid barrier crash testing of 67 recent tests on model year 2013 and 2014 vehicles. Data gathered from these tests show 88 percent of the vehicles were rated 4 or 5 stars and those vehicles had ORA values ranging from 25.6 G up to 58.8 G with an average value of 35.9 G.

After evaluating this information, FHWA has concluded that the existence of an ORA value slightly above 20.49 G during crash testing does not reflect a dramatically increased risk of serious injury in comparison to an ORA value of 20.49 G. FHWA is not aware of any additional information relating to the modified REACT 350 to lead FHWA to a different conclusion.

Notwithstanding that conclusion, FHWA notes that the modified 9 cylinder REACT 350 device does not meet the NCHRP 350 recommended maximum value for ORA. Therefore, FHWA requests that Trinity notify highway agencies of the 2007 test results in a manner reasonably likely to reach all purchasers and users of the modified 9 cylinder REACT 350 device. FHWA also requests that Trinity develop a plan to offer modification or replacement of any modified 9 cylinder REACT 350 device that an owner or operator identifies. Given the limited ability to visually distinguish between the 1.4” and 1.8” thickness cylinders, Trinity should also provide guidance and assistance with identifying the modified 9 cylinder REACT 350.

FHWA intends to notify the FHWA Division Offices who work with each State Department of Transportation about the existence of these devices on highways. Please contact me if you have any questions or would like to discuss in more detail.

Sincerely yours,



Michael S. Griffith  
Director, Office of Safety Technologies