TTMA-200 AASHTO MASH TL-3 Trailer TMA
GENERAL SPECIFICATIONS

I. GENERAL:

Scope: This specification describes a trailer truck mounted attenuator (TTMA) system designed to protect motorists from impacts with stationary or slow-moving trucks utilized in work zones and/or maintenance operations. The TTMA-200 system design provides safety protection in the event an errant vehicle enters a stationary or mobile work-zone. The TTMA design safely dissipates the impact energy of typical passenger vehicles traveling at MASH 2016 tested speeds up to 100 km/h (62 mph).

Functional Benefits of the TMA are:

1. Reduces the possibility of errant vehicle intrusion in stationary and mobile work-zones
2. Increases survival rate and lowers injury rate for the occupants of errant vehicles
3. Increases protection and reduces damage to valuable assets such as barrier/shadow vehicle, equipment and work-zone personnel.
4. Versatility and Reparability. The TTMA-200 attaches easily to a variety of shadow/barrier vehicles and is easy to repair following various types of impacts.
5. Reduced incident management time.

II. PRODUCT:

The TTMA-200 Trailer Truck-Mounted Attenuator (TTMA) shall be designed and manufactured in accordance with this specification as written by Gregory Industries, Inc.

The TTMA-200 is a MASH 2016 Test Level 3 (TL-3) crash cushion designed for use with a support truck in both stationary and moving work zones.

The TTMA-200 when properly deployed shall meet Manual for Assessing Safety Hardware (MASH) 2016 Test Level 3 (100 km/h) performance criteria. The TTMA shall meet the MASH 2016 criteria for the specified mandatory Tests 3-50, 3-51, 3-52 and 3-53. Tests 3-50, 3-51 and 3-52 shall satisfy the criteria when attached to support vehicle completely restrained from forward and lateral movement during impact. Test 3-53 shall allow the forward movement of the support vehicle and shall satisfy the minimum weight requirement detailed in MASH 2016.

The support vehicle roll-ahead distances are affected by several factors including, but not limited to; the weight of the shadow or barrier vehicle, TTMA weight, surface conditions, and errant vehicle collision energy. When equipped with a TTMA-200, an unrestrained support vehicle weighing 4535 kg (10,000 lbs.) typically has an estimated forward skid distance of 8-12 m (25-40 ft.) when positioned on a dry asphalt surface with minimal debris obstructions and impacted under Test 3-53 impact conditions with the park brake set and the transmission in second gear. The TTMA-200 can be used with a 10,000 lbs. minimum weight shadow and barrier vehicles. However, it is always suggested the user deploy the TTMA-200 with the heaviest shadow or barrier vehicle possible to reduce to the rate of roll-ahead or skid distance.

Guidance Charts for Estimating Roll-Ahead Distance

Tow Vehicle Weight	Traffic Operating Speed	Impact Vehicle Weight			
		4500 lbs.	10000 lbs.	15000 lbs.	24000 lbs.
10000 lbs.	65 mph	119 ft.	205 ft.	261 ft.	333 ft.
	55 mph	97 ft.	158 ft.	198 ft.	247 ft.
	45 mph	77 ft.	118 ft.	143 ft.	174 ft.
15000 lbs.	65 mph	93 ft.	161 ft.	211 ft.	278 ft.
	55 mph	78 ft.	127 ft.	162 ft.	209 ft.
	45 mph	65 ft.	97 ft.	120 ft.	150 ft.
24000 lbs.	65 mph	71 ft.	118 ft.	157 ft.	215 ft.
	55 mph	62 ft.	97 ft.	124 ft.	165 ft.
	45 mph	54 ft.	77 ft.	96 ft.	122 ft.
40000 lbs.	65 mph	56 ft.	86 ft.	112 ft.	155 ft.
	55 mph	50 ft.	73 ft.	92 ft.	123 ft.
	45 mph	45 ft.	61 ft.	74 ft.	95 ft.
60000 lbs.	65 mph	48 ft.	68 ft.	86 ft.	118 ft.
	55 mph	44 ft.	60 ft.	73 ft.	96 ft.
	45 mph	41 ft.	52 ft.	61 ft.	77 ft.
80000 lbs.	65 mph	44 ft.	59 ft.	73 ft.	97 ft.
	55 mph	41 ft.	53 ft.	63 ft.	81 ft.
	45 mph	39 ft.	47 ft.	54 ft.	67 ft.

Calculated Roll Ahead Distances for Mobile Operation

Tow Vehicle Weight	Traffic Operating Speed	Impact Vehicle Weight			
		4500 lbs.	10000 lbs.	15000 lbs.	24000 lbs.
10000 lbs.	65 mph	38 ft.	103 ft.	152 ft.	216 ft.
	55 mph	27 ft.	74 ft.	109 ft.	155 ft.
	45 mph	18 ft.	50 ft.	73 ft.	104 ft.
15000 lbs.	65 mph	22 ft.	68 ft.	108 ft.	166 ft.
	55 mph	16 ft.	49 ft.	77 ft.	119 ft.
	45 mph	11 ft.	33 ft.	52 ft.	80 ft.
24000 lbs.	65 mph	11 ft.	38 ft.	65 ft.	111 ft.
	55 mph	8 ft.	27 ft.	47 ft.	80 ft.
	45 mph	6 ft.	18 ft.	32 ft.	54 ft.
40000 lbs.	65 mph	5 ft.	18 ft.	34 ft.	64 ft.
	55 mph	4 ft.	13 ft.	24 ft.	46 ft.
	45 mph	3 ft.	9 ft.	16 ft.	31 ft.
60000 lbs.	65 mph	3 ft.	10 ft.	19 ft.	38 ft.
	55 mph	2 ft.	7 ft.	13 ft.	27 ft.
	45 mph	2 ft.	5 ft.	9 ft.	18 ft.
80000 lbs.	65 mph	2 ft.	6 ft.	12 ft.	25 ft.
	55 mph	1 ft.	5 ft.	9 ft.	18 ft.
	45 mph	1 ft.	3 ft.	6 ft.	12 ft.

Calculated Roll Ahead Distances for Stationary Operation

III. DESCRIPTION OF SYSTEM

A. General Assembly

The TTMA-200 shall be equipped with a heavy-duty 8-ton lunette ring to make a simple attachment to and detachment from the support or host vehicle. The TTMA shall be capable of safely absorbing impact energy as designed when impacted by vehicles in mandatory MASH 2016 TL-3 specified test conditions.

B. Design and Major Components

1. Impact Head

The TTMA-200's impact head designed to capture the front of a vehicle and lock the trailer between the impacting vehicle and the tow vehicle. The TTMA-200's impact head utilizes vertical steel angles to prevent impacting vehicles from sliding horizontally along the face of the trailer. The impact head also utilizes steel channels with the legs oriented toward traffic to prevent vertical motion on the front of an impacting vehicle to eliminate the risk of diving under or riding over the attenuator.

2. Bursting Mandrel/Bursting Tubes

The TTMA-200 uses a patented tube bursting technology to dissipate the energy of the impacting vehicle. The simplified concept of a tapered mandrel with a square cross-section being forced into a square tube with smaller inside dimensions, the mandrel pushes against the inside of the tube. The outward forces on the inside of the tube concentrate stresses in the corners, creating a controlled cracking of the steel. As the mandrel proceeds forward, the tube splits into four flat straps of metal that curl outward by the flared portion of the mandrel.

3. Trailer A-Frame

Tube bursting technology allows the TTMA-200 to use the trailer frame as the energy absorber, eliminating the need for a separate energy absorbing cartridges. This simplifies the design and reduces the costs of the TTMA-200. The straps of metal have no structural strength and curl up and away from the impacting vehicle eliminating any hazard posed to the impacting vehicle. Furthermore, the straps of metal remain securely attached to the un-bursted section of the tube. Thus there are no detached elements that can be thrown forward and pose hazard to workers and adjacent traffic.

4. Axle Assembly

The suspension consists of the axle, wheels, tires, and fenders, which support the TTMA and allow it to be trailered by the host vehicle. The forward position of the axle offers a "typical trailer" experience when transporting the TTMA.

5. Lighting and Visibility

The TTMA-200 shall have trailer lighting assembly meeting the specifications of Federal Motor Vehicle Safety Standards (FMVSS) 108 "Lamps, Reflective Devices, and Associated Equipment". All components shall be appropriate for their intended purpose under any adoptions issued by the FMVSS, National Highway Transportation Safety Administration (NHTSA), and Society of Automotive

Engineers (SAE) for standard practice for electrical lighting. TTMA conspicuity tape and reflectors shall be installed following these same established standards as specified by local requirements. The TTMA shall include brake lights, taillights, turn signals and an ICC bar light. An industry standard 7-pin trailer connector shall be provided to power TTMA lighting.

6. Jack Stand

One hand crank jack stand with swivel caster having a total rated load capacity of at least 910 kg (3000 lbs.) shall be supplied with the TTMA to facilitate easy movement when attaching and detaching TTMA from host vehicle.

7. Chevrons

The Impact Head surface facing approaching traffic shall have a display color and pattern as required by the State where the TTMA is deployed. Chevrons (2) shall provide at minimum 1,728 square inches of reflectivity and measure 24” x 36” each.

8. Arrow Board Stand and Arrow Board

The TTMA shall have an arrow board stand installed with an arrow board (4ft x 8ft) when deployed. The arrow board provides advanced awareness to approaching traffic that there is a TTMA deployed. If an arrow board stand and arrow board are not installed the TTMA must be properly ballasted to match the weight of the unit when tested to MASH 2016 criteria. Contact manufacturer for ballast details.

9. Galvanizing

All exposed steel surfaces on the TTMA shall be hot-dip galvanized after fabrication per ASTM A-123

10. Hardware

Unless otherwise specified; the TTMA shall be assembled with Commercial Quality bolts, nuts, and washers conforming to ANSI (American National Standard) specifications. Refer to TTMA-200 User Manual

IV. WEIGHT AND DIMENSIONS

Trailer:

Overall Dimensions

Length	23’ - 6”
Width	8’ - 0”
Height (to top of impact head)	39”
Height (to top of light bar)	43”
Ground Clearance (to bottom of impact head)	13”

Capacity

Trailer Weight	1,835 lbs.
Approximate Tongue Weight (w/ Optional Equipment)	300 lbs.
Minimum Support Truck Weight	10,000 lbs.
Maximum Support Truck Weight	Unlimited

Pintle Hook

Hitch	Lunette ring with no other structural attachment
Capacity Rating (Minimum)	8 tons
Mounting Height	19.5” – 32.0”

Breakaway Axle

Rating	2,200 lbs.
Tire Size	205/75D15
Rim Size	15x5JJ
Cold Tire Inflation Pressure	50 psi

Lighting

Lighting	Integrated light bar
Lighting Standard	FMVSS 108

Arrow Board Frame

Arrow Board Frame	3” x 3” x 3/16” A500B
Manual Winch	

Construction

Frame	Open design
All energy absorbing components	6” x 6” x 3/16” A500 B
All structural members in impact system	Hot-dipped galvanized
Axle	Mid-mounted breakaway
Fender	Full-fender

Safety Performance

MASH 2016 required tests	AASHTO
Support truck weight – MASH 2016 Tests 3-50, 3-51, 3-52	Unlimited
Support truck weight – MASH 2016 Test 3-53	10,000 lbs. (minimum)
Energy Absorbing System	Bursting Tube Technology
FHWA Letter of Eligibility	CC-152

Warranty against defects in material and workmanship ..... One year

V. CRASH TESTING PERFORMANCE CRITERIA

The TTMA-200 Trailer Truck Mounted Attenuator has successfully passed the mandatory tests contained within the AASHTO MASH 2016 Test Level 3 guidelines for truck and trailer mounted attenuators.

MASH TESTING CRITERIA**

TESTS 50 and 51
Test 50 is designed to evaluate the impact performance of TMA's during small car impacts. Test 51 is intended to examine the energy dissipation capacity of the TMA, structural adequacy, occupant risk, and the roll-ahead distance for the support truck during heavy passenger vehicle impacts. Both tests should be conducted with the heaviest allowable support truck or a rigidly blocked support truck for no upper support-truck weight limit.

TESTS 52 and 53
Tests 52 and 53 examine the capability of a TMA to safely attenuator off-center and angular impacts from heavy passenger vehicles. Structural adequacy of the TMA and occupant risk are the two primary concerns for these tests. Test 52 should be conducted with the heaviest allowable support truck or a rigidly blocked support truck for no upper support-truck weight limit while Test 53 should be conducted with the lightest allowable support truck.

The recommended full-scale crash tests only evaluate the impact performance of a TMA during passenger vehicle collisions. To date, no truck-mounted attenuators have been developed that are capable of safely accommodating heavy truck impacts. Further, the full-scale crash testing does not evaluate operational considerations, such as the potential for fatigue failure of structural elements, moisture absorption that increases unit weight, mobility of the system, or the influences of temperature variations or other factors. *Performance and Operational Experience of Truck-Mounted Attenuators (93)* presents a synthesis of practices related to the selection of truck-mounted attenuators.

** *Manual for Assessing Safety Hardware Second Edition 2016*

VI. DURABILITY TESTING

The TTMA-200 shall be subjected to vibration/shake testing at a minimum of 2 million cycles. This testing provides a simulation of the rigors of use a TTMA may endure during a typical life cycle. The vibration/shake testing shall include optional equipment such as arrow board stand and a basic 15/25 light arrow board.