

TTMA-100 GENERAL SPECIFICATIONS

I. Scope

These general specifications present product information for the Trailer Truck Mounted Attenuator, herein referred to as model TTMA-100, manufactured and distributed by Gregory Industries, Inc.. The specifications include the following sections:

- Intended applications
- Support truck guidelines
- Product description
- Product approvals
- Product durability
- Mounting of optional equipment
- Dimensions and weight

II. Intended Applications

The TTMA-100 is designed to protect motorists and workers in both moving shadow vehicle and stationary barrier vehicle applications. The TTMA-100 has been successfully crash tested with both small car and pickup truck test vehicles impacting at speeds up to 62 mph. When properly deployed, the TTMA-100 will:

- 1. Reduce the severity of impact for occupants of errant vehicles that collide with the rear of a shadow or barrier vehicle.
- 2. Reduce crash severity for occupants of shadow vehicles.
- 3. Minimize or prevent damage to the shadow or barrier vehicle.
- 4. Reduce the time required to clear the accident scene and restore traffic flow.

The TTMA-100 utilizes the patented tube bursting technology to dissipate the energy in vehicular impacts. The structural tube rail members of the trailer also function as energy absorbers, thus simplifying the attenuator design and keeping the costs low.

Figure 1 illustrates the patented tube bursting process. An over-sized mandrel is inserted into the energy absorbing tube and held in place with a restraining or shear bolt. In a crash, the impacting vehicle would push the mandrel forward and shear off the restraining bolt. As the over-sized mandrel is pushed into the energy absorbing tube by the impacting vehicle, cracks would develop at the corners of the tube, splitting the tube into four straps, thus dissipating the energy.



Figure 1. Tube Bursting Process

The straps would remain attached to the tube, thus there are no detached elements. Also, the straps have no structural strength and do not pose any hazard for the impacting vehicle, the shadow vehicle, or workers and others in the immediate vicinity of the impact. The level of energy dissipation is controlled by the tube thickness, the length of the tube sections, and scoring of the tubes. This allows the TTMA-100 to be designed to provide a smooth deceleration to the impacting

III. Support Truck Guidelines

The TTMA-100 may be attached directly to the work truck or to a support truck that serves as a barrier or moving shadow vehicle. In either case, the minimum weight of the tow vehicle should be 10,000 lbs. FHWA does not recommend the use of any TMA (Truck Mounted Attenuator) system with the support truck weighing less than 10,000 lbs due to concern over the potential for high roll-ahead distance that could pose a hazard to workers and others in the path of the support truck. In general, lighter support trucks would increase the risk to shadow vehicle operators and the vehicle roll-ahead distance during an impact. Note that support truck drivers should utilize an adequate head rest, lap belt, and shoulder harness at all times, regarding of the support truck weight.

On the other hand, heavier support trucks would increase the deceleration rate and the impact force on the occupants of the impact vehicle. A support weight of 20,000 lbs is used in all of the NCHRP Report 350 required and optional crash tests. The TTMA-100 is the only TMA design that has utilized a support truck blocked against forward motion to simulate an infinitely heavy vehicle in all of the NCHRP Report 350 required and optional crash tests. All other trailer and conventional TMA systems have utilized a 20,000 lb truck in at least some of their crash tests. Therefore, the TTMA -100 is the only system that can be safely used on support trucks weighing more than 20,000 lbs. In fact, there is no upper limit on the acceptable support truck weight for the TTMA-100.

The distance between the shadow vehicle and work zone activities should be maintained at acceptable minimums to prevent the support truck from rolling into workers or other construction equipment. Support truck roll-ahead distance is a function of the weight and speed of both the shadow truck and the impacting vehicle. Table 1 shows calculated shadow vehicle roll-ahead distances for a variety of shadow and impacting vehicle weights and impact speeds. Roll-ahead calculation procedures were adapted to include the weight of the TTMA-100 and are based upon a shadow vehicle speed of 15 mph.

Support	Traffic	Impact Vehicle Weight, lb			
Truck Weight, lb	Operating Speed, mph	4500	10000	15000	24000
	65	119′	205´	261´	333´
10,000	55	97 <i>´</i>	158´	198´	247
	45	77´	118′	143´	174´
	65	931	161´	211	278´
15,000	55	78´	127´	162´	209
	45	65´	97 <i>´</i>	120′	150′
	65	71 <i>´</i>	118′	157´	215
24,000	55	62	97 <i>´</i>	124´	165´
	45	54´	77 <i>´</i>	96´	122
	65	56'	86'	112'	155'
40,000	55	50'	73'	92'	123'
	45	45'	61'	74'	95'
	65	48'	68'	86'	118'
60,000	55	44'	60'	73'	96'
	45	41'	52'	61'	77'
	65	44'	59'	73'	97'
80,000	55	41'	53'	63'	81'
	45	39'	47'	54'	67'

Table1. Calculated Roll-Ahead Distances for Shadow Vehicles (Moving at 15 mph).

Calculated roll-ahead distances for stationary barrier vehicles utilizing a Trailer TMA are shown in Table 2. When the TTMA-100 is attached to a stationary barrier vehicle, the support truck should be placed in second gear with the parking brake fully engaged. In order to minimize barrier truck roll-ahead distance, the vehicle's parking brake should be maintained in good operating condition.

Support	Traffic	Impact Vehicle Weight, lb			
Truck Weight, lb	Operating Speed, mph	4500	10000	15000	24000
	65	38′	103	152	216
10.000	55	27 <i>´</i>	74 <i>´</i>	109′	155´
,	45	18′	50′	73´	104´
	65	22	68´	108′	166´
15.000	55	16′	49´	77 <i>´</i>	119′
10,000	45	11′	33′	521	80′
	65	11′	38′	65´	111′
24,000	55	8´	27 <i>′</i>	47 <i>´</i>	80´
21,000	45	6´	18′	32	54´
	65	5'	18'	34'	64'
40,000	55	4'	13'	24'	46'
	45	3'	9'	16'	31'
	65	3'	10'	19'	38'
60,000	55	2'	7'	13'	27'
00,000	45	2'	5'	9'	18'
	65	2'	6'	12'	25'
80.000	55	1'	5'	9'	18'
	45	1'	3'	6'	12'

Table 2. Calculated Roll-Ahead Distances for Barrier Vehicles.

The TTMA-100 is attached to the tow vehicle using a standard pintle hook rated at 8 tons or more. Otherwise, no other modification is needed for the tow vehicle for use with the TTMA-100. The pintle hook must be securely mounted to an appropriately strong structural component on the frame of the support truck. The pintle hook should be mounted at a nominal height of approximately 28 in. The pintle hook height, after ballast is added to the support truck, must be maintained between 20 and 32 in. The lunette ring should be placed in the lower mounting holes when the pintle hook is mounted between 20 and 26 in. and in the upper mounting holes when the pintle hook is mounted between 26 and 32 in. The support truck must be equipped with a standard wiring connector to power the TTMA-100 marker and brake lights. The trailer can be supplied with any standard 4, 6, or 7 pin connector.

Connecting the TTMA-100 to a tow vehicle is a simple task that involves the following steps and takes only a few minutes:

- 1. Move the tow vehicle or the trailer so that the lunette ring on the trailer is lined up with the pintle hook on the tow vehicle. Note that, when the TTMA-100 is not in use, the trailer is kept at a horizontal position with a trailer jack located on the cross member of the A-frame.
- 2. Place the lunette ring in the truck's pintle hook and close the hook.
- 3. Connect the trailer lighting connector and attach the safety chains.
- 4. Raise the trailer jack to a horizontal position and the trailer is ready for operation.

The light weight of the TTMA-100 at 1,450 lbs and its very low tongue weight of approximately 200 lbs make the connection process very quick and easy. Even with the addition of the optional arrow board and mount, the tongue weight is still below 500 lbs, thus not significantly affects the load carrying capacity of the support truck,

IV. Product Description

A. Major Components

The TTMA-100 incorporates the following major components:

- 1. A-frame assembly
- 2. Energy absorbing tubes
- 3. Axle assembly with push rods
- 4. Fender, wheel and tire assembly
- 5. Mandrels
- 6. Impact Head

B. General Assembly

The two energy absorbing tubes are attached to the A-frame assembly with a special splice connection. The A-frame and the two energy absorbing tubes serve as the primary longitudinal frame elements as well as the primary energy dissipation system. The axle assembly is bolted onto the energy absorbing tube and includes: the axle, fenders, and wheels and tires. There are also two push rods welded to the axle. The impact head would contact these push rods and break away the axle prior to the impact head reaching the axle. Two over-sized mandrels are inserted into the two energy absorbing tubes on one end and attached to the impact plate on the other end. A lunette ring is attached to the end of the A- frame assembly for connection to the tow vehicle equipped with a standard 8 ton or larger pintle hook.

C. TTMA-100 Function

The TTMA-100 is designed to safely attenuate passenger vehicle impacts on the rear of the trailer. When a vehicle strikes the rear of the trailer, the impact head is forced forward and it drives the tube bursting mandrels into the bursting tubes. Energy dissipation by the bursting tubes provides a controlled deceleration of the impacting vehicle. As the tube bursting mandrels continue forward, they contact axle shear

connectors and fracture the bolts holding the trailer axle to the bursting tubes. Shortly thereafter, the trailer's impact head contacts the axle push tubes and moves the axle toward the front of the trailer. For high energy impacts, the impact head will continue forward until the bursting tubes are completely ruptured. If needed, the side rails of the trailer frame assembly will then begin to burst and the energy dissipation will continue until the impacting vehicle is brought to a safe stop.

During high energy impact testing, the TTMA-100 proved to be capable of attenuating all of the impact energy without producing any damage to undercarriage, suspension, or tires of the tow vehicle. Structural components of the TTMA-100 should be not forced under the support vehicle during high energy passenger vehicle impacts.

During moderate energy impacts, trailer damage should be limited to the two bursting tubes which can be easily replaced. This process involves removing the impact head, tube bursting mandrels, and the axle assembly from the trailer by removing four bolts and pulling the system apart. The damaged bursting tubes will then need to be replaced and the axle, tube bursting mandrels and impact head can be re-attached. Note that the trailer wiring and light system must be carefully inspected and any needed repairs made before placing the restored trailer back into service. Complete repair should be accomplished with simple hand tools and the appropriate replacement parts.

The trailer is capable of absorbing low-speed impacts up to 5 mph without sustaining any damage.

D. Lights and Visibility

The TTMA-100 is equipped with the following items to enhance the visibility and conspicuity of the trailer:

An integrated light bar bolted to the top of the impact head, Side lights and markers, Reflective tapes on the sides, and Chevron panels on the face of the impact head. The chevron panels have highly reflective sheeting and may be ordered in the following color combination:

yellow/black, white/orange or white/red stripes. The lighting assembly meets, and actually exceeds, the lighting requirements set forth under FMVSS No. 108, "Lamps, Reflective Devices, and Associated Equipment." It should be borne in mind that FMVSS 108 represents a minimum requirement. Any modification or additions to the lighting, marker, and reflectivity should conform to

E. Corrosion Protection

these specifications.

All components of the energy dissipation system, including the impact head, tube bursting mandrels, bursting tubes, and trailer frame assembly are hot-dip galvanized to

prevent corrosion. Bolts and other exposed attachment hardware are also galvanized where possible to prevent corrosion.

V. Product Approvals

The TTMA-100 was approved by the Federal Highway Administration (FHWA) as a Test Level-3 (TL-3) Trailer Truck Mounted Attenuator (TMA) in a letter dated April 15th, 2005. It has also been recognized by FHWA as meeting the TL-3 optional tests set forth in NCHRP Report 350 in a letter dated September 18th, 2006. Many states do not require individual approval of TMA systems and rely only on FHWA approval. The TTMA-100 is now fully qualified for use in all of these states.

Gregory Industries, Inc. is pursuing approval in every state where a separate approval process is required. If your state requires individual approval of TMA's and the Trailer TMA is not listed on the appropriate approved product list, please call Gregory Industries, Inc. at (330) 477-4800 for information regarding approval status in your state.

VI. Product Durability

The TTMA-100 has been subjected to extensive road testing at both high and low speed operations on both paved and unpaved roadways. This testing has shown no evidence of fatigue failure of any components of the TTMA-100. Gregory Industries, Inc. is also conducting vibration testing of the trailer to assure that no fatigue problems develop. If your state requires special testing of TMA durability, please contact Gregory Industries, Inc. for help in testing the TTMA-100 to meet any state standards and gaining the needed state approval.

VII. Optional Equipment

The TTMA-100 is designed to accommodate optional flashing arrow boards and variable message signs attached to the front of the trailer. A specially designed arrow board support mount is available as optional equipment.

Note that the TTMA-100 has not been crash tested with an arrow board and Gregory Industries, Inc. has not sought FHWA approval. Supports for an arrow board or variable message sign support are only subjected to impact loads when the TTMA-100 and the support truck are accelerated forward during a crash. All crash tests of the TTMA-100 were conducted with the support truck blocked to simulate infinite weight. Hence, the TTMA-100 was not subjected to high accelerations that would cause problems for an arrow board or VMS. However, design loads for the TTMA-100's sign mounting system were obtained from the highest sustained accelerations measured during test 3-51. This maximum acceleration was converted to an equivalent force that was then applied to the lightest allowable support truck and trailer combination, a 10,000-lb truck with a 1,400-lb trailer. The trailer acceleration resulting from this level of applied force was then used as a design load when analyzing the stresses in the sign mounting system.

It is important to note that this procedure for estimating sign support loading is very conservative. Forces applied to an impacting vehicle are greatly reduced when the support truck is allowed to roll ahead. Therefore, when attached to a lighter support truck, actual accelerations on the trailer and support truck combination are much lower than those used in the sign support design process and the loading of the sign support system would be much lower. Users wishing to supply a different mounting system must design it to withstand a 10 g acceleration with the sign in the maximum height configuration without collapse.

Note that the wiring harness supplied with the TTMA-100 provides a convenient power source for an arrow board, VMS sign, or other warning device.

The TTMA-100 should not used to carry any equipment other than the optional arrow board or variable message sign. It is recommended that the users to contact Gregory Industries, Inc. for additional advice if additional equipment is attached to the trailer.

VIII. Dimensions and Weight

The TTMA-100 has an overall length of 23 ft-6 in. and an overall width of 8 ft-0 in. The trailer has a very low profile, with a maximum height of 31 in. to the top of the impact head and 37 in. to the top of the integrated light bar. The ground clearance to the bottom of the impact head is 13 in. This low profile allows excellent visibility for any optional equipment, such as a flashing arrow board attached to the front of the trailer.

The weight of the TTMA-100 without any optional equipment is approximately 1,450 lbs with a tongue weight of 190 lbs. With the optional arrow board and mount, the total weight is still under 2,000 lbs and the tongue weight is under 500 lbs.

IX. Warranty

There is a one-year warranty against defects in material and workmanship.



TECHNICAL SPECIFICATIONS

Trailer:

C	Overall Dimensions:	
С	Length	23'-6"
С	Width	8'-0''
С	Height (to top of impact head)	31"
С	Height (to top of light bar)	37"
С	Ground Clearance (to bottom of impact head)	13"
C	Capacity:	
С	Trailer Weight (w/o Optional Equipment)	. 1,450 lb
С	Approximate Tongue Weight (w/o Optional Equipment)	. 190 lb
С	Minimum support truck weight	10,000 lb
С	Maximum support truck weight	Unlimited
P	intle Hook:	
C	Hitch Lunette ring with no other structura	l attachment
C	Capacity Rating (Minimum)	8 tons
С	Mounting Height	19.5"-32.0"
E c c	Breakaway Axle: Rating Tire Size Rim Size	1,750 lb 205/75D15 15x5JJ
С	Cold Tire Inflation Pressure	30 psi
L	ighting: Lighting Integr	ated light bar
С	Lighting standard	FMVSS 108
Construc	ction:	
F	rame	Open design
A	Ill energy absorbing components Hea	vy gage steel
Ag	All structural members in impact systemalvanized	Hot-dipped
A	Axle Mid-mount	ed breakawav
Fe	ender	Full-fender



TECHNICAL SPECIFICATIONS

Safety Performance:

NCHRP 350 required tests	FHWA approved
NCHRP 350 optional tests	FHWA approved
Support truck weight - NCHRP Report 350 Tests 3-50 & 3-51	Unlimited
Support truck weight - NCHRP Report 350 Tests 3-52 & 3-53	Unlimited
Energy Absorbing System	Bursting Tube Technology

Warranty:

Warranty against o	defects in	material and	l workmanshir		One yea
manun y ugunist v	defects in	mater full and	* workinging	J	One yea



TTMA-100 FEATURES & BENEFITS

Patented tube bursting technology utilizes the trailer frame as the energy absorber, thus simplifying the design and reducing cost.

Meets all required and optional NCHRP 350 Test Level 3 (TL-3) criteria with the support vehicle blocked to eliminate all forward movement (worst case scenario).

Provides continuous protection at all times and speeds.

No need to raise TMA (Truck Mounted Attenuator) to vertical position for transport; no overhead clearance issues.

Can be used with any support vehicle of 10,000-lb GVW or more equipped with a standard 8-ton pintle hook.

No modification of support vehicle required.

No maximum support vehicle weight limit.

No need for dedicated support vehicle; change support vehicle in a matter of minutes.

Fully galvanized for long-term moisture and corrosion protection; built to last.

Can be attached directly to snow plowing equipment and some sanding and salting equipment.

Can be equipped with arrow board or variable message sign panels (optional) for improved conspicuity.

Field replacement components for low-cost in-field repair after nuisance hits.

Tongue weights of less than 200 lbs. empty and 500 lbs. with arrow board do not significantly reduce the load carrying capacity of the support vehicle.

Operates like any trailer and does not change the operating characteristics of the support vehicle.



HOW IT WORKS

Tube Bursting Technology

The TTMA-100 uses a patented tube bursting technology to dissipate the energy of the impacting vehicle. The basic concept is quite simple. When a tapered mandrel with a square cross-section is 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 is split into four flat straps of metal that are curled outward by the flared portion of the mandrel. The graphics shown in figure 1 illustrate this bursting process.



Figure 1. Tube Bursting Process

The setup of the mandrel and the actual bursting process are demonstrated in the photographs shown in Figure 2.



Tapered and over-sized mandrel inserted into the energy absorbing tube.



The mandrel cracks the energy absorbing tube at the corners and split it into four flat straps of metal.



Close-up of mandrel and energy absorbing tube.

Figure 2. Photographs Illustrating the Bursting Process

This bursting process, i.e., cracking of the tube at the corners and splitting it into four straps of flat metal, dissipates the energy of the impacting vehicle. The level of energy dissipation can be regulated by using different thickness of tubing and scoring of the tube, i.e., cutting grooves into

the tubes at the corners reduce the energy dissipated during cracking. By adjusting the level of energy dissipation and the lengths of the energy absorbing tubes, the amount of energy dissipation and the rate of vehicle deceleration can be controlled to bring the impacting vehicle to a gradual and safe stop.

Tube bursting technology allows the TTMA-100 to use the trailer frame as the energy absorber, thus eliminating the need for a separate energy absorbing material. This simplifies the design and reduces the costs of the TTMA-100. Also, the straps of metal have no structural strength and curl up and away from the impacting vehicle, thus 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.

Pintle Hook Attachment:

Another major improvement in TMA safety technology is the TTMA-100's ability to rotate. While competing trailer attenuators utilize rotational restraints to prevent the attenuator from rotating, the TTMA-100 allows the trailer to rotate in order to keep the system aligned with the impacting vehicle to maximize energy dissipation. It is this innovative approach to energy management that has allowed the TTMA-100 to become the only TMA system to successfully pass NCHRP Report 350 optional offset and angled tests when attached to a support truck blocked against forward motion.

The primary concern about allowing a trailer to rotate is that the impacting vehicle could push the trailer out of its path and directly strike the rear of the support truck. However, as shown in Figure 3, an impacting vehicle must slide along the trailer's impact face in order to disengage from the trailer.



Figure 3. Simulation of Vehicle Disengaging from a Trailer.

The patented innovation that eliminates this risk is the way the TTMA-100 engages an impacting vehicle. The TTMA-100's impact plate is designed to capture the front of a vehicle and lock the trailer between the impacting vehicle and the tow vehicle. The TTMA-100's impact head, shown in Figure 4, 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.



Figure 4. TTMA-100 Impact Head.

The effectiveness of this mechanical interlock system can be illustrated by comparing final rest locations from NCHRP Report 350 pickup truck offset and angled tests (tests 3-52 and 3-53, respectively) for the three trailer TMA systems that have received FHWA approval. Note that only the TTMA-100 was tested under the much more stringent conditions of blocking the support truck against any forward motion. The other two trailer TMA systems were tested with 20,000-lb support trucks which were allowed to roll ahead during the crash. Figure 3, shown below, was developed from FHWA approval letters and shows the final rest locations of the three trailer TMA systems for the optional offset and angled tests recommended by NCHRP 350. This figure clearly shows that the final rest locations for the three designs are not substantially different, even though the TTMA-100 was tested under the more severe condition with the support truck blocked against forward movement. Figure 5 clearly demonstrates that the TTMA-100's simple pintle hook attachment and its vehicle capturing impact head are able to perform very well during offset and angled impacts, even when attached to an infinitely heavy support truck.

In fact, the combination of the simple pintle hook attachment and the trailer's connection with the support vehicle, forces the trailer to rotate and align itself with the impacting force, which would in turn maximize energy dissipation. Hence, the TTMA-100 provides maximum energy dissipation for impacts at any angle to provide maximum safety to both motorists and construction workers.





TTMA-100 Innovative, Flexible and Affordable

User's Manual



Gregory Industries 4100 13th Street, SW • Canton, Ohio 44710 • Phone 330-477-4800 www.gregorycorp.com May 2010

FOREWORD

Thank you for your purchase of the Trailer Truck Mounted Attenuator, Model 100, from Gregory Industries. (herein referred to as the TTMA-100). The TTMA-100 is a Test Level 3 (TL-3) crash cushion designed for use with a support truck in both stationary and moving work zones. We are committed to providing our customers with highway safety products that have the best performance and value for your money, as well as the highest level of customer service. The TTMA-100 is one of the most innovative TMA's in the market, offering a higher level of performance with heavy tow vehicles and requiring no modification of the tow vehicle. It has successfully passed all required and optional crash tests set forth in NCHRP Report 350 and is fully approved for use on the National Highway System by the Federal Highway Administration.

This manual has been written to help you with the operation and maintenance of the TTMA-100. Please read and understand the recommendations contained in this manual thoroughly before use, and keep it handy for future reference. If you have any questions or comments regarding the operation and maintenance of this product, please do not hesitate to contact us by telephone at (330) 477-4800, e-mail at RMauer@gregorycorp.com, or conventional mail at 4100 13th Street SW, Canton, Ohio 44710

This manual is divided into five sections:

- TTMA Design and Major Components. An overview of the TTMA-100 design and major components are presented in this section, including the product specifications and parts list. Also, instructions for wiring the trailer plug for connection to the tow vehicle are provided.
- How It Works. A brief explanation of the innovative features of the TTMA-100 and how it works to absorb and dissipate the energy from an impacting vehicle are outlined and illustrated in this section.
- Operation Guidelines. Guidelines pertaining to the operation of the TTMA-100 are presented in this section, such as minimum support truck weight, roll-ahead distances, connections, and other operational items.
- Maintenance Guidelines. Considerations on the routine maintenance of the TTMA-100 are outlined in this section.
- Repair of Damaged Trailer. Discussion of impacts by an errant vehicle and the associated repair and replacement of trailer parts are presented in this section.

CUSTOMER SERVICE CONTACTS

Gregory Industries is committed to providing the best service and care to our customers. You are automatically registered with your purchase and you will be notified of any future changes or upgrades to the TTMA-100. If you have any comments or questions regarding this product, please contact us via telephone, e-mail or conventional mail:

Telephone: (866) 994-4929: Monday to Friday, 9:00 a.m. to 5:00 p.m. Eastern Standard Time.

Fax:	(330) 477-0626
Email:	<u>TTMATechnicalSupport@gregorycorp.com</u> Or <u>TTMASales@gregorycorp.com</u>
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TTMA-100 DESIGN AND MAJOR COMPONENTS

GENERAL

A schematic of the TTMA-100 is shown in Figure 1. The major components of the TTMA-100, as shown in Figure 1, are as follows:

Component	Description
А	Impact Head
В	Bursting Mandrel
С	First Energy Absorbing Tube
D	Trailer Frame
E	Axle Assembly
F	Plastic Guide Plates
G	End Caps
Н	Hitch Assembly
J	Spacer
Κ	Jack Assembly

Table 1 presents the technical specifications for the TTMA-100, including:

- Overall dimensions,
- Capacity of the trailer,
- Capacity and mounting height of the pintle hook.
- Information on the axle assembly,
- Construction of the trailer.
- Safety performance of trailer, and
- Warranty.

Table 2 provides a list of parts with legends and part numbers. Please refer to these part numbers and legends for ordering of spare parts. Note that this is not a complete parts list. Please inquire about the complete parts list and pricing from the manufacturer, distributor, or reseller of the TTMA-100.

Figure 2 shows the schematic of the wiring details of the TTMA-100. Also, detailed instructions on the wiring of the TTMA-100 are provided in a separate Wiring Manual and will not be repeated herein. However, the TTMA-100 is fully wired at the time of delivery. The only item that may require attention of the user is the wiring of the trailer plug for connection to the tow vehicle. More detailed instructions on are provided in the next section.



Figure 1. Schematic and Parts Layout of TTMA-100

Table 1. TTMA-100 Technical Specifications

Trailer:

Overall Dimensions:	
o Length	23'-6"
• Width	8'-0"
• Height (to top of impact head)	31"
• Height (to top of light bar)	37"
• Ground Clearance (to bottom of impact head)	13"
• Capacity:	
• Trailer Weight (w/o Optional Equipment)	1,450 lb
• Approximate Tongue Weight (w/o Optional Equipment)	190 lb
• Minimum support truck weight	10,000 lb
• Maximum support truck weight	Unlimited
• Pintle Hook:	
• Hitch	ral attachment
• Capacity Rating (Minimum)	8 tons
• Mounting Height	19.5"-32.0"
• Breakaway Axle:	
• Rating	1.750 lb
• Tire Size	205/75D15
• Rim Size	15x5JJ
• Cold Tire Inflation Pressure	30 psi
• Lighting.	
\circ Lighting Integration	rated light bar
 Lighting standard 	FMVSS 108
Construction:	
• Frame	Open design
All energy absorbing components	
- An energy absorbing components Ite	avy gage sider

All structural members in impact system Hot-dipped galvanized
Axle Mid-mounted breakaway
Fender Full-fender

Table 1. TTMA-100 Technical Specifications (Continued)

Safety Performance:

 NCHRP 350 required tests NCHRP 350 optional tests Support truck weight – NCHRP Report 350 Tests 3-50 & 3-5 	FHWA approved FHWA approved 1
 Unlimited Support truck weight – NCHRP Report 350 Tests 3-52 & 3-5 Unlimited 	3
Energy Absorbing System	Bursting Tube Technology
Warranty:	

• Warranty against defects in material and workmanship One year

ITEM	PART #	QUANTITY	DESCRIPTION				
TRAILER COMPONENTS							
А	T100A	1	Impact Head				
В	T100B	2	Bursting Mandrel				
С	T100C	2	First Stage Energy Absorber				
D	T100D	1	Trailer A-Frame				
Е	T100E	1	Axle Assembly				
F	T100F	4	Plastic Guide Plates				
G	T100G	2	End Caps				
Н	T100H	1	Hitch Assembly				
J	T100J	8	Spacer				
Κ	T100K	1	Jack Assembly				
	HARDWARE ITEMS						
а	B0516070A	6	5/16" x 7" Grade 5 Hex Bolt				
b	W0516	6	5/16" Washer				
с	LW0516A	6	5/16" Heavy Lock Washer				
d	N0516A	6	5/16" Grade 5 Hex Nut				
e	B0816020A	8	1/2" x 2" Grade 5 Hex Bolt				
f	W0816	8	1/2" Washer				
g	LW0816A	12	1/2" Heavy Lock Washer				
h	N0816A	12	1/2" Grade 5 Hex Nut				
j	B0916030A	16	9/16" x 3" Grade 5 Hex Bolt				
k	W0916S	16	9/16" SAE Washer				
m	LW0916A	16	9/16" Heavy Lock Washer				
n	N0916A	16	9/16" Grade 5 Hex Nut				
О	B1016025A	4	5/8" x 2 1/2" Grade 5 Hex Bolt				
р	W1016	4	5/8" Washer				
q	LW1016A	4	5/8" Heavy Lock Washer				
r	N1016A	4	5/8" Grade 5 Hex Nut				

Table 2. Trailer Component And Parts List



Figure 2. TTMA-100 Wiring and Light Layout

WIRING INSTRUCTIONS

The only item that may require attention of the user is the wiring of the trailer plug for connection to the tow vehicle. There are two distinctly different wire plugs that are not compatible, one is the RV plug and the other is the heavy duty truck plug. It is necessary to first determine which type of plug is used with the tow vehicle, i.e., an RV plug or a heavy duty truck plug. The shapes of the two plug types are easier distinguishable as shown Figure 3. Also, the RV plug uses blades and the truck plug uses round pins. Note that the wiring scheme for the two plug types are totally different, details of which are shown in the following tables. (The TTMA-100 is normally supplied with the Heavy Duty Truck Plug unless otherwise ordered in advance.)



Figure 3. Photographs of RV and Heavy Duty Truck Plugs

Figure 4 shows the different standard wiring layouts for the RV plug and the heavy duty truck plug. Details of the wiring layouts are shown in Table 3.



Figure 4. Standard Wiring Layouts of RV and Heavy Duty Truck Plugs

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Table 3. Standard Wiring Layouts of RV and Heavy Duty Truck Plugs

		Plug Labels	
Function	Trailer Wire Color	Number	Color
Common Ground	White	1	White
Auxiliary	Black	2	Black
Left Turn	Yellow	3	Yellow
Brake light	Red	4	Red
Right Turn	Green	5	Green
Tail/Marker lights	Brown	6	Brown
12V Power supply	Blue	7	Blue

RV Plugs with Separate Brake Wire

Heavy Duty Truck Plugs

		Plug Labels	
Function	Trailer Wire Color	Number	Color
Common Ground	White	1	White
Brake light	Red	2	Blue
Tail/Marker lights	Brown	3	Green
12V Power supply	Blue	4	Black
Left Turn	Yellow	5	Red
Right Turn	Green	6	Brown
Auxiliary	Black	7	(center)

Note that the above wiring patterns represent standard wiring for the tow vehicle. The above pattern may need to be adjusted if the tow vehicle does not use standard wiring.

HOW IT WORKS

TUBE BURSTING TECHNOLOGY

The TTMA-100 uses a patented tube bursting technology to dissipate the energy of the impacting vehicle. The basic concept is quite simple. When a tapered mandrel with a square cross-section is 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 is split into four flat straps of metal that are curled outward by the flared portion of the mandrel. The graphics shown in figure 5 illustrate this bursting process.



Figure 5. Tube Bursting Process

The setup of the mandrel and the actual bursting process are demonstrated in the photographs shown in Figure 6.



Tapered and over-sized mandrel inserted into the energy absorbing tube.



The mandrel cracks the energy absorbing tube at the corners and split it into four flat straps of metal.



Close-up view of mandrel and energy absorbing tube.

Figure 6. Photographs Illustrating the Bursting Process

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This bursting process, i.e., cracking of the tube at the corners and splitting it into four straps of flat metal, dissipates the energy of the impacting vehicle. The level of energy dissipation can be regulated by using different thickness of tubing and scoring of the tube, i.e., cutting grooves into the tubes at the corners reduce the energy dissipated during cracking. By adjusting the level of energy dissipation and the lengths of the energy absorbing tubes, the amount of energy dissipation and the rate of vehicle deceleration can be controlled to bring the impacting vehicle to a gradual and safe stop.

Tube bursting technology allows the TTMA-100 to use the trailer frame as the energy absorber, thus eliminating the need for a separate energy absorbing material. This simplifies the design and reduces the costs of the TTMA-100. Also, the straps of metal have no structural strength and curl up and away from the impacting vehicle, thus 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.

PINTLE HOOK ATTACHMENT

Another major improvement in TMA safety technology is the TTMA-100's ability to rotate. While competing trailer attenuators utilize rotational restraints to prevent the attenuator from rotating, the TTMA-100 allows the trailer to rotate in order to keep the system aligned with the impacting vehicle to maximize energy dissipation. It is this innovative approach to energy management that has allowed the TTMA-100 to become the only TMA system to successfully pass NCHRP Report 350 optional offset and angled tests when attached to a support truck blocked against forward motion.

The primary concern about allowing a trailer to rotate is that the impacting vehicle could push the trailer out of its path and directly strike the rear of the support truck. However, as shown in Figure 7, an impacting vehicle must slide along the trailer's impact face in order to disengage from the trailer.

The patented innovation that eliminates this risk is the way the TTMA-100 engages an impacting vehicle. The TTMA-100's impact plate is designed to capture the front of a vehicle and lock the trailer between the impacting vehicle and the tow vehicle. The TTMA-100's impact head, shown in Figure 8, 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.

The effectiveness of this mechanical interlock system can be illustrated by comparing final rest locations from NCHRP Report 350 pickup truck offset and angled tests (tests 3-52 and 3-53, respectively) for the three trailer TMA systems that have received FHWA approval. Figure 9 shows the final rest locations of the three trailer TMA systems for the optional offset and angled tests, as developed from FHWA approval letters.



Figure 7. Simulation of Vehicle Disengaging from a Trailer.



Figure 8. TTMA-100 Impact Head.

As shown in the figure, the final rest positions for the three designs are not substantially different, even though the TTMA-100 was tested under much more severe condition with the support truck blocked against forward movement. The other two trailer TMA systems were tested with 20,000-lb support trucks which were allowed to roll ahead during the crash. Figure 9 clearly demonstrates that the TTMA-100's simple pintle hook attachment and its vehicle capturing impact head are able to perform very well during offset and angled impacts, even when attached to an infinitely heavy support truck.

In fact, the combination of the simple pintle hook attachment and the trailer's connection with the support vehicle, forces the trailer to rotate and align itself with the impacting force, which would in turn maximize energy dissipation. Hence, the TTMA-100 provides maximum energy dissipation for impacts at any angle to provide maximum safety to both motorists and construction workers.



Figure 9. Final Rest Locations of Trailer TMA Systems

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OPERATION GUIDELINES

INITIAL SETUP

This TTMA-100 should be delivered fully assembled. If there are problems with the delivered trailer, please contact Gregory Industries immediately.

There are three items that will require your attention prior to utilizing the trailer:

• Check to make sure that there are no missing bolts and the bolts are tightened to the specific torque. The following are the recommended torques to the bolts according to the bolt size:

Bolt Size (in)	5/16"	1/2"	9/16"	5/8"
Torque (ft-lb)	15	60	85	115
Torque (N-m)	20	81	115	156

- Check to make sure that the wiring of the trailer plug for connection to the tow vehicle is appropriate. As mentioned previously, there are two distinctly different wire plugs that are not compatible, one is the RV plug and the other is the heavy duty truck plug. Make sure that you have the correct type of plug and that the plug is wired properly. Also, check to confirm that the lights are functioning properly prior to putting the TTMA into service.
- Check to make sure that the pintle hook is mounted properly. Due to the wide variations in the frame structures of different tow vehicles, there is not a single standard means of mounting the pintle hook assembly to the frame of the tow vehicle. The major considerations in mounting of the pintle hook are the strength of the attachment and the mounting height.

The pintle hook assembly may be welded or bolted to the frame of the tow vehicle. Regardless of the method of mounting or attachment to the tow vehicle, it is critical to ensure that the strength of the attachment exceeds the rated capacity of the pintle hook with a wide margin of safety. It is the obligation of the users to ensure that their particular pintle hook attachment system meets these strength requirements. There are two mounting positions for the lunette ring. The nominal height of the upper mounting position is 28 inches and the nominal height for the lower position is 23.5 inches. The TTMA-100 can accommodate a variation of up to 4 inches from the nominal height. Hence, when the lunette ring is in the upper position, the TTMA-100 can be attached to a pintle hitch ranging from a minimum of 24 in. to a maximum of 32 in. in height. When the lunette ring is in the lower position, the TTMA-100 can be mounted on pintle hooks ranging from a minimum of 19.5 in. to a maximum of 27.5 in. in height.

Figure 10 shows the lunette ring in the lower position. Note the bolt holes that can be used with the upper position.



Figure 10. Mounting Position of Lunette Ring

MINIMUM AND MAXIMUM WEIGHT OF TOW VEHICLE

The minimum recommended weight for the tow vehicle is 10,000 lb gross vehicle weight (GVW). There is no specified maximum weight for the tow vehicle. All TTMA-100 crash tests, including the required and optional crash tests specified under NCHRP Report 350, were conducted with the Trailer TMA attached to a tow vehicle that was blocked against any forward movement.
TOW VEHICLE ROLL AHEAD DISTANCES

One of the major safety considerations is the roll ahead distance of the shadow vehicle when impacted by an errant vehicle. When the tow vehicle with a TTMA-100 attached is impacted by an errant vehicle, it will move forward. It is therefore important to allow sufficient space between the tow vehicle and the workers so that the roll ahead of the tow vehicle would not pose a safety concern for the workers. Tables 4 and 5 show the expected roll ahead distances for rolling and stationary tow vehicles, respectively, as a function of impact speed and weights of the support truck and impacting vehicle. The space between the support vehicle and the workers should exceed the roll ahead distance under the prevailing operating conditions.

Please follow the following steps to determine the appropriate roll ahead distance:

- 1. Assess the nature of the operation (i.e., moving or stationary operation). In a moving operation, the tow vehicle is moving at slow speed, such as 15 mph. In a stationery operation, the shadow vehicle is stopped with the parking brakes on. Use Table 4 for moving operations and Table 5 for stationary operations.
- 2. Select the weight that best approximates the actual weight of the tow vehicle: 10,000, 15,000, 24,000, 40,000, 60,000 or 80,000 lb. Note that the weight of the support truck should include the weights of items to be carried on the truck during the operation and the weight of the TTMA-100.
- 3. Select the range of prevailing speed of the traffic at the work zone: 45, 55 or 65 mph.
- 4. Select the weight of the impact vehicle to be contained: 10,000, 15,000, or 24,000 lb.
- 5. Select from the appropriate table the expected roll ahead distance

For example: If you are operating a tow vehicle with a gross weight of 15,000 lb as a stopped shadow vehicle in an area where the operating traffic speed is 45 mph, and there are few if any large trucks in the mix of traffic. You would start with Table 5, select the appropriate values from above, and determine that the maximum roll ahead distance would be 11 ft. This is the distance from the front of the tow vehicle to the work area that should be provided.

ATTACHMENT OF TTMA-100 TO TOW VEHICLE

The TTMA-100 is attached to the tow vehicle via a pintle hook with a minimum capacity of 8 tons.

Warning! Verify that the retaining pin for the pintle hook is properly locked to avoid accidental release of the pintle hook and the TTMA-100.

Warning! Make sure that the trailer lights are connected to the tow vehicle and are operating properly.

Warning! Ensure that the safety chains properly secure the TTMA-100 to the tow vehicle.

Tow	Traffic Operating Speed	Impact Vehicle Weight				
Weight		4500 lb	10000 lb	15000 lb	24000 lb	
	65 mph	119 ft	205 ft	261 ft	333 ft	
10000 lb	55 mph	97 ft	158 ft	198 ft	247 ft	
	45 mph	77 ft	118 ft	143 ft	174 ft	
	65 mph	93 ft	161 ft	211 ft	278 ft	
15000 lb	55 mph	78 ft	127 ft	162 ft	209 ft	
	45 mph	65 ft	97 ft	120 ft	150 ft	
24000 lb	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 lb	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 lb	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 lb	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	

 Table 4. Calculated Roll Ahead Distances for Moving Operation (15 mph)

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

 Table 5. Calculated Roll Ahead Distances for Stationary Operation

OPERATION OF TTMA-100

Operation of the Trailer TMA is similar to that of other trailers. Special attention should be given to the following issues:

Warning! The TTMA-100 device does not have brakes. All braking will be dependent on the tow vehicle. Thus, additional distance should be allowed for in braking and stopping of the tow vehicle.

Warning! Do not use the TTMA-100 for hauling. Objects on the trailer would be a hazard for vehicles impacting the TTMA-100.

Warning! Attachment of the TTMA-100 results in wider turns. Drivers should be aware of this need for wider turning radius and adjust their driving accordingly.

Warning! Attachment of any trailer TMA will result in different handling for the tow vehicle while backing up. Drivers should be aware of this difference in vehicle handling characteristics and adjust their driving accordingly.

Warning! Tow vehicles should be equipped with head rests, lap belts and shoulder straps to provide proper crash protection for the driver and passengers. Operators should adjust their head rest to contact the center of the head and should wear seat belt and shoulder strap at all times.

Warning! Do not attach any item to the trailer or hitch without explicit approval from the manufacturer. Contact Gregory Industries Technical Support for any question regarding attachments to the trailer <u>TTMATechnicalSupport@gregorycorp.com</u>, Phone: (330) 477-4800

This manual does not cover the operation of optional equipment such as arrow boards, variable message sign boards, and other approved hitch mounted equipment. Please see appropriate operating manuals accompanying those devices for instructions.

MAINTENANCE GUIDELINES

Proper maintenance of the TTMA-100 is critical to assure continuing safe operation and longterm durability of the device. Even though the unit is galvanized, the outside of the TTMA-100 should be washed periodically, particularly during winter usage, to eliminate salt and other road contaminants. The inside of the frame should also be washed annually. The end caps (Item G) can be removed to allow rinsing the inside of the frame. Care should be taken with the wiring for the side marker lights during this process. Note that all critical parts of the TTMA-100 are hotdip galvanized, thus require minimal maintenance.

Item	Function Required	Before Each Use	Weekly	3 Months/ or 3,000 Miles	12 Months or 12,000 Miles
Lighting System	Lighting System Test that all lights are operational				
Pintle Hook	Check capacity and verify that the retaining pin is properly inserted	••			
Safety Chains	Check that they are properly attached	••			
Mandrel Restraining Bolts Check that the restraining bolts are not missing, bent, or broken, and tightened to the specified torque		••			
Tire Inflation	Set to 30 psi		••		
Tire Condition Inspect for cuts, wear, bulging, etc				••	
Wheels Inspect for cracks, dents, distortion or other signs of wear				••	
Splice BoltsCheck that the splice bolts are not missing, bent, or broken, and tightened to the specified torque				••	
Wheel Nuts Tighten to manufacturer specified torque values				••	
Wheel Bearings and Cups	Wheel Bearings and CupsInspect for corrosion or wear.Clean and repack				••
Frame WeldsCheck for cracks; call GregoryIndustries immediately for instruction if cracks are detected.					••

The following preventive maintenance schedule is recommended:

REPAIR OF DAMAGED TRAILER

IMPACT BY ERRANT VEHICLE

The TTMA-100 is designed to reduce the impact severity for both the occupants of the impacting vehicle and the tow vehicle by dissipating the impact energy in a gradual and controlled manner. When the TTMA-100 is impacted by an errant vehicle, the following sequence of events will occur (all references to parts are depicted in Figure 1 and described in Table 2):

- 1. For impacts of 5 mph or less, which are generally termed as nuisance hits, results from crash testing have shown that there is typically no damage to the energy absorption assembly of the TTMA-100.
- 2. For higher speed impacts, the shear bolts holding the mandrels (Part a) to the energy absorbing tubes will be sheared off, thus releasing the mandrels to move forward.
- 3. The mandrels (Part B) are pushed forward by the impacting vehicle and engage the ends of the energy absorbing tubes (Part C).
- 4. As the mandrels are pushed forward, bursting of the energy absorbing tubes into four strips of metal is initiated as shown in Figure 11, thereby dissipating the energy from the impacting vehicle.



Figure 11. Bursting of Energy Absorbing Tube

5. The sequence of events from here on depends on the speed and weight of the impacting vehicle.

Low-speed impact:

a. The impacting vehicle comes to a complete stop prior to the mandrels (Part B) reaching the breakaway axle (Part E)

Medium-speed impact:

- a. The mandrels (Part B) reach the breakaway axle and shear off the bolts connecting the axle assembly to the energy absorbing tube, thus releasing the axle.
- b. The impact head (Part A) contacts the axle push rods and move the axle forward as the bursting process continues.
- e. The impacting vehicle comes to a complete stop prior to the mandrels reaching the splice connecting the energy absorbing tubes and the trailer frame (Part D).



Figure 12. Damage from Medium-Speed Impact

High-speed impact:

a. The mandrels (Part B) continue past the splice connecting the energy absorbing tubes (Part C) and the trailer frame (Part D). The vehicle is eventually brought to a safe stop against the impact head or disengages from the impact head and spins out prior coming to a complete stop.

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TTMA-100 REPAIR

For impacts requiring repair and replacement of parts on the TTMA-100, Gregory Industries, Inc offers different parts packages depending on the extent of damage sustained by the unit. These parts packages come with specific instructions regarding repair of your damaged trailer. These parts packages are available through STI or a designated distributor in your area.

FOR A LIMITED TIME, REBATES OF 20 PERCENT OFF THE MSRP WILL BE OFFERED ON REPLACEMENT PARTS IN EXCHANGE FOR DOCUMENTATION OF THE IMPACTS AND/OR ACCIDENTS.

To facilitate our evaluation of the in-service performance of the TTMA-100, we offer, for a limited time, a rebate equal to 20 percent off the MSRP of the repair parts packages, if complete records of the incident are forwarded to Gregory Industries within 30 days of the occurrence. These records include a completed Gregory Industries incident report (available on our web site <u>www.gregorycorp.com</u> or by calling (330)477-4800) and one or more of the following items: photographs of damaged trailer, photographs of the impacting and tow vehicles, and police accident report if available.

DAMAGE ASSESSMENT AND REPAIR PARTS PACKAGES

Inspect the TTMA-100 to assess the extent of the damage and the necessary repairs. Due to the simple design of the TTMA-100, damages to the trailers are usually very evident. Nevertheless, **the trailer should be thoroughly inspected to assure that it is in proper working order prior to returning the trailer into service.**

The extent of damage to the trailer will vary greatly, depending on the nature and severity of the impact. It would not possible to cover all situations that could potentially be encountered in real-world crashes. Thus, the instructions are presented in general terms for the following levels of damage to the trailer.

- No apparent damage to trailer.
- Energy absorbing tubes (Part C) bursted, but axle assembly (Part E) not detached.
- Energy absorbing tubes (Part C) bursted and axle assembly (Part E) detached, but the bursting does not reach the trailer A-frame (Part D).
- Bursting reaches trailer A-frame.

Detailed discussions on the required repair and replacement parts for each level of damage are presented as follows:

No Apparent Damage to Trailer

- Inspect shear bolts (Part a) holding mandrels (Part B) in place with the energy absorbing tubes (Part C). If the shear bolts are bent or broken, replace the bolts.
- Inspect trailer lighting system for damage. If the lighting system sustains only minor damage, such as a broken lens or light bulb, repair the damaged items, which may be readily purchased from automotive supplies stores. Make sure that all the lights are working properly prior to returning the trailer to service.
- The following replacements parts are typically required for repair with this severity of damage sustained by the trailer..

Part No.	Items in Package
NHRC	Shear bolts, nuts, washers and plastic guide plates.

• Replacement of the shear bolts and plastic guide plates for the mandrels and repair of the lights may be conducted in the field by the user without involving the distributor or manufacturer.

Axle Assembly not Detached

- Replace energy absorbing tubes (Part C) and shear bolts (Parts a, b, c, d).
- Inspect trailer lights for damage. If the lighting system sustains only minor damage, such as a broken lens or light bulb, repair the damaged items, which may be readily purchased from automotive supplies stores. Make sure that all the lights are working properly prior to returning the trailer to service. If the lighting system is severely damaged and no longer functional, replace the entire lighting system.
- Inspect impact head (Part A) and mandrels (Parts B) for damage. For this severity of impact, it is unusual for either the impact head or the mandrels to be damaged to the extent that they are no longer usable and needs to be replaced. Nonetheless, check to make sure that the impact head and mandrels are not severely bent and are properly aligned with the energy absorbing tubes.
- Inspect lunette ring and pintle hook for damage. For this severity of impact, it is unusual for either the lunette ring or the pintle hook to be damaged to the extent that they are no longer usable and needs to be replaced. Nonetheless, check to make sure that the lunette ring and the pintle hook are not severely bent and can be hooked up properly.
- The following replacements parts are typically required for repair with this severity of damage sustained by the trailer. It is recommended that such repairs be conducted by a manufacturer certified technician, either at the facility of a distributor or at the facility of the user.

Part No.	Items in Package	
LSRC	2 each (Parts C, a, b, c, d, g, and h)	
T100-LB	Basic light system	

Axle Assembly Detached, but No Damage to Trailer A-Frame.

- Replace energy absorbing tubes (Part C) and shear bolts (Parts a, b, c, d, g and h).
- Inspect the breakaway axle assembly (Part E) for damage. Replace axle if visibly bent. If the axle is not damaged, but the push rods are bent, straighten out the push rods. Make sure that the push rods are attached to the axle properly. If the axle is not damaged, but the fenders are severely bent, replace only the fenders.
- Inspect trailer lights for damage. If the lighting system sustains only minor damage, such as a broken lens or light bulb, repair the damaged items, which may be readily purchased from automotive supplies stores. Make sure that all the lights are working properly prior to returning the trailer to service. If the lighting system is severely damaged and no longer functional, replace the entire lighting system.
- Inspect impact head (Part A) and mandrels (Parts B) for damage. For this severity of impact, it is unusual for either the impact head or the mandrels to be damaged to the extent that they are no longer usable and needs to be replaced. Nonetheless, check to make sure that the impact head and mandrels are not severely bent and are properly aligned with the energy absorbing tubes.
- Inspect lunette ring and pintle hook for damage. For this severity of impact, it is unusual for either the lunette ring or the pintle hook to be damaged to the extent that they are no longer usable and needs to be replaced. Nonetheless, check to make sure that the lunette ring and the pintle hook are not severely bent and can be hooked up properly.

• The following replacements parts are typically required for repair with this severity of damage. It is recommended that such repairs be conducted by a manufacturer certified technician, either at the facility of a distributor or at the facility of the user.

Part No.	Items in Package
LSRC	2 each (Parts C, a, b, c, d, g, and h)
T100-AA	Axle Assembly (Part E)
T100EF	Fenders (2)
T100-LB	Basic lighting system

Bursting Reaches Trailer A-Frame

For this high severity of impact, it is not advisable to repair the trailer. It is recommended that the user should consider purchasing a new trailer. First, the cost for the replacement parts would approach that of a new trailer. Second, extensive assembly would be required, which may pose some problems for someone not familiar with the details of the trailer.

TECHNICAL ASSISTANCE

If you have any questions regarding these inspections and assessment of damage to the trailer or required repair parts, please contact your distributor or Gregory Industries Technical Help by telephone at (330)477-4800, e-mail at <u>TTMATechnicalSupport@gregorycorp.com</u> or conventional mail at 4100 13th Street SW, Canton, Ohio 44710. In order for Technical assistance to better provide assessment of the trailer or required repair parts, it would be most helpful if you can send photographs of the damaged trailer, both showing the overall damages and damages to the specific areas or parts in question.



TTMA-100 Assembly Manual



Gregory Industries, Inc.

4100 13th Street, SW • Canton, Ohio 44710 • Phone 330-477-4800 www.gregorycorp.com

June 2010

FOREWORD

Thank you for your purchase of the Trailer Truck Mounted Attenuator, Model 100, from Gregory Industries, Inc. (herein referred to as the TTMA-100). The TTMA-100 is a Test Level 3 (TL-3) crash cushion designed for use with a support truck in both stationary and moving work zones. We are committed to providing our customers with highway safety products that have the best performance and value for your money, as well as the highest level of customer service. The TTMA-100 is one of the most innovative TMA's in the market, offering a higher level of performance with heavy tow vehicles and requiring no modification of the tow vehicle. It has successfully passed all required and optional crash tests set forth in NCHRP Report 350 and is fully approved for use on the National Highway System by the Federal Highway Administration.

This manual provides step-by-step instructions on the assembly of the TTMA-100 and applies to both initial assembly and repair and replacement of damaged components. Please read and understand the recommendations contained in this manual thoroughly before actual assembly, and keep it handy for future reference. If you have any questions or comments regarding the operation and maintenance of this product, please contact us by telephone 330-477-4800 or by mail at Gregory Industries, Inc. 4100 13th Street, SW, Canton, Ohio 44710. Technical issues can be emailed to TTMATechnicalSupport@gregorycorp.com This manual is divided into four sections:

- TTMA Design and Major Components. An overview of the Trailer TMA design and major components are presented in this section, including the product specifications and parts list.
- General Instructions. Some general information regarding assembly of the TTMA-100, such as shipping package, recommended tool list, bolt torque specifications, pintle hook, and removal of excess zinc.
- Assembly Instructions. Step-by-step instructions on the assembly of the TTMA-100 are outlined and illustrated in this section.
- Repair of Damaged Trailer. Discussions of impacts by an errant vehicle and the associated repair and replacement of trailer parts are presented in this section.

CUSTOMER SERVICE CONTACTS

Gregory Industries, Inc. is committed to providing the best service and care to our customers. You are automatically registered with your purchase and you will be notified of any future changes or upgrades to the TTMA-100. If you have any comments or questions regarding this product, please contact Gregory Industries via telephone, e-mail or conventional mail:

Telephone (330)-477-4800; Monday to Friday, 9:00 a.m. to 5:00 p.m. Eastern Standard Time.

Email: TTMATechnicalSupport@gregorycorp.com

Web Site: <u>http://www.gregorycorp.com</u>

Mail: Gregory Industries, Inc. 4100 13th Street, SW Canton, Ohio 44710

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TTMA-100 DESIGN AND MAJOR COMPONENTS

GENERAL

A schematic of the TTMA-100 is shown in Figure 1. The major components of the TTMA-100, as shown in Figure 1, are as follows:

<u>Component</u>	Description
А	Impact Head
В	Bursting Mandrel
С	First Energy Absorbing Tube
D	Trailer Frame
E	Axle Assembly
F	Plastic Guide Plates
G	End Caps
Н	Hitch Assembly
J	Spacer
Κ	Jack Assembly

Table 1 presents the general specifications for the Trailer TMA, including:

- Overall dimensions, i.e., length, width and maximum height to the top of the impact head and the top of the light bar
- Weight of the trailer with no optional equipment and the tongue weight. Note the small tongue weight of the trailer, which would not affect the load carrying capacity of the tow vehicle.
- The capacity and mounting height of the pintle hook.
- Information on the axle assembly, i.e., load rating, wheel and tire sizes, and cold inflation pressure.

Table 2 provides a list of parts with legends and part numbers. Please refer to these part numbers and legends for ordering of spare parts. Note that this is not a complete parts list. Please inquire about the complete parts list and pricing from the manufacturer, distributor, or reseller of the Trailer TMA.

Figure 2 shows the schematic of the wiring details of the Trailer TMA. Also, detailed instructions on the wiring of the trailer TMA are provided in a separate Wiring Manual and will not be repeated herein.



Figure 1. Schematic and Parts Layout of TTMA-100

TABLE 1. GENERAL SPECIFICATIONS

Overall Dimensions:	
Length	23 ft 6 in.
Width	8 ft 0 in.
Maximum Height (to top of impact head)	31 in.
Maximum Height (to top of light bar)	37 in.
Ground Clearance (to bottom of impact head)	13 in.
Weight:	
Basic Trailer Weight with No Optional Equipment	1,450 lb
Approximate Tongue Weight	190 lb
Pintle Hook:	
Capacity Rating (Minimum)	8 tons
Mounting Height	19.5-32.0 in.
Breakaway Axle:	
Rating	1,750 lb
Tire Size	205/75D15
Rim Size	15x5JJ
Cold Tire Inflation Pressure	30 psi

TABLE 2. TRAILER COMPONENT AND PARTS LIST

TRAILER COMPONENTS							
ITEM	PART #	QUANTITY	DESCRIPTION				
А	T100A	1	Impact Head				
В	T100B	2	Bursting Mandrel				
С	T100C	2	First Stage Energy Absorber				
D	T100D	1	Trailer A-Frame				
Е	T100E	1	Axle Assembly				
F	T100F	4	Plastic Guide Plates				
G	T100G	2	End Caps				
Н	T100H	1	Hitch Assembly				
J	T100J	8	Spacer				
K	T100K	1	Jack Assembly				
	HARDWARE ITEMS						
ITEM	PART#	QUANTITY	DESCRIPTION				
a	B0516070A	6	5/16" x 7" Grade 5 Hex Bolt				
b	W0516	6	5/16" Washer				
с	LW0516A	6	5/16" Heavy Lock Washer				
d	N0516A	6	5/16" Grade 5 Hex Nut				
e	B0816020A	8	1/2" x 2" Grade 5 Hex Bolt				
f	W0816	8	1/2" Washer				
g	LW0816A	12	1/2" Heavy Lock Washer				
h	N0816A	12	1/2" Grade 5 Hex Nut				
j	B0916030A	16	9/16" x 3" Grade 5 Hex Bolt				
k	W0916S	16	9/16" SAE Washer				
m	LW0916A	16	9/16" Heavy Lock Washer				
n	N0916A	16	9/16" Grade 5 Hex Nut				
0	B1016025A	4	5/8" x 2 1/2" Grade 5 Hex Bolt				
р	W1016	4	5/8" Washer				
q	LW1016A	4	5/8" Heavy Lock Washer				
r	N1016A	4	5/8" Grade 5 Hex Nut				



Figure 2. TTMA-100 Wiring and Light Layout

GENERAL INSTRUCTIONS

SHIPPING PACKAGE

This manual is intended for the assembly of the TTMA-100. Note that the unit may be shipped in different stages of assembly, depending on the order. Similarly, when repairing a damaged trailer, the extent of disassembly and re-assembly would vary depending on the nature and extent of repair and the parts that need to be replaced. Thus, the instructions cover the entire assembly process, with the exception of wiring, even though only part of the instructions may be applicable in any given situation.

RECOMMENDED TOOL LIST

The following is the recommended tool list for assembling the TTMA-100:

- Socket wrenches: 1/2", 3/4", 13/16", 15/16"
- Open end wrenches: 1/2", 3/4", 13/16", 15/16"
- Pneumatic wrench
- Drift pin
- Wire crimper
- Round and flat metal files
- Electric drill and bits
- 4-ft level
- Measuring tape

Optional:

• Fork lift/crane for parts manipulation. Note that some parts are very heavy and care should be taken in assembling and disassembling the unit.

BOLT TORQUE SPECIFICATIONS

All bolts should be tightened to the specified torque prior to use of the Trailer TMA. The following are the recommended torques to the bolts according to the bolt size:

Bolt Size (in)	5/16"	1/2"	9/16"	5/8"
Torque (ft-lb)	15	60	85	115
Torque (N-m)	20	81	115	156

PINTLE HOOK ASSEMBLY

The pintle hook should have a minimum capacity rating of 8 tons. Due to the wide variations in the frame structures of different tow vehicles, there is not a single standard means of mounting the pintle hook assembly to the frame of the tow vehicle. The major considerations in mounting of the pintle hook are the strength of the attachment and the mounting height.

The pintle hook assembly may be welded or bolted to the frame of the tow vehicle. Regardless of the method of mounting or attachment to the tow vehicle, it is critical to ensure that the strength of the attachment exceeds the rated capacity of the pintle hook with a wide margin of safety. It is the obligation of the users to ensure that their particular pintle hook attachment system meets these strength requirements.

CLEARING OF EXCESS ZINC

• All the major components of the TTMA-100 are galvanized to protect the metal from the weather elements. It is not unusual for some of the holes to have excess zinc as a result of the hot-dip process, as shown in the photograph.



The excess zinc would effectively reduce the size of the hole so that the bolt would not fit through the hole. It is, therefore, necessary to remove excess zinc from the pre-drilled holes. Depending on the excess amount of zinc, punching through the hole with a drift pin may be sufficient; otherwise, an electric drill may be necessary, as shown in the following photographs.

• Use drift pin to remove excess zinc.



• Use electric drill pin to remove excess zinc.



INSTALLATION INSTRUCTIONS

The trailer can be assembled from scratch by two men in about 2 to 4 hours. Depending on the shipping package, the trailer may already be partially assembled and certain steps in the assembly process are, therefore, not applicable. However, all the steps of the assembly process are shown for information purposes, in case the trailer has to be disassembled and reassembled.

Warning! Part D, the trailer frame, is too heavy for two men to move safely. It is recommended that a lifting device be utilized to move the heavy parts.

Warning! Various parts of the trailer are heavy. Care in lifting should be exercised and steel-toed boots are recommended.

Warning! The parts of trailer may have sharp asperities from the welding and galvanizing processes. Use of appropriate gloves is recommended.

The major steps in the assembly of the trailer are as follows:

- A. Arrange major components in approximate positions for assembly.
- B. Connect energy absorbing tubes to A-frame.
- C. Insert connecting block for axle and fender assembly.
- D. Install mandrels.
- E. Attach impact head.
- F. Align and tighten connections between energy absorbing tubes and A-frame
- G. Assemble axle, fenders, and wheels and tires.
- H. Install light bar.
- I. Install accessories.
- J. Install chevron panels and conspicuity tapes.

More detailed descriptions of these major steps are presented in the following sections. A separate section on wiring instructions is provided and will not be provided herein.

A. LAYOUT OF MAJOR COMPONENTS

Place the major components of the trailer in their approximate positions for assembly, as shown in the following photograph. Note that the A-frame and the first energy absorbing tubes should be placed on benches.



The following are close-up photographs of each major component:

• A-frame with lunette ring and safety chains.



• Energy absorbing tubes.



• Connection between energy absorbing tubes and A-frame.



• Axle assembly with push rods, fenders, and wheels and tires.



• Impact head, mandrels and light bar assembly.



B. CONNECT ENERGY ABSORBING TUBES TO A-FRAME

• Align the energy absorbing tubes with the A-frame. Note the attachment hardware, including spacers, bolts, washers and nuts.



• Place a spacer between the end of A-frame and the end of energy absorbing tube for one of the four flanges and align bolt holes. Insert bolts and nuts with washers on both sides.



• Repeat the process for other three flanges. Do not tighten the bolts and keep the connection loose at this time.





• Repeat the process for the other energy absorbing tube.

C. INSERT CONNECTING BLOCK FOR AXLE AND FENDER ASSEMBLY

A connecting block with two protruding bolts is used to attach the axle assembly to the energy absorbing tubes. The connecting block is placed inside the energy absorbing tube so that the two protruding bolts will pass through two pre-drilled holes on the bottom of the energy absorbing tube. The axle assembly is then attached to the energy absorbing tubes using these protruding bolts.

• To facilitate placing of the connecting block inside the energy absorbing tube, a tool similar to that shown in the photograph is recommended. The tool is fabricated by welding or attaching a long handle to a flat plate with a slot to accommodate the two protruding bolts from the connecting block.



• This photograph illustrates how the tool is used to hold the connecting block in place with the two protruding bolts in the slot.



- Check to make sure the two protruding bolts will fit properly in the pre-drilled holes at the bottom of the energy absorbing tube. If the bolts and the holes are not aligned properly, adjust as necessary by tapping on the bolts and cleaning out the holes of excess zinc from galvanizing.
- Slide the tool with the connecting block into the open end of the energy absorbing tube until the two protruding bolts go through the holes on the bottom of the energy absorbing tube, as shown in the following photograph.





• Install retaining clips to keep bolts in place.



• Repeat the process for the other energy absorbing tube.

D. INSTALL MANDRELS

• Slide the mandrel into the open end of the energy absorbing tube until the holes for the shear bolt on the energy absorbing tube and the mandrel are aligned.



• When the holes are aligned, use the drift pin to hold mandrel in place.



• Two plastic guide plates, as shown in the photograph, are used to keep the mandrel from bouncing up and down during field operations. The two guide plates are distinguished by the color, black for the top guide plate and white for the bottom guide plate.



- Lift up the open end of the mandrel and slide in the white plastic guide plate at the bottom between the mandrel and the energy absorbing tube. Adjust the plastic guide plate until the holes for the shear bolt on the energy absorbing tube, mandrel, and the guide plate are properly aligned. Use the drift pin to hold mandrel and white plastic guide plate in place.
- Slide the top black plastic guide plate between the mandrel and the energy absorbing tube. Adjust mandrel and plastic guide plate until the holes for the shear bolt on the energy absorbing tube, mandrel, and the plastic guide plate are properly aligned.





• Insert shear bolt with washer through the aligned holes through the top of the energy absorbing tube, the black plastic guide plate, the mandrel, the white plastic guide plate, and the bottom of the energy absorbing tube.



• Insert shear bolt with washer through the aligned holes through the top of the energy absorbing tube, the black plastic guide plate, the mandrel, the white plastic guide plate, and the bottom of the energy absorbing tube. Insert nut with washer to shear bolt and tighten.



• Repeat the process for the other mandrel.

E. ATTACH IMPACT HEAD

• Lift the impact head to the connecting plates on the open ends of the mandrels.



• Align the holes on the impact head and the connecting plate on one mandrel. Insert drift pin to hold the alignment in place. Insert bolts and nuts with washers. Photos showing sequence and completed operation.





- Repeat the process for the other mandrel.
- Tighten bolts and nuts to specified torque.


F. ALIGN AND TIGHTEN CONNECTIONS BETWEEN ENERGY ABSORBING TUBES AND A-FRAME

Tighten and torque the bolts connecting the energy absorbing tubes and the A-frame. Before tightening the bolts, make sure that the trailer is aligned properly:

• Check to make sure the A-frame, the energy absorbing tubes, and the top of the impact head are level.





• Place two struts to make sure that the two energy absorbing tubes and the A-frame are straight and separated at a constant distance.



• Check to make sure that the trailer frame is not skewed. This is checked by measuring the distance diagonally from front center of the A-frame to the corner of the end of the energy absorbing tube while the tape measure is aligned with the corner of mandrel. The diagonal distance on both sides should be the same if the frame is skewed.









• If necessary, use plastic shims at the connections to make minor adjustments on the alignment of the trailer frame. Remove bolts and spacer on flange needing adjustment. Insert plastic shim with spacer between the flanges and insert, tighten and torque the bolts and nuts.



• Tighten the bolts to the specified torque.



G. ASSEMBLE AXLE, FENDERS, AND WHEELS AND TIRES

• Attach the fenders to both ends of the axle assembly. Align the holes and insert bolts and nuts with washers.



• Lift the axle assembly with the attached fenders and align the holes on the axle assembly and fenders with the protruding bolts from the bottom of the energy absorbing tube. Attach with nuts and washers.





• Check to make sure that axle is lined up perpendicular to the trailer frame. Measure the distance from cross member of the A-frame to the center of the axle. The measurements on both sides should be the same.



• Install wheels and tires onto axle assembly.



• Measure to make sure that the face of tire is separated from the fender by a couple of inches to avoid any potential influence between the fender and the wheel.



• Tighten and torque all bolts and nuts.



• Insert plastic end caps into all tubular members with open ends.



H. INSTALL LIGHT BAR

• The light bar is attached to the top of the impact head with four bolts. As shown in the photographs, screw inserts are incorporated into the bottom of the light bar with corresponding pre-drilled holes on the top of the impact head.







• Place light bar on top of the impact head and align the holes on the impact head with the bolt holes on the light bar. Insert bolt with washer into bolt hole and tighten. Repeat for other three bolt holes. Photos of sequence and completed installation.



• Install the wiring for the light bar next. A separate section on wiring instructions is provided and will not be repeated herein. Please refer to the "Wiring Instructions" section for detailed information.

NOTE ALL LIGHTS ARE 12 Volt. For 24 Volt usage a 12 volt to 24 volt converter must be installed. (Not supplied by Gregory Industries, Inc.) If used without converter the lights WILL BE DAMMAGED and will need to be replaced.

I. INSTALL ACCESSORIES

There are a number of accessories that need to be installed onto the A-frame, including lunette ring, safety chains, end caps and jack. Instructions for installing each of these accessories are outlined as follows.

Lunette Ring

• Align holes on the base plate of the lunette ring assembly with those on the front plate of the A-frame. Inserts bolts and nuts with washers.





• Tighten and torque bolts.



Safety Chains

• Align hole on anchor plate of safety chain with that on the gusset plate. Inserts bolt and nut with washers. Tighten and torque. Repeat process for the safety chain anchor plate on the other side.



End Caps

End caps are used to cover the open ends of the tubular members at the A-frame to keep moisture from the inside of the tubes.

• After completing the wiring, place the end cap into the open end of the tube. Align the holes on the end cap with those on the open end of the tubular member. Inserts bolts and nuts with washers.



• Tighten the nuts and torque to specification.



• Repeat the process for the open end of the tubular member on the other side.

Jack

The trailer is equipped with a sidewind jack. A connection is provided on the cross member of the A-frame for the jack. When not in use, the jack is stalled in the horizontal position.



J. INSTALL CHEVRON PANELS AND CONSPICUITY TAPES

The trailer may be equipped with chevron panels on the front of the impact head and reflective tapes on the sides and front of the trailer to increase the conspicuity of the trailer. Step-by-step instructions on installing the chevron panels and conspicuity tape are provided as follows.

Chevron Panel

• The chevron panels may have pre-drilled holes and straps are welded to the front of the impact head for attachment.



• If supplied with pre-drilled holes, mark the location of the pre-drilled holes on the straps and drill starter holes. If not drill holes in center of strap and affix panels.



• Screw or bolt the chevron panels to the straps.



Conspicuity Tape

There are six locations where conspicuity tapes are attached;

- Two on sides of the energy absorbing tubes.
- Two on sides of the A-frame tubes.
- Two on the angled members of the A-frame.

The process for attaching the conspicuity tapes are the same for all locations and are described as follows.

• Mark the locations of where the conspicuity tapes are to be installed, both horizontally and vertically.



• Measure the required length of the conspicuity tape.



• Cut the conspicuity tape to the required length.



• Paste the cut conspicuity tape onto the side of the tubular member. Make sure that the surface is clean and free of contaminants that could adversely affect the attachment of the tape. Peel the backing off the tape and paste the tape onto the surface in the pre-marked areas.





Palletized Shipments:

The below picture depict a palletized shipment of 3 trailers ready for overseas transport. These trailers were pre-assembled at the factory then partially de-assembled to be properly palletized. Many of the preceding installation steps in this manual have all ready been completed.



Step that must be completed to assemble palletized trailers are as follow:

ASSEMBLY OF ENERGY ABSORBING TUBES TO A-FRAME INSTLATION OF JACK STAND TO A-FRAME ASSEMBLY OF ENERGY ABSORBING TUBES

Check for square of trailer frame. ASSEMBLY OF AXLE TO FRAME ASSEMBLY OF WHEELS TO AXLE ASSEMBLY OF FENDERS TO FRAME INSTALATION OF IMPACT HEAD TO MANDRILS INSTLATION OF ELECTRICAL WIRING HARNESS INSTALATION OF LIGHT BAR INSTALATION OF REFLECTIVE PANNES TO IMPACT HEAD (16"X36")



ASSEMBLY OF ENERGY ABSORBING TUBES TO A-FRAME



ALLIGNMENT OF ENERGY ABSORBING TUBES



ASSEMBLY OF ENERGY ABSORBING TUBES



ASSEMBLY OF FENDERS TO FRAME Check for square of trailer frame.



INSTALLATION OF IMPACT HEAD TO MANDRILS



Figure 2. TTMA-100 Wiring and Light Layout

INSTLATION OF ELECTRICAL WIRING HARNESS

NOTE: ALL LIGHTS ARE 12 Volt. For 24 Volt usage a 12 volt to 24 volt converter must be installed. (Not supplied by Gregory Industries, Inc.) If used without converter the lights WILL BE DAMAGED and will need to be replaced.



INSTALLATION OF LIGHT BAR





INSTALATION OF REFLECTIVE CHEVERON PANELS TO IMPACT HEAD (16"X36") Optional reflective panels can be installed on tabs. Panels are not supplied by Gregory

Industries, Inc.



The enclosed light bar is mounted to the rear impact plate, as shown in Figure 1, by

means of four ¹/₄" bolts. To replace the lights on an existing trailer, first layout a drilling pattern as shown in Figure 2. Check to make sure that alignment of the holes is correct with regard to the threaded inserts on the bottom of the light bar prior to drilling.

Figure 1: Light bar mounted on Impact Head.





After drilling the holes, mount the light bar with the

4 enclosed ¹/₄" hex bolts as shown in Figure 3.

Figure 3: Installation of light bar utilizing 1/4" Hex Bolts.



Take the cable extending from the back of the light bar and feed it through the annulus between the mandrel and the bursting tube as shown in Figure 4.



Figure 4: Cable Path Beside Mandrel.

Working from the rear of the trailer, pull the cable through the bursting tube, as shown in Figure 5, to the front driver's side of trailer, through the holes in the angled frame and through the draw bar plate on the front of the trailer. The two long wires with bullet connectors can be fed through to the passenger side marker light.

The wiring kit comes with ³/₄" marker lights for the front drivers and passenger sides as shown in Figure 6.

If the trailer was equipped with a different set of lights, a ³/₄" mounting hole will be required. Wire the 7 pin connector as described in the enclosed documentation. If the connector does not have separate turn and brake lines, these wires will need to be combined. The extra black and red wires fed through to the driver's side front connector are to provide power for optional equipment such as arrow boards or variable message boards. For questions or comments please contact Gregory Industries, Inc. (TTMATechnicalSupport@gregorycorp.com) or (330) 477-4800.



Figure 5: Trailer Wiring Schematic



Figure 6: Side Marker Lights and Cable Feed Through

Parts and Pricing for TTMA-100 Attenuator

<u>Part #</u>	<u>Description</u>	<u>Price</u>
T-100A	Impact Head	\$1,540.00
T-100B	Bursting Mandrel	\$1,190.00
T-100C	First Stage Energy Bursting Tube	\$1,880.00
T-100E	Fender Light & Bracket	\$30.00
T-100EF-R	Fender (right)	\$155.00
T-100EF-L	Fender (left)	\$155.00
Т-100Н	Lunette Ring	\$220.00
T-100J	Spacers (package of 8)	\$130.00
Т-100К	Jack Assembly	\$275.00
T-100L	Safety Chains with Grade 70 Hooks	\$155.00
T-100M	16" Hitch Extension	\$495.00
T-NHRC	Guide Plates & Shear Bolts	\$120.00
T-100P	Axle and 5 Lug Hub Assembly	\$950.00
T-100S	Spare Tire Mount	\$75.00
T-100T	Spare Tire (radial) with Rim	\$220.00
T-CHEV-CHKRW	16" X 36" Reflective Panel – Red/White	\$160.00
T-LIGHTBAR-12V	Light Bar with Wiring Harness	\$1,100.00
T-ABF	Arrow Board Mounting Frame (unassembled)	\$1,485.00
T-ABF-W	Arrow Board Frame & Manual Winch (unassembled)	\$1,695.00

To order parts, please contact:

Roadway Safety Technologies – 3937 Randall Dr., Jefferson City, MO 65109

Phone: (573) 301-0101 – E-mail: roadwaysafety@aol.com

Optional parts listed below may require more than 60 days to deliver

Par36	Emergency Alert Lighting Package (uninstalled)	\$2,995.00
Par36-1	Emergency Alert Lighting Package (installed)	\$3 <i>,</i> 495.00
PSB-AB	Protection Services Arrow Board with Controller,	\$8,995.00
	Battery Box (No batteries) and Par36 Emergency	
	Lighting Package (installed)	

To order parts, please contact:

Roadway Safety Technologies – 3937 Randall Dr., Jefferson City, MO 65109

Phone: (573) 301-0101 – E-mail: roadwaysafety@aol.com



TTMA-100 Innovative, Flexible and Affordable

User Manual



Gregory Industries, Inc. 4100 13th Street, SW • Canton, Ohio 44710 • Phone 330-477-4800 www.gregorycorp.com January 2012

amended 08-09-2013

OPERATION OF TTMA-100

Operation of the Trailer TMA is similar to that of other trailers. Special attention should be given to the following issues:

Warning!

The TTMA-100 device does not have brakes. All braking will be dependent upon the tow vehicle. Thus, additional distance should be allowed for in braking and stopping of the tow vehicle.

Warning!

Do not use the TTMA-100 for hauling. Objects on the trailer can potentially be a hazard for vehicles impacting the TTMA-100.

Warning!

Attachment of the TTMA-100 will result in wider turning for the tow vehicle. Drivers should be aware of this need for wider turning radius and adjust their driving accordingly.

Warning!

Attachment of any trailer TMA will result in different handling for the tow vehicle while backing up. Drivers should be aware of this difference in vehicle handling characteristics and adjust their driving accordingly.

Warning!

The tow vehicles should be equipped with head rests, lap belts and shoulder straps to provide proper crash protection for the driver and passengers. Operators should adjust their head rest to contact the center of the head and should wear seat belt and shoulder strap at all times.

Warning!

Do not attach any item to the trailer or hitch without explicit approval from the manufacturer. Contact Gregory Industries, Inc. for any questions regarding attachments to the TTMA-100

E-mail: <u>TTMATechnicalSupport@gregorycorp.com</u> Phone: (330) 477-4800 Fax: (330) 477-0328

This manual does not cover the operation of optional equipment such as arrow boards, variable message sign boards, and other approved hitch mounted equipment. Please see appropriate operating manuals accompanying those devices for instructions.

FOREWORD

Thank you for your purchase of the Trailer Truck Mounted Attenuator, Model 100 from Gregory Industries, Inc. (herein referred to as the TTMA-100). The TTMA-100 is a Test Level 3 (TL-3) crash cushion designed for use with a support truck in both stationary and moving work zones. We are committed to providing our customers with highway safety products that have the best performance and value for your money, as well as the highest level of customer service. The TTMA-100 is one of the most innovative TMA's in the market, offering a higher level of performance with heavy tow vehicles and requiring no modification of the tow vehicle. It has successfully passed all required and optional crash tests set forth in NCHRP Report 350 and is fully approved for use on the National Highway System by the Federal Highway Administration.

This manual has been written to help you with the operation, maintenance, repair and step by step assembly of the TTMA-100. Please read and understand the recommendations contained within this manual thoroughly before use/assembly and keep it readily available for future reference. If you have any questions or comments regarding the operation and maintenance of this product, please do not hesitate to contact us:

Gregory Industries, Inc. 4100 13th Street SW, Canton, Ohio 44710 Phone: (330) – 477 - 4800 Fax: (330) – 477 - 0328 E-Mail: <u>TTMATechnicalSupport@gregorycorp.com</u>

This manual is divided into eight sections:

- **TTMA Design and Major Components**. An overview of the TTMA-100 design and major components are presented in this section, including the product specifications and parts list.
- How It Works. A brief explanation of the innovative features of the TTMA-100 and how it works to absorb and dissipate the energy from an impacting vehicle are outlined and illustrated within this section.
- **Operation Guidelines.** Guidelines pertaining to the operation of the TTMA-100 are presented in this section, such as minimum support truck weight, roll-ahead distances, connections, and other operational items.
- Maintenance Guidelines. Considerations on the routine maintenance of the TTMA-100 are outlined in this section.
- **Repair of Damaged Trailer**. Discussion of impacts by an errant vehicle and the associated repair and replacement of trailer parts are presented in this section.
- Assembly Instructions. Step-by-step instructions on the assembly of the TTMA-100 are outlined and illustrated in this section.
- General Instructions. Some general information regarding assembly of the TTMA-100, such as shipping package, recommended tool list, bolt torque specifications, pintle hook, and removal of excess zinc
- Wiring Instructions. Standard wiring layout diagram and instructions for assembly are included within this section

CUSTOMER SERVICE CONTACTS

J

Gregory Industries, Inc. is committed to providing the best service and care to our customers. You are automatically registered with your purchase and you will be notified of any future changes or upgrades to the TTMA-100. If you have any comments or questions regarding this product, please contact us via telephone, e-mail or conventional mail:

Gregory Industries, Inc. 4100 13th Street SW, Canton, Ohio 44710 Phone: (330) – 477 – 4800 Toll Free: (866) – 994 – 4929 Fax: (330) – 477 – 0328

E-Mail: <u>TTMATechnicalSupport@gregorycorp.com</u> E-Mail: <u>TTMASales@gregorycorp.com</u>

www.gregorycorp.com

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TTMA-100 DESIGN AND MAJOR COMPONENTS

GENERAL

A schematic of the TTMA-100 is shown in Figure 1. The major components of the TTMA-100, as shown in Figure 1, are as follows:

 A Impact Head B Bursting Mandrel C First Energy Absorbing Tul D Trailer Frame E Axle Assembly F Plastic Guide Plates G End Caps H Hitch Assembly 	mponent	Description
BBursting MandrelCFirst Energy Absorbing TulDTrailer FrameEAxle AssemblyFPlastic Guide PlatesGEnd CapsHHitch Assembly	А	Impact Head
C First Energy Absorbing Tul D Trailer Frame E Axle Assembly F Plastic Guide Plates G End Caps H Hitch Assembly	В	Bursting Mandrel
DTrailer FrameEAxle AssemblyFPlastic Guide PlatesGEnd CapsHHitch Assembly	С	First Energy Absorbing Tube
 E Axle Assembly F Plastic Guide Plates G End Caps H Hitch Assembly 	D	Trailer Frame
FPlastic Guide PlatesGEnd CapsHHitch Assembly	Е	Axle Assembly
G End Caps H Hitch Assembly	F	Plastic Guide Plates
H Hitch Assembly	G	End Caps
	Н	Hitch Assembly
J Spacer	J	Spacer
K Jack Assembly	K	Jack Assembly

Table 1 presents the technical specifications for the TTMA-100, including:

- Overall Dimensions including length, width and maximum height to the top of the impact head and the top of the light bar
- Capacity of TTMA-100 including weight (w/o optional equipment), approximate tongue weight (w/o
 optional equipment) Note: the small tongue weight of the trailer, which would not affect the load
 carrying capacity of the tow vehicle, minimum support truck weight and maximum support truck weight
- Pintle Hook information including hitch, capacity rating (minimum) and mounting height
- Breakaway Axle rating, tire size, rim size and cold inflation pressure
- Lighting standards and integrated light bar
- Construction information including frame, energy absorbing components, structural members in impact system, axle, fender
- Safety Performance including NCHRP 350 required tests, NCHRP 350 optional tests, support truck weight and energy absorbing system
- Warranty against defects in material and workmanship details

Table 2 provides a list of parts with legends and part numbers. Please refer to these part numbers and legends for ordering of spare parts. Note that this is not a complete parts list. Please inquire about the complete parts list and pricing from the manufacturer, distributor, or reseller of the TTMA-100.



Figure 1. Schematic and Parts Layout of TTMA-100

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Table 1. TTMA-100 Technical Specifications

Trailer:

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• Overall Dimensions:	
o Length	23'-6"
• Width	8'-0"
• Height (to top of impact head)	31"
• Height (to top of light bar)	37"
• Ground Clearance (to bottom of impact head)	13"
• Capacity:	
• Trailer Weight (w/o Optional Equipment)	1,450 lb
• Approximate Tongue Weight (w/o Optional Equipment)	190 lb
• Minimum support truck weight	10,000 lb
Maximum support truck weight	Unlimited
• Pintle Hook:	
• Hitch Lunette ring with no other structur	al attachment
 Capacity Rating (Minimum) 	8 tons
• Mounting Height	19.5"-32.0"
• Breakaway Axle:	1 550 11
• Rating	1,750 lb
• Tire Size	205/75D15
• Rim Size	15x5JJ
• Cold Tire Inflation Pressure	30 psi
• Lighting:	ata di Umbé ban
• Lighting Integr	EMAYOR 100
o Lighting standard	FIVLV 55 100
Construction:	Onen decign
• Frame	Open design
All energy absorbing components	avy gage steel
• All structural members in impact system Hot-dipp	ed galvanized
• Axle Mid-mount	ed breakaway
• Fender	Full-tender
Safety Performance:	A 117
NUHKP 350 required tests	w A approved
• NCHRP 350 optional tests FH	w A approved
• Support truck weight – NCHRP Report 350 Tests 3-50 & 3-51	
Unlimited	-
 Support truck weight – NCHRP Report 350 Tests 3-52 & 3-53 	Unlimited
Energy Absorbing System Bursting Tub	e Technology
Warranty:	0
Warranty against detects in material and workmanship	One year

ITEM	PART #	QUANTITY	DESCRIPTION			
	TRAILER COMPONENTS					
А	T100A	1	Impact Head			
В	T100B	2	Bursting Mandrel			
С	T100C	2	First Stage Energy Absorber			
D	T100D	1	Trailer A-Frame			
Е	T100E	1	Axle Assembly			
F	T100F	4	Plastic Guide Plates			
G	T100G	2	End Caps			
н	T100H	1	Hitch Assembly			
J	T100J	8	Spacer			
К	T100K	1	Jack Assembly			
HARDWARE ITEMS						
а	B0516070A	6	5/16" x 7" Grade 5 Hex Bolt			
b	W0516	6	5/16" Washer			
с	LW0516A	6	5/16" Heavy Lock Washer			
d	N0516A	6	5/16" Grade 5 Hex Nut			
e	B0816020A	8	1/2" x 2" Grade 5 Hex Bolt			
f	W0816	8	1/2" Washer			
g	LW0816A	12	1/2" Heavy Lock Washer			
h	N0816A	12	1/2" Grade 5 Hex Nut			
j	B0916030A	16	9/16" x 3" Grade 5 Hex Bolt			
k	W0916S	16	9/16" SAE Washer			
m	LW0916A	16	9/16" Heavy Lock Washer			
n	N0916A	16	9/16" Grade 5 Hex Nut			
0	B1016025A	4	5/8" x 2 1/2" Grade 5 Hex Bolt			
р	W1016	4	5/8" Washer			
q	LW1016A	4	5/8" Heavy Lock Washer			
r	N1016A	4	5/8" Grade 5 Hex Nut			

Table 2. Trailer Component and Parts List

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HOW IT WORKS

TUBE BURSTING TECHNOLOGY

The TTMA-100 uses a patented tube bursting technology to dissipate the energy of the impacting vehicle. The basic concept is quite simple. When a tapered mandrel with a square cross-section is 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 is split into four flat straps of metal that are curled outward by the flared portion of the mandrel. The graphics shown in figure 5 illustrate this bursting process.



Figure 5. Tube Bursting Process

The setup of the mandrel and the actual bursting process are demonstrated in the photographs shown in Figure 6.

Figure 6. Photographs Illustrating the Bursting Process



Tapered and over-sized mandrel inserted into the energy absorbing tube.



The mandrel cracks the energy absorbing tube at the corners and split it into four flat straps of metal.



Close-up view of mandrel and energy absorbing tube.

The Bursting Process

This bursting process consists of the cracking of the tube at the corners and splitting it into four straps of flat metal thus dissipating the energy of the impacting vehicle. The level of energy dissipation can be regulated by using different thickness of tubing and scoring of the tube (cutting grooves into the tubes at the corners) to reduce the energy dissipated during cracking. By adjusting the level of energy dissipation and the lengths of the energy absorbing tubes, the amount of energy dissipation and the rate of vehicle deceleration can be controlled to bring the impacting vehicle to a gradual and safe stop.

Tube bursting technology allows the TTMA-100 to use the trailer frame as the energy absorber, thus eliminating the need for a separate energy absorbing material. This simplifies the design and reduces the costs of the TTMA-100. Also, the straps of metal have no structural strength and curl up and away from the impacting vehicle, thus eliminating any hazard to the impacting vehicle. Furthermore, the straps of metal remain securely attached to the non-bursted section of the tube. Thus there are no detached elements that can be thrown forward and pose hazard to workers and adjacent traffic.

PINTLE HOOK ATTACHMENT

Another major improvement in TMA safety technology is the TTMA-100's ability to rotate. While competing trailer attenuators utilize rotational restraints to prevent the attenuator from rotating the TTMA-100 allows the trailer to rotate in order to keep the system aligned with the impacting vehicle to maximize energy dissipation. It is this innovative approach to energy management that has allowed the TTMA-100 to become the only TMA system to successfully pass NCHRP Report 350 optional offset and angled tests when attached to a support truck blocked against forward motion.

The primary concern about allowing a trailer to rotate is that the impacting vehicle could push the trailer out of its path and directly strike the rear of the support truck. However, as shown in Figure 7, an impacting vehicle must slide along the trailer's impact face in order to disengage from the trailer.

The patented innovation that eliminates this risk is the way the TTMA-100 engages an impacting vehicle. The TTMA-100's impact plate is designed to capture the front of a vehicle and lock the trailer between the impacting vehicle and the tow vehicle. The TTMA-100's impact head, shown in Figure 8 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.

The effectiveness of this mechanical interlock system can be illustrated by comparing final rest locations from NCHRP Report 350 pickup truck offset and angled tests (tests 3-52 and 3-53, respectively) for the three trailer TMA systems that have received FHWA approval. Figure 9 shows the final rest locations of the three trailer TMA systems for the optional offset and angled tests, as developed from FHWA approval letters.



Figure 7. Simulation of Vehicle Disengaging from a Trailer.

Figure 8. TTMA-100 Impact Head.

As shown in Figure 7, the final resting positions for the three designs are not substantially different even though the TTMA-100 was tested under a much more severe condition with the support truck blocked against forward movement. The other two trailer TMA systems were tested with 20,000-lb support trucks which were allowed to roll ahead during the crash. Figure 9 clearly demonstrates that the TTMA-100's simple pintle hook attachment and its vehicle capturing impact head are able to perform very well during offset and angled impacts, even when attached to an infinitely heavy support truck.

In fact, the combination of the simple pintle hook attachment and the trailer's connection with the support vehicle forces the trailer to rotate and align itself with the impacting force, which would in turn maximize energy dissipation. Hence, the TTMA-100 provides maximum energy dissipation for impacts at any angle to provide maximum safety to both motorists and construction workers.









Figure 9. Final Resting Locations of Trailer TMA Systems

OPERATION GUIDELINES

INITIAL SETUP

This TTMA-100 should be delivered fully assembled. If there are problems with the delivered trailer please contact Gregory Industries, Inc. immediately.

There are three items that will require your attention prior to utilizing the trailer:

• Check to make sure that there are no missing bolts and the bolts are tightened to the specific torque. The following are the recommended torques to the bolts according to the bolt size:

Bolt Size (in)	5/16"	1/2"	9/16"	5/8"
Torque (ft-lb)	15	60	85	115
Torque (N-m)	20	81	115	156

- Check to make sure that the wiring of the trailer plug for connection to the tow vehicle is appropriate. There are two distinctly different wire plugs that are not compatible, one is the RV plug and the other is the heavy duty truck plug. Make sure that you have the correct type of plug and that the plug is wired properly (refer to Wiring Instructions in the final section of this document). Also, check to confirm that the lights are functioning properly prior to putting the TTMA into service.
- Check to make sure that the pintle hook is mounted properly. Due to the wide variations in the frame structures of different tow vehicles there is not a single standard means of mounting the pintle hook assembly to the frame of the tow vehicle. The major considerations in mounting of the pintle hook are the strength of the attachment and the mounting height.

The pintle hook assembly may be welded or bolted to the frame of the tow vehicle. Regardless of the method of mounting or attachment to the tow vehicle it is critical to ensure that the strength of the attachment exceeds the rated capacity of the pintle hook with a wide margin of safety. It is the obligation of the users to ensure that their particular pintle hook attachment system meets these strength requirements.

There are two mounting positions for the lunette ring. The nominal height of the upper mounting position is 28 inches and the nominal height for the lower position is 23.5 inches. The TTMA-100 can accommodate a variation of up to 4 inches from the nominal height. Hence, when the lunette ring is in the upper position the TTMA-100 can be attached to a pintle hitch ranging from a minimum of 24 in. to a maximum of 32 in. in

height. When the lunette ring is in the lower position, the TTMA-100 can be mounted on pintle hooks ranging from a minimum of 19.5 in. to a maximum of 27.5 in. in height.

Figure 10 shows the lunette ring in the lower position. Note the bolt holes that can be used with the upper position.



Figure 10. Mounting Position of Lunette Ring

MINIMUM AND MAXIMUM WEIGHT OF TOW VEHICLE

The minimum recommended weight for the tow vehicle is 10,000 lb gross vehicle weight (GVW). There is no specified maximum weight for the tow vehicle. All TTMA-100 crash tests, including the required and optional crash tests specified under NCHRP Report 350, were conducted with the Trailer TMA attached to a tow vehicle that was blocked against any forward movement.

ATTACHMENT OF TTMA-100 TO TOW VEHICLE

The TTMA-100 is attached to the tow vehicle via a pintle hook with a minimum capacity of 8 tons.

Warning! Verify that the retaining pin for the pintle hook is properly locked to avoid accidental release of the pintle hook and the TTMA-100.

Warning! Make sure that the trailer lights are connected to the tow vehicle and are operating properly.

Warning! Ensure that the safety chains properly secure the TTMA-100 to the tow vehicle.

TOW VEHICLE ROLL AHEAD DISTANCES

One of the major safety considerations is the roll ahead distance of the shadow vehicle when impacted by an errant vehicle. When the tow vehicle with a TTMA-100 attached is impacted by an errant vehicle, through laws of motion the tow vehicle will move forward. It is therefore important to allow sufficient space between the tow vehicle and the workers, so that the roll ahead of the tow vehicle would not pose a safety concern for the workers in the area of impact. Tables 4 and 5 show the expected roll ahead distances for rolling and stationary tow vehicles, respectively, as a function of impact speed and weights of the support truck and impacting vehicle. The space between the support vehicle and the workers should exceed the roll-ahead distance under the prevailing operating conditions.

Please follow the following steps to determine the appropriate roll-ahead distance:

- 1. Assess the nature of the operation (i.e., moving or stationary operation). In a moving operation the tow vehicle is moving at slow speed, such as 15 mph. In a stationery operation the shadow vehicle is stopped with the parking brakes on. Use Table 4 for moving operations and Table 5 for stationary operations.
- 2. Select the weight that best approximates the actual weight of the tow vehicle: 10,000, 15,000, 24,000, 40,000, 60,000 or 80,000 lb. Note that the weight of the support truck should include the weights of items to be carried on the truck during the operation and the weight of the TTMA-100.
- 3. Select the range of prevailing speed of the traffic at the work zone: 45, 55 or 65 mph.
- 4. Select the weight of the impact vehicle to be contained: 10,000, 15,000, or 24,000 lb.
- 5. Select from the appropriate table the expected roll ahead distance

For example: If you are operating a tow vehicle with a gross weight of 15,000 lbs. as a stopped shadow vehicle in an area where the operating traffic speed is 45 mph, and there are few if any large trucks in the mix of traffic. You would start with Table 5, select the appropriate values from above, and determine that the maximum roll-ahead distance would be 11 ft. This is the distance from the front of the tow vehicle to the work area that should be provided.

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

Table 4. Calculated Roll Ahead Distances for Moving Operation (15 mph)

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

Table 5. Calculated Roll Ahead Distances for Stationary Operation

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MAINTENANCE GUIDELINES

Proper maintenance of the TTMA-100 is critical to assure continuing safe operation and longterm durability of the device. Even though the unit is galvanized, the outside of the TTMA-100 should be washed periodically, particularly during winter usage, to eliminate salt and other road contaminants. The inside of the frame should also be washed annually. The end caps (Item G) can be removed to allow rinsing the inside of the frame. Care should be taken with the wiring for the side marker lights during this process. Note that all critical parts of the TTMA-100 are hot-dip galvanized, thus require minimal maintenance.

Item	Function Required	Before Each Use	Weekly	3 Months/ or 3,000 Miles	12 Months or 12,000 Miles
Lighting System	Test that all lights are operational				
Pintle Hook	Check capacity and verify that the retaining pin is properly inserted				
Safety Chains	Check that they are properly attached	••			
Mandrel Restraining Bolts	Check that the restraining bolts are not missing, bent, or broken, and tightened to the specified torque	••			
Axle and Bolt on Push Rods	Verify the bolts are tight and the push rods are properly positioned 90 degrees to the axle to engage the impact head during a crash event. (see Figure 11)	••			
Tire Inflation	Set to 30 psi		66		
Tire Condition	Inspect for cuts, wear, bulging, etc				
Wheels	Inspect for cracks, dents, distortion or other signs of wear				
Splice Bolts	Check that the splice bolts are not missing, bent, or broken, and tightened to the specified torque			••	
Wheel Nuts	Tighten to manufacturer specified torque values			••	
Wheel Bearings and Cups	Inspect for corrosion or wear. Clean and repack				••
Frame Welds	Check for cracks; call Gregory Industries immediately for instruction if cracks are detected.				98

The following preventive maintenance schedule is recommended:



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Figure 11. Push Rod Alignment with Impact Head

REPAIR OF DAMAGED TRAILER

IMPACT BY ERRANT VEHICLE

The TTMA-100 is designed to reduce the impact severity for both the occupants of the impacting vehicle and the tow vehicle by dissipating the impact energy in a gradual and controlled manner. When the TTMA-100 is impacted by an errant vehicle the following sequence of events will occur (all references to parts are depicted in Figure 1 and described in Table 2):

- 1. For impacts of 5 mph or less, which are generally termed as nuisance hits, results from crash testing have shown that there is typically no damage to the energy absorption assembly of the TTMA-100.
- 2. For higher speed impacts, the shear bolts holding the mandrels (Part A) to the energy absorbing tubes will be sheared off, thus releasing the mandrels to move forward.
- 3. The mandrels (Part B) are pushed forward by the impacting vehicle and engage the ends of the energy absorbing tubes (Part C).
- 4. As the mandrels are pushed forward, bursting of the energy absorbing tubes into four strips of metal is initiated as shown in Figure 12a, thereby dissipating the energy from the impacting vehicle.



Figure 12a. Bursting of Energy Absorbing Tube

IMPACT BY ERRANT VEHICLE (Cont.)

5. The sequence of events from here on depends on the speed and weight of the impacting vehicle.

Low-speed impact:

a. The impacting vehicle comes to a complete stop prior to the mandrels (Part B) reaching the breakaway axle (Part E)

Medium-speed impact:

- a. The mandrels (Part B) reach the breakaway axle and shear off the bolts connecting the axle assembly to the energy absorbing tube, thus releasing the axle.
- b. The impact head (Part A) contacts the axle push rods and move the axle forward as the bursting process continues.
- e. The impacting vehicle comes to a complete stop prior to the mandrels reaching the splice connecting the energy absorbing tubes and the trailer frame (Part D).



Figure 12b. Damage from Medium-Speed Impact

IMPACT BY ERRANT VEHICLE (Cont.)

High-speed impact:

a. The mandrels (Part B) continue past the splice connecting the energy absorbing tubes (Part C) and the trailer frame (Part D). The vehicle is eventually brought to a safe stop against the impact head or disengages from the impact head and spins out prior coming to a complete stop.

TTMA-100 REPAIR

For impacts requiring repair and replacement of parts on the TTMA-100, different parts packages are available. All parts packages are specific to the extent of damage sustained by the unit. These parts packages come with specific instructions regarding repair of your damaged trailer. These parts packages are available through Gregory Industries, Inc. or a designated distributor in your area.

FOR A LIMITED TIME, REBATES OF 20 PERCENT OFF THE MSRP WILL BE OFFERED ON REPLACEMENT PARTS IN EXCHANGE FOR DOCUMENTATION OF THE IMPACTS AND/OR ACCIDENTS.

To facilitate our evaluation of the in-service performance of the TTMA-100, we offer, for a limited time, a rebate equal to 20 percent off the MSRP of the repair parts packages, if complete records of the incident are forwarded to Gregory Industries, Inc. within 30 days of the occurrence. These records include a completed Gregory Industries, Inc. incident report (available on our web site <u>www.gregorycorp.com</u> or by calling (330)-477-4800 and one or more of the following items: photographs of damaged trailer, photographs of the impacting and tow vehicles and police accident report if available.

DAMAGE ASSESSMENT AND REPAIR PARTS PACKAGES

Inspect the TTMA-100 to assess the extent of the damage and the necessary repairs. Due to the simple design of the TTMA-100, damages to the trailers are usually very evident. Nevertheless, the trailer should be thoroughly inspected to assure that it is in proper working order prior to returning the trailer into service.

The extent of damage to the trailer will vary greatly, depending on the nature and severity of the impact. It would not possible to cover all situations that could potentially be encountered in real-world crashes. Thus, the instructions are presented in general terms for the following levels of damage to the trailer.

- No apparent damage to trailer.
- Energy absorbing tubes (Part C) bursted, but axle assembly (Part E) not detached.
- Energy absorbing tubes (Part C) bursted and axle assembly (Part E) detached, but the bursting does not reach the trailer A-frame (Part D).
- Bursting reaches trailer A-frame.

Detailed discussions on the required repair and replacement parts for each level of damage are presented as follows:

No Apparent Damage to Trailer

- Inspect shear bolts (Part a) holding mandrels (Part B) in place with the energy absorbing tubes (Part C). If the shear bolts are bent or broken, replace the bolts.
- Inspect trailer lighting system for damage. If the lighting system sustains only minor damage, such as a broken lens or light bulb, repair the damaged items, which may be readily purchased from automotive supplies stores. Make sure that all the lights are working properly prior to returning the trailer to service.
- The following replacements parts are typically required for repair with this severity of damage sustained by the trailer.

Part No.	Items in Package
NHRC	Shear bolts, nuts, washers and plastic guide plates.

• Replacement of the shear bolts and plastic guide plates for the mandrels and repair of the lights may be conducted in the field by the user without involving the distributor or manufacturer.

Axle Assembly not Detached

- Replace energy absorbing tubes (Part C) and shear bolts (Parts a, b, c, d).
- Inspect trailer lights for damage. If the lighting system sustains only minor damage, such as a broken lens or light bulb, repair the damaged items, which may be readily purchased from automotive supplies stores. Make sure that all the lights are working properly prior to returning the trailer to service. If the lighting system is severely damaged and no longer functional, replace the entire lighting system.
- Inspect impact head (Part A) and mandrels (Parts B) for damage. For this severity of impact, it is unusual for either the impact head or the mandrels to be damaged to the extent that they are no longer usable and needs to be replaced. Nonetheless, check to make sure that the impact head and mandrels are not severely bent and are properly aligned with the energy absorbing tubes.
- Inspect lunette ring and pintle hook for damage. For this severity of impact, it is unusual for either the lunette ring or the pintle hook to be damaged to the extent that they are no

longer usable and needs to be replaced. Nonetheless, check to make sure that the lunette ring and the pintle hook are not severely bent and can be hooked up properly.

• The following replacements parts are typically required for repair with this severity of damage sustained by the trailer. It is recommended that such repairs be conducted by a manufacturer certified technician, either at the facility of a distributor or at the facility of the user.

Part No.	Items in Package
LSRC	2 each (Parts C, a, b, c, d, g, and h)
T100-LB	Basic light system

Axle Assembly Detached, but No Damage to Trailer A-Frame.

- Replace energy absorbing tubes (Part C) and shear bolts (Parts a, b, c, d, g and h).
- Inspect the breakaway axle assembly (Part E) for damage. Replace axle if visibly bent. If the axle is not damaged, but the push rods are bent, straighten out the push rods. Make sure that the push rods are attached to the axle properly. If the axle is not damaged, but the fenders are severely bent, replace only the fenders.
- Inspect trailer lights for damage. If the lighting system sustains only minor damage, such as a broken lens or light bulb, repair the damaged items, which may be readily purchased from automotive supplies stores. Make sure that all the lights are working properly prior to returning the trailer to service. If the lighting system is severely damaged and no longer functional, replace the entire lighting system.
- Inspect impact head (Part A) and mandrels (Parts B) for damage. For this severity of impact, it is unusual for either the impact head or the mandrels to be damaged to the extent that they are no longer usable and needs to be replaced. Nonetheless, check to make sure that the impact head and mandrels are not severely bent and are properly aligned with the energy absorbing tubes.
- Inspect lunette ring and pintle hook for damage. For this severity of impact, it is unusual for either the lunette ring or the pintle hook to be damaged to the extent that they are no longer usable and needs to be replaced. Nonetheless, check to make sure that the lunette ring and the pintle hook are not severely bent and can be hooked up properly.

• The following replacements parts are typically required for repair with this severity of damage. It is recommended that such repairs be conducted by a manufacturer certified technician, either at the facility of a distributor or at the facility of the user.

Part No.	Items in Package
LSRC	2 each (Parts C, a, b, c, d, g, and h)
T100-AA	Axle Assembly (Part E)
T100EF	Fenders (2)
T100-LB	Basic lighting system

Bursting Reaches Trailer A-Frame

For this high severity of impact, it is not advisable to repair the trailer. It is recommended that the user should consider purchasing a new trailer. First, the cost for the replacement parts would approach that of a new trailer. Second, extensive assembly would be required, which may pose some problems for someone not familiar with the details of the trailer.

TECHNICAL ASSISTANCE

If you have any questions regarding these inspections and assessment of damage to the trailer or required repair parts, please contact your distributor or Gregory Industries, Inc. Technical Assistance.

> **Gregory Industries, Inc.** 4100 13th Street SW, Canton, Ohio 44710 Phone: (330) – 477 – 4800 Toll Free: (866) – 994 – 4929 Fax: (330) – 477 – 0328

E-Mail: <u>TTMATechnicalSupport@gregorycorp.com</u> E-Mail: <u>TTMASales@gregorycorp.com</u>

www.gregorycorp.com

In order for Technical assistance to better provide assessment of the trailer or required repair parts, it would be most helpful if you can send photographs of the damaged trailer, both showing the overall damages and damages to the specific areas or parts in question.



TTMA-100 Innovative, Flexible and Affordable

Assembly Manual



Gregory Industries, Inc. 4100 13th Street, SW • Canton, Ohio 44710 • Phone 330-477-4800 www.gregorycorp.com January 2012

GENERAL INSTRUCTIONS

SHIPPING PACKAGE

This manual is intended for the assembly of the TTMA-100. Note that the unit may be shipped in different stages of assembly, depending on the order. Similarly, when repairing a damaged trailer, the extent of disassembly and re-assembly would vary depending on the nature and extent of repair and the parts that need to be replaced. Thus, the instructions cover the entire assembly process, with the exception of wiring, even though only part of the instructions may be applicable in any given situation.

RECOMMENDED TOOL LIST

The following is the recommended tool list for assembling the TTMA-100:

- Socket wrenches: 1/2", 3/4", 13/16", 15/16"
- Open end wrenches: 1/2", 3/4", 13/16", 15/16"
- Pneumatic wrench
- Drift pin
- Wire crimper
- Round and flat metal files
- Electric drill and bits
- 4-ft level
- Measuring tape

Optional:

• Fork lift/crane for parts manipulation. Note that some parts are very heavy and care should be taken in assembling and disassembling the unit.

BOLT TORQUE SPECIFICATIONS

All bolts should be tightened to the specified torque prior to use of the Trailer TMA. The following are the recommended torques to the bolts according to the bolt size:

Bolt Size (in)	5/16"	1/2"	9/16"	5/8"
Torque (ft-lb)	15	60	85	115
Torque (N-m)	20	81	115	156

CLEARING OF EXCESS ZINC

• All the major components of the TTMA-100 are galvanized to protect the metal from the weather elements. It is not unusual for some of the holes to have excess zinc as a result of the hot-dip process, as shown in the photograph.



The excess zinc would effectively reduce the size of the hole so that the bolt would not fit through the hole. It is, therefore, necessary to remove excess zinc from the pre-drilled holes. Depending on the excess amount of zinc, punching through the hole with a drift pin may be sufficient; otherwise, an electric drill may be necessary, as shown in the following photographs.

• Use drift pin to remove excess zinc.



• Use electric drill pin to remove excess zinc.



INSTALLATION INSTRUCTIONS

The trailer can be assembled from scratch by two men in about 2 to 4 hours. Depending on the shipping package, the trailer may already be partially assembled and certain steps in the assembly process are, therefore, not applicable. However, all the steps of the assembly process are shown for information purposes, in case the trailer has to be disassembled and reassembled.

Warning!

Part D, the trailer frame, is too heavy for two men to move safely. It is recommended that a lifting device be utilized to move the heavy parts.

Warning!

Various parts of the trailer are heavy. Care in lifting should be exercised and steel-toed boots are recommended.

Warning!

The parts of trailer may have sharp asperities from the welding and galvanizing processes. Use of appropriate gloves is recommended.

The major steps in the assembly of the trailer are as follows:

- A. Arrange major components in approximate positions for assembly.
- B. Connect energy absorbing tubes to A-frame.
- C. Insert connecting block for axle and fender assembly.
- D. Install mandrels.
- E. Attach impact head.
- F. Align and tighten connections between energy absorbing tubes and A-frame
- G. Assemble axle, fenders, and wheels and tires.
- H. Install light bar.
- I. Install accessories.
- J. Install chevron panels and conspicuity tapes.

More detailed descriptions of these major steps are presented in the following sections. A separate section on wiring instructions is provided and will not be provided herein.

A. LAYOUT OF MAJOR COMPONENTS

Place the major components of the trailer in their approximate positions for assembly, as shown in the following photograph. Note that the A-frame and the first energy absorbing tubes should be placed on benches.



The following are close-up photographs of each major component:

• A-frame with lunette ring and safety chains.



• Energy absorbing tubes.

• Connection between energy absorbing tubes and A-frame.





• Axle assembly with push rods, fenders, and wheels and tires.



• Impact head, mandrels and light bar assembly.



B. CONNECT ENERGY ABSORBING TUBES TO A-FRAME

• Align the energy absorbing tubes with the A-frame. Note the attachment hardware, including spacers, bolts, washers and nuts.



• Place a spacer between the end of A-frame and the end of energy absorbing tube for one of the four flanges and align bolt holes. Insert bolts and nuts with washers on both sides.



• Repeat the process for other three flanges. Do not tighten the bolts and keep the connection loose at this time.





• Repeat the process for the other energy absorbing tube.

C. INSERT CONNECTING BLOCK FOR AXLE AND FENDER ASSEMBLY

A connecting block with two protruding bolts is used to attach the axle assembly to the energy absorbing tubes. The connecting block is placed inside the energy absorbing tube so that the two protruding bolts will pass through two pre-drilled holes on the bottom of the energy absorbing tube. The axle assembly is then attached to the energy absorbing tubes using these protruding bolts.

• To facilitate placing of the connecting block inside the energy absorbing tube, a tool similar to that shown in the photograph is recommended. The tool is fabricated by welding or attaching a long handle to a flat plate with a slot to accommodate the two protruding bolts from the connecting block.



• This photograph illustrates how the tool is used to hold the connecting block in place with the two protruding bolts in the slot.



• Check to make sure the two protruding bolts will fit properly in the pre-drilled holes at the bottom of the energy absorbing tube. If the bolts and the holes are not aligned properly, adjust as

necessary by tapping on the bolts and cleaning out the holes of excess zinc from galvanizing.

• Slide the tool with the connecting block into the open end of the energy absorbing tube until the two protruding bolts go through the holes on the bottom of the energy absorbing tube, as shown in the following photograph.





• Install retaining clips to keep bolts in place.



• Repeat the process for the other energy absorbing tube.

D. INSTALL MANDRELS

- Slide the mandrel into the open end of the energy absorbing tube until the holes for the shear bolt on the energy absorbing tube and the mandrel are aligned.
- When the holes are aligned, use the drift pin to hold mandrel in place.



• Two plastic guide plates, as shown in the photograph, are used to keep the mandrel from bouncing up and down during field operations. The two guide plates are distinguished by the color, black for the top guide plate and white for the bottom guide plate.



- Lift up the open end of the mandrel and slide in the white plastic guide plate at the bottom between the mandrel and the energy absorbing tube. Adjust the plastic guide plate until the holes for the shear bolt on the energy absorbing tube, mandrel, and the guide plate are properly aligned. Use the drift pin to hold mandrel and white plastic guide plate in place.
- Slide the top black plastic guide plate between the mandrel and the energy absorbing tube. Adjust mandrel and plastic guide plate until the holes for the shear bolt on the energy absorbing tube, mandrel, and the plastic guide plate are properly aligned.





• Insert shear bolt with washer through the aligned holes through the top of the energy absorbing tube, the black plastic guide plate, the mandrel, the white plastic guide plate, and the bottom of the energy absorbing tube.



• Insert shear bolt with washer through the aligned holes through the top of the energy absorbing tube, the black plastic guide plate, the mandrel, the white plastic guide plate, and the bottom of the energy absorbing tube.



• Repeat the process for the other mandrel.

PINTLE HOOK ASSEMBLY

The pintle hook should have a minimum capacity rating of 8 tons. Due to the wide variations in the frame structures of different tow vehicles, there is not a single standard means of mounting the pintle hook assembly to the frame of the tow vehicle. The major considerations in mounting of the pintle hook are the strength of the attachment and the mounting height.

The pintle hook assembly may be welded or bolted to the frame of the tow vehicle. Regardless of the method of mounting or attachment to the tow vehicle, it is critical to ensure that the strength of the attachment exceeds the rated capacity of the pintle hook with a wide margin of safety. It is the obligation of the users to ensure that their particular pintle hook attachment system meets these strength requirements.

E. ATTACH IMPACT HEAD

• Lift the impact head to the connecting plates on the open ends of the mandrels.



• Align the holes on the impact head and the connecting plate on one mandrel. Insert drift pin to hold the alignment in place. Insert bolts and nuts with washers. Photos showing sequence and completed operation.





- Repeat the process for the other mandrel.
- Tighten bolts and nuts to specified torque.


F. ALIGN AND TIGHTEN CONNECTIONS BETWEEN ENERGY ABSORBING TUBES AND A-FRAME

Tighten and torque the bolts connecting the energy absorbing tubes and the A-frame. Before tightening the bolts, make sure that the trailer is aligned properly:

• Check to make sure the A-frame, the energy absorbing tubes, and the top of the impact head are level.





• Place two struts to make sure that the two energy absorbing tubes and the A-frame are straight and separated at a constant distance.



• Check to make sure that the trailer frame is not skewed. This is checked by measuring the distance diagonally from front center of the A-frame to the corner of the end of the energy absorbing tube while the

tape measure is aligned with the corner of mandrel. The diagonal distance on both sides should be the same if the frame is skewed.







• If necessary, use plastic shims at the connections to make minor adjustments on the alignment of the trailer frame. Remove bolts and spacer on flange needing adjustment. Insert plastic shim with spacer between the flanges and insert, tighten and torque the bolts and nuts.



• Tighten the bolts to the specified torque.



G. ASSEMBLE AXLE, FENDERS, AND WHEELS AND TIRES

• Attach the fenders to both ends of the axle assembly. Align the holes and insert bolts and nuts with washers.



• Lift the axle assembly with the attached fenders and align the holes on the axle assembly and fenders with the protruding bolts from the bottom of the energy absorbing tube. Attach with nuts and washers.





• Check to make sure that axle is lined up perpendicular to the trailer frame. Measure the distance from cross member of the A-frame to the center of the axle. The measurements on both sides should be the same.





• Install wheels and tires onto axle assembly.



• Measure to make sure that the face of tire is separated from the fender by a couple of inches to avoid any potential influence between the fender and the wheel.



• Tighten and torque all bolts and nuts.



• Insert plastic end caps into all tubular members with open ends.



H. LIGHT BAR MOUNTING INSTRUCTIONS

The enclosed light bar is mounted to the rear impact plate, as shown in Figure 13, by means

of four ¼" bolts. To replace the lights on an existing trailer, first layout a drilling pattern as shown in Figure 14. Check to make sure that alignment of the holes is correct with regard to the threaded inserts on the bottom of the light bar prior to drilling.

Figure 13: Light bar mounted on Impact Head.





After drilling the holes, mount the light bar with the 4 enclosed 4" hex bolts as shown in Figure 15.

Figure 15: Installation of light bar utilizing 1/4" Hex Bolts.



• The light bar is attached to the top of the impact head with four bolts. As shown in the photographs, screw inserts are incorporated into the bottom of the light bar with corresponding pre-drilled holes on the top of the impact head.







• Place light bar on top of the impact head and align the holes on the impact head with the bolt holes on the light bar. Insert bolt with washer into bolt hole and tighten. Repeat for other three bolt holes. Photos of sequence and completed installation.



• Install the wiring for the light bar next. A separate section on wiring instructions is provided and will not be repeated herein. Please refer to the "Wiring Instructions" section for detailed information.

WARNING!

All Lights are 12 Volts. For 24 Volt usage a 12 volt to 24 volt converter must be installed (Not supplied by Gregory Industries, Inc.). If used without converter the lights WILL BE DAMAGED and will need to be replaced.

Take the cable extending from the back of the light bar and feed it through the annulus between the mandrel and the bursting tube as shown in Figure 16.



Figure 16: Cable Path Beside Mandrel.

Working from the rear of the trailer, pull the cable through the bursting tube, as shown in

Figure 5, to the front driver's side of trailer, through the holes in the angled frame and through the draw bar plate on the front of the trailer. The two long wires with bullet connectors can be fed through to the passenger side marker light.

The wiring kit comes with $\frac{3}{4}$ " marker lights for the front drivers and passenger sides as shown in Figure 17.

If the trailer was equipped with a different set of lights, a ³/₄" mounting hole will be required. Wire the 7 pin connector as described in the enclosed documentation. If the connector does not have separate turn and brake lights, these wires will need to be combined. The extra black and red wires fed through to the driver's side front connector are to provide power for optional equipment such as arrow boards or variable message boards. For questions or comments please contact Gregory Industries, Inc.

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I. INSTALL ACCESSORIES

There are a number of accessories that need to be installed onto the A-frame, including lunette ring, safety chains, end caps and jack. Instructions for installing each of these accessories are outlined as follows.

Lunette Ring

• Align holes on the base plate of the lunette ring assembly with those on the front plate of the A-frame. Inserts bolts and nuts with washers.





• Tighten and torque bolts.



Safety Chains

• Align hole on anchor plate of safety chain with that on the gusset plate. Inserts bolt and nut with washers. Tighten and torque. Repeat process for the safety chain anchor plate on the other side.



End Caps

End caps are used to cover the open ends of the tubular members at the A-frame to keep moisture from the inside of the tubes.

• After completing the wiring, place the end cap into the open end of the tube. Align the holes on the end cap with those on the open end of the tubular member. Inserts bolts and nuts with washers.



• Tighten the nuts and torque to specification.



• Repeat the process for the open end of the tubular member on the other side.

Jack

The trailer is equipped with a sidewind jack. A connection is provided on the cross member of the A-frame for the jack. When not in use, the jack is stalled in the horizontal position.



J. INSTALL CHEVRON PANELS AND CONSPICUITY TAPES

The trailer may be equipped with chevron panels on the front of the impact head and reflective tapes on the sides and front of the trailer to increase the conspicuity of the trailer. Step-by-step instructions on installing the chevron panels and conspicuity tape are provided as follows.

Chevron Panel

• The chevron panels may have pre-drilled holes and straps are welded to the front of the impact head for attachment.



• If supplied with pre-drilled holes, mark the location of the pre-drilled holes on the straps and drill starter holes. If not drill holes in center of strap and affix panels.



• Screw or bolt the chevron panels to the straps.



Conspicuity Tape

There are six locations where conspicuity tapes are attached;

- Two on sides of the energy absorbing tubes.
- Two on sides of the A-frame tubes.
- Two on the angled members of the A-frame.

The process for attaching the conspicuity tapes are the same for all locations and are described as follows.

• Mark the locations of where the conspicuity tapes are to be installed, both horizontally and vertically.



• Measure the required length of the conspicuity tape.



• Cut the conspicuity tape to the required length.



• Paste the cut conspicuity tape onto the side of the tubular member. Make sure that the surface is clean and free of contaminants that could adversely affect the

attachment of the tape. Peel the backing off the tape and paste the tape onto the surface in the pre-marked areas.





Palletized Shipments:

The below picture depict a palletized shipment of 3 trailers ready for overseas transport. These trailers were pre-assembled at the factory then partially de-assembled to be properly palletized. Many of the preceding installation steps in this manual have all ready been completed.



Steps that must be completed to assemble palletized trailers are as follow:

- Assembly of Energy Absorbing Tubes to A-Frame
- Installation of Jack Stand to A-Frame
- Assembly of Energy Absorbing Tubes
- Check for square trailer frame
- Assembly of Axle to Frame
- Assembly of Wheels to Axle
- Assembly of Fenders to Frame
- Installation of Impact Head to Mandrels
- Installation of Electrical Wiring Harness
- Installation of Light Bar
- Installation of Chevron Reflective Panels to Impact Head (16"X36")



ASSEMBLY OF ENERGY ABSORBING TUBES TO A-FRAME



ALIGNMENT OF ENERGY ABSORBING TUBES



ASSEMBLY OF ENERGY ABSORBING TUBES



Check for square of trailer frame.

ASSEMBLY OF FENDERS TO FRAME

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INSTALLATION OF IMPACT HEAD TO MANDRELS





INSTALLATION OF REFLECTIVE CHEVERON PANELS TO IMPACT HEAD (16"X36")

Optional reflective panels can be installed on tabs. Panels are available for purchase through Gregory Industries, Inc., but are not a standard part included in the price of TTMA-100.



INSTALLATION OF LIGHT BAR

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WIRING INSTRUCTIONS

The only item that may require attention of the user is the wiring of the trailer plug for connection to the tow vehicle. There are two distinctly different wire plugs that are not compatible, one is the RV plug and the other is the heavy duty truck plug. It is necessary to first determine which type of plug is used with the tow vehicle, i.e., an RV plug or a heavy duty truck plug. The shapes of the two plug types are easier distinguishable as shown Figure 3. Also, the RV plug uses blades and the truck plug uses round pins. Note that the wiring scheme for the two plug types are totally different, details of which are shown in the following tables. (The TTMA-100 is normally supplied with the Heavy Duty Truck Plug unless otherwise ordered in advance.)



Figure 3. Photographs of RV and Heavy Duty Truck Plugs

Figure 4 shows the different standard wiring layouts for the RV plug and the heavy duty truck plug. Details of the wiring layouts are shown in Table 3.



Heavy Duty Truck Plug



Figure 4. Standard Wiring Layouts of RV and Heavy Duty Truck Plugs

Table 3. Standard Wiring Layouts of RV and Heavy Duty Truck Plugs

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Function	Trailer Wire Color	Plug Labels	
		Number	Color
Common Ground	White	1	White
Auxiliary	Black	2	Black
Left Turn	Yellow	3	Yellow
Brake light	Red	4	Red
Right Turn	Green	5	Green
Tail/Marker lights	Brown	6	Brown
12V Power supply	Blue	7	Blue

RV Plugs with Separate Brake Wire

Heavy Duty Truck Plugs

Note that the above wiring patterns represent standard wiring for the tow vehicle. The

Function	Trailer Wire Color	Plug Labels	
		Number	Color
Common Ground	White	1	White
Brake light	Red	2	Blue
Tail/Marker lights	Brown	3	Green
12V Power supply	Blue	4	Black
Left Turn	Yellow	5	Red
Right Turn	Green	6	Brown
Auxiliary	Black	7	(center)

above pattern may need to be adjusted if the tow vehicle does not use standard wiring.



Figures 17: Trailer Wiring Schematic

INSTALLATION OF ELECTRICAL WIRING HARNESS

NOTE: ALL LIGHTS ARE 12 Volt. For 24 Volt usage a 12 volt to 24 volt converter must be installed. (Not supplied by Gregory Industries, Inc.) If used without converter the lights WILL BE DAMAGED and will need to be replaced.

Figure 2 shows the schematic of the wiring details of the TTMA-100. Also, detailed instructions on the wiring of the TTMA-100 are provided in a separate Wiring Manual and will not be repeated herein. However, the TTMA-100 is fully wired at the time of delivery. The only item that may require attention of the user is the wiring of the trailer plug for connection to the tow vehicle. More detailed instructions are provided in the next section. ч. 13 П



Figure 18: Side Marker Lights and Cable Feed Through