



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

400 Seventh St., S.W.
Washington, D.C. 20590

April 15, 2005

In Reply Refer To: HSA-10/CC-90

Dean L. Sicking, P.E., Ph.D.
CEO
Safety By Design Company
6307 Yellowstone Circle
Lincoln, Nebraska 68510

Dear Dr. Sicking:

In your March 10 letter, you provided design and crash test information on a Trailer Truck-Mounted Attenuator (TMA) and requested formal acceptance of this device for use on the National Highway System (NHS) at the National Cooperative Highway Research Program (NCHRP) Report 350 test level 3 (TL-3). To support your request, you also sent me a copy of the Midwest Roadside Safety Facility's February 28 report entitled "Performance Evaluation of the Trailer-Truck-Mounted Attenuator (Trailer TMA) – NCHRP 350 test nos. 3-50 and 3-51 (TTMA-3 and TTMA-4)" and videotapes of the crash tests conducted.

The Trailer TMA design is based on the bursting tube technology originally developed for the energy-absorbing terminal for box-beam guardrail and subsequently adopted for use on trailer-mounted changeable message signs/arrow boards. The Trailer TMA includes four major components: an impact head assembly, a trailer frame, a hitch assembly, and a breakaway axle assembly. The trailer frame incorporates three levels of energy absorption: (1) a 610-mm (24-in) long bursting tube fabricated from 152 mm x 152 mm x 3.2 mm (6 in x 6 in x 1/8 in) ASTM A500 Grade B structural tube, (2) a 2594-mm (9-ft, 6.125-in) long second stage bursting tube of the same size and material, and (3) an 1834-mm (6-ft, 3/16-in) 152 mm x 152 mm x 4.8 mm (6 in x 6 in x 3/16 in) ASTM A500 Grade B structural tube. The general design of the Trailer TMA is shown in Enclosure 1. As noted therein, the total length of the tested design is 7050 mm (23 ft, 1-9/16 in) and its width is 2438 mm (8 ft) at the impact plate assembly. The trailer frame is 464 mm (18.25 in) above the ground and the total weight of the TMA is approximately 640 kg (1410 lbs). I am assuming that users may obtain detailed drawings directly from you and that such drawings will accurately depict the device that was crash tested.

The safety performance of the Trailer TMA was verified through full-scale crash testing. Both mandatory NCHRP Report 350 tests required for a truck-mounted attenuator were conducted: the 820-kg car (test 3-50) and the 2000-kg pickup truck (test 3-51) impacting head-on at



100 km/h. Summary sheets for these two tests are shown in Enclosure 2. In both tests, the support truck was blocked to prevent any forward movement. Thus, there is no upper limit to the weight of the support vehicle with which the Trailer TMA is used.

Although TMAs may also be used with lighter support vehicles, potential users must be made aware that its use with a *significantly* lighter vehicle, while likely to decrease impact forces on the occupants of the errant vehicle, will increase the forces transmitted to the driver of a lighter support vehicle. It then becomes critical that the support vehicle has proper headrest supports and that the driver be securely belted. Furthermore, the support vehicle roll-ahead and the post-crash trajectories (particularly following off-center impacts) of both vehicles will differ considerably from those seen in tests with the “standard” 9000 kg (19,840 lbs) support vehicle. Thus, it is not recommended that any TMA be used with a support vehicle as light as a pickup truck without test verification.

You have also submitted results of a bogie test showing an offset impact with the device similar to optional test no. 3-52. While the results of the bogie test indicate that the device may meet Report 350 evaluation criteria under offset impact conditions, the two optional tests (nos. 3-52 and 3-53) recommended in Report 350 should be conducted to confirm that the device will perform satisfactorily in these two tests.

Based on the above, I conclude that your tested design meets the NCHRP Report 350 evaluation criteria for tests 3-50 and 3-51 and may be used on the NHS if such use is acceptable to the contracting agency.

Please note the following standard provisions that apply to the FHWA letters of acceptance:

- Our acceptance is limited to the crashworthiness characteristics of this device and does not cover its structural features or durability, or its conformity with the Manual on Uniform Traffic Control Devices insofar as impact face reflectorization is concerned.
- Any design changes that may adversely affect the crashworthiness of the device will require a new acceptance letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the device being marketed is significantly different from the version that was crash tested, we reserve the right to modify or revoke our acceptance.
- This letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented device for which the applicant is not the patent holder. The FHWA is neither prepared nor required to become involved in issues concerning patent law. Any such issues that may arise are to be resolved by the applicant.
- You will be expected to supply potential users with sufficient information on design and installation requirements, including specifications for the support vehicle trailer hitch attachment, to ensure proper performance in a crash.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for acceptance.

- To prevent misunderstanding by others, this acceptance letter, designated as acceptance letter CC-90, shall not be reproduced except in full. This letter, and the test documentation upon which this letter is based, is public information. All such letters and documentation may be reviewed at our office upon request.
- The Trailer TMA is a patented device and is considered "proprietary." The use of proprietary hardware in a work zone on Federal-aid projects is generally of a temporary nature. These features are usually *selected by the contractor* for use as needed and removed upon completion of the project. Under such conditions they can be presumed to meet requirement (a) given below for the use of proprietary products on Federal-aid projects. On the other hand, if proprietary devices are *specified by a highway agency* for use on Federal-aid projects, except exempt, non-NHS projects, they: (a) must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with existing highway facilities or that no equally suitable alternative exists or; (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.

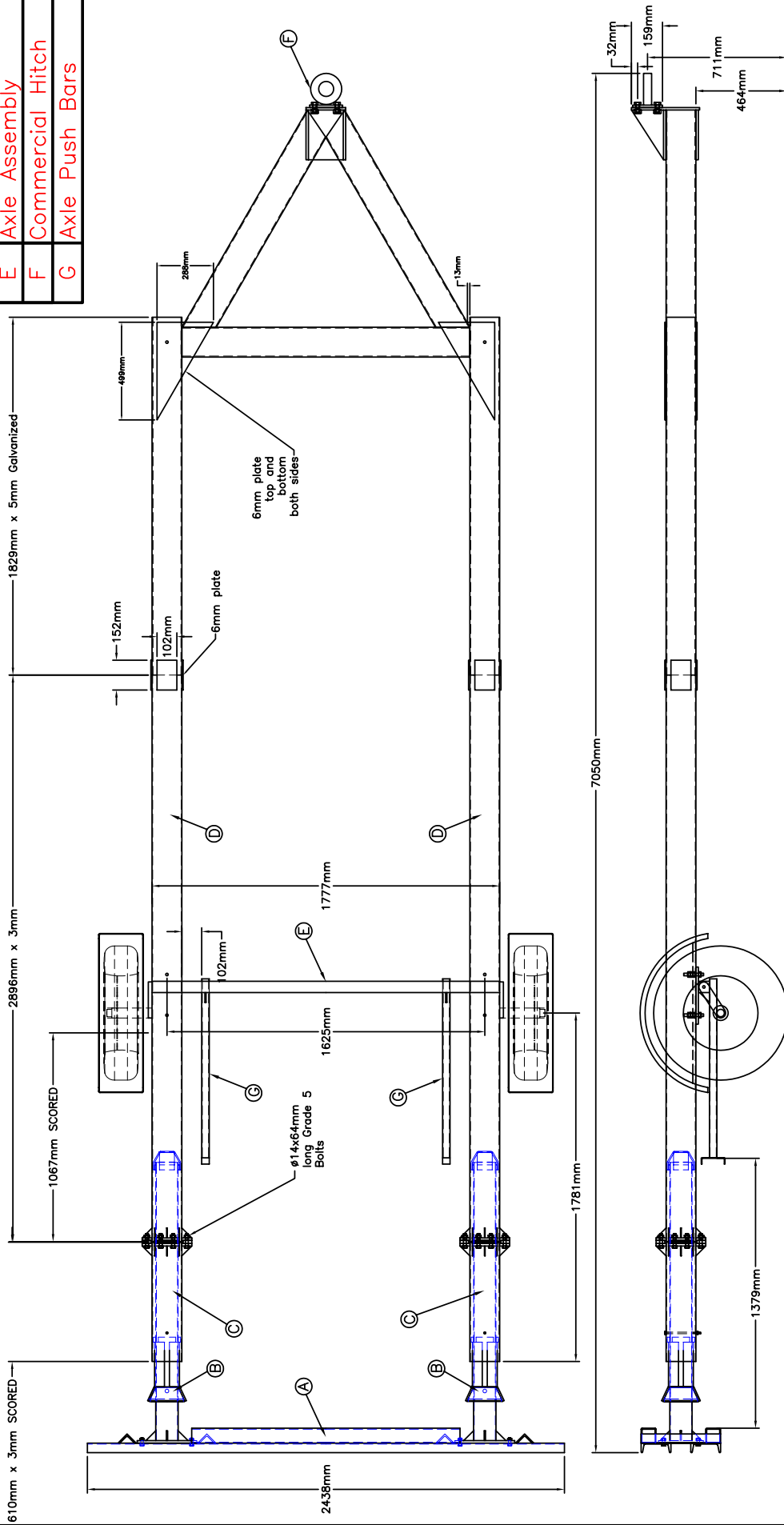
Sincerely yours,

/original signed by/

John R. Baxter, P.E.
Director, Office of Safety Design
Office of Safety

2 Enclosures

ITEM	DESCRIPTION
A	Impact Head
B	Mandrel
C	First Tube
D	Trailer Frame
E	Axle Assembly
F	Commercial Hitch
G	Axle Push Bars



**Midwest Roadside
Safety Facility**

**Safety By Design Company
Trailer TMA**

Layout

Sheet:	system
Date:	01/26/2005
By:	JRR
Rev:	

Drawing Name:	TTMA-3 R2.dwg
Scale:	1=30



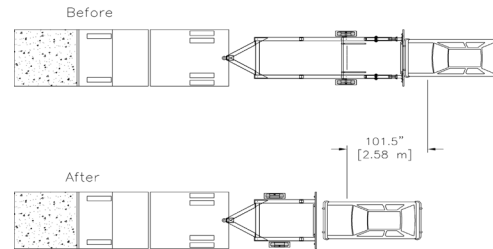
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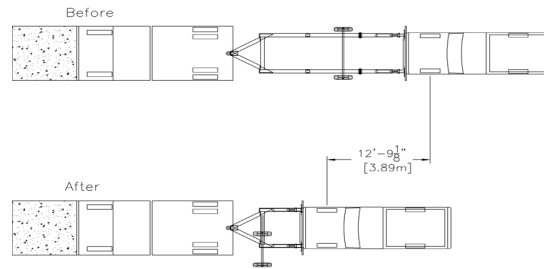
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- Test Number TTMA-3 (3-30)
- Date 8/04/04
- Test Article
 - Type Trailer TMA
 - Key Elements Trailer TMA impact head
 - Tubular steel frame
 - Trailer wheel and axle assembly
 - Orientation center of vehicle with center of TMA
- Soil Type NA
- Vehicle Model 1999 Geo Metro
 - Curb 743 kg
 - Test Inertial 821 kg
 - Gross Static 897 kg
- Vehicle Speed
 - Impact 96.0 km/h
 - Exit 0.0 km/h
- Vehicle Angle
 - Impact (trajectory) 0.13 deg
 - Exit (trajectory) NA
- Vehicle Stability Satisfactory
- Occupant Ridedown Deceleration (10 msec avg.)
 - Longitudinal 11.86 g's < 20 g's
 - Lateral 2.11 g's < 20 g's
- Occupant Impact Velocity
 - Longitudinal 11.42 m/s < 12 m/s
 - Lateral 0.02 m/s < 12 m/s
- Post-Impact Head Deceleration and Theoretical Head Impact Velocity
 - THIV 11.41 m/s < 12 m/s (not req.)
 - PHD 11.89 g's < 20 g's (not req.)
- Vehicle Damage Moderate
 - TAD⁷ 12-FD-4
 - SAE⁸ 12FDEW2
- Vehicle Stopping Distance 2.58 m downstream
- Test Article Damage Moderate
- Maximum Deflection
 - Permanent Set 3,102 mm
 - Dynamic 3,077 mm
- Working Width 6.97-m long by 5.05-m wide

Figure 21. Summary of Test Results and Sequential Photographs, Test TTMA-3



19

- Test Number TTMA-4 (3-51)
- Date 12/14/04
- Test Article
 - Type Trailer TMA
 - Key Elements Trailer TMA impact head
 - Tubular steel frame
 - Trailer wheel and axle assembly
 - Orientation center of vehicle with center of TMA
- Soil Type NA
- Vehicle Model 1999 GMC 2500
 - Curb 1,955 kg
 - Test Inertial 2,012 kg
 - Gross Static 2,012 kg
- Vehicle Speed
 - Impact 99.5 km/h
 - Exit 0.0 km/h
- Vehicle Angle
 - Impact (trajectory) 0.63 deg
 - Exit (trajectory) NA
- Vehicle Stability Satisfactory
- Occupant Ridedown Deceleration (10 msec avg.)
 - Longitudinal 17.69 g's < 20 g's
 - Lateral 4.11 g's < 20 g's
- Occupant Impact Velocity
 - Longitudinal 8.59 m/s < 12 m/s
 - Lateral 0.21 m/s < 12 m/s
- Post-Impact Head Deceleration and Theoretical Head Impact Velocity
 - THIV 8.58 m/s < 12 m/s (not req.)
 - PHD 17.72 g's < 20 g's (not req.)
- Vehicle Damage Moderate
 - TAD⁷ 12-FD-3
 - SAE⁸ 12FDEW2
- Vehicle Stopping Distance 3.89 m downstream
- Test Article Damage Moderate
- Maximum Deflection
 - Permanent Set 4,632 mm
 - Dynamic 5,132 mm
- Working Width 6.97-m long by 7.21-m wide

Figure 35. Summary of Test Results and Sequential Photographs, Test TTMA-4