



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

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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

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TTMASales@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:

<u>Component</u>	<u>Description</u>
A	Impact Head
B	Bursting Mandrel
C	First Energy Absorbing Tube
D	Trailer Frame
E	Axle Assembly
F	Plastic Guide Plates
G	End Caps
H	Hitch Assembly
J	Spacer
K	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.

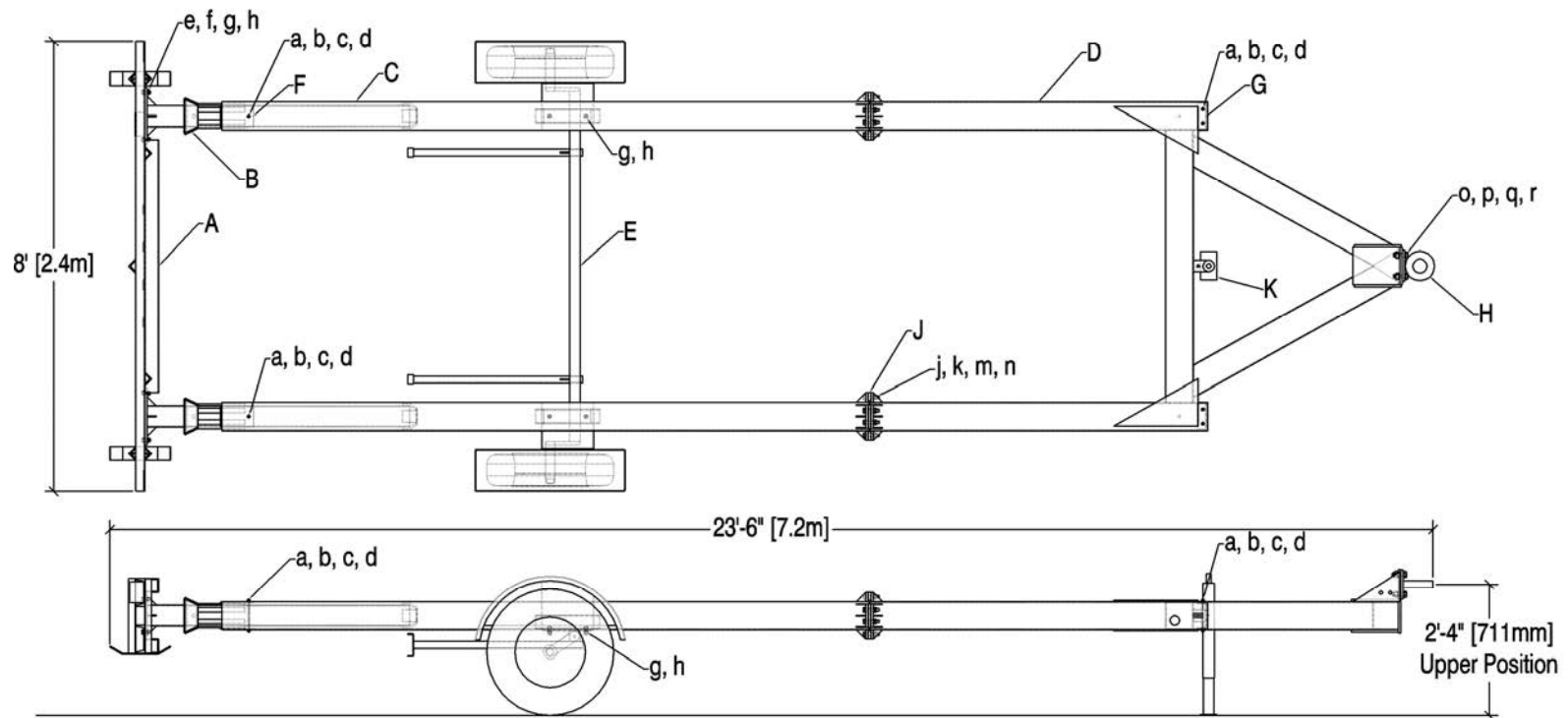


Figure 1. Schematic and Parts Layout of TTMA-100

Table 1. TTMA-100 Technical Specifications

Trailer:

- Overall Dimensions:
 - 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 structural 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:
 - Lighting Integrated light bar
 - Lighting standard FMVSS 108

Construction:

- Frame Open design
- All energy absorbing components Heavy gage steel
- 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 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 defects in material and workmanship One year

Table 2. Trailer Component And Parts List

ITEM	PART #	QUANTITY	DESCRIPTION
TRAILER COMPONENTS			
A	T100A	1	Impact Head
B	T100B	2	Bursting Mandrel
C	T100C	2	First Stage Energy Absorber
D	T100D	1	Trailer A-Frame
E	T100E	1	Axle Assembly
F	T100F	4	Plastic Guide Plates
G	T100G	2	End Caps
H	T100H	1	Hitch Assembly
J	T100J	8	Spacer
K	T100K	1	Jack Assembly
HARDWARE ITEMS			
a	B0516070A	6	5/16" x 7" Grade 5 Hex Bolt
b	W0516	6	5/16" Washer
c	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
o	B1016025A	4	5/8" x 2 1/2" Grade 5 Hex Bolt
p	W1016	4	5/8" Washer
q	LW1016A	4	5/8" Heavy Lock Washer
r	N1016A	4	5/8" Grade 5 Hex Nut

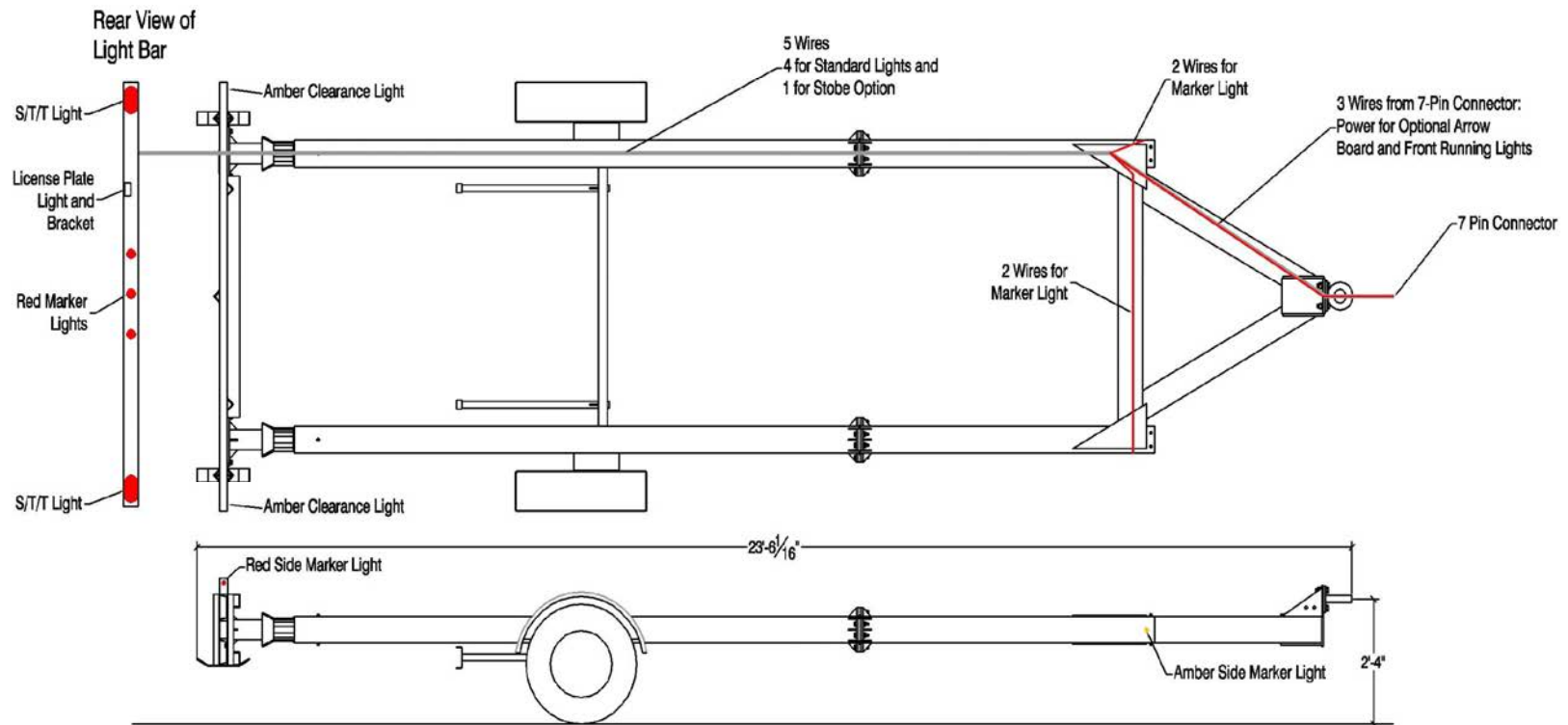


Figure 2. TTMA-100 Wiring and Light Layout

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.

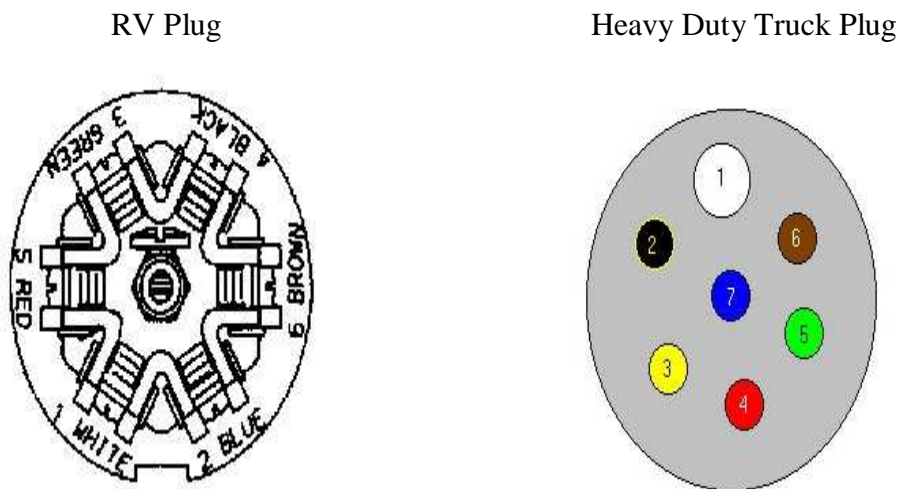


Figure 4. Standard Wiring Layouts of RV and Heavy Duty Truck Plugs

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

RV Plugs with Separate Brake Wire

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

Heavy Duty Truck Plugs

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)

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.

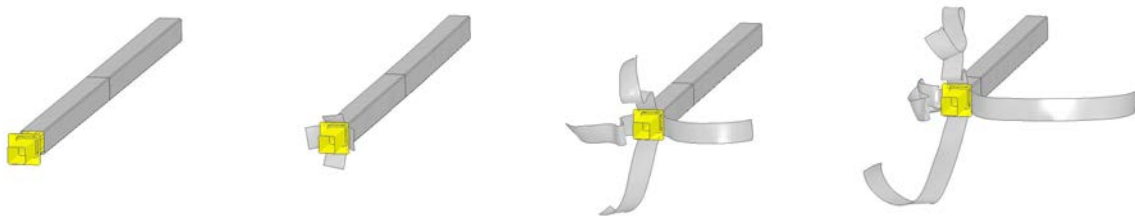


Figure 5. Tube Bursting Process

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

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.

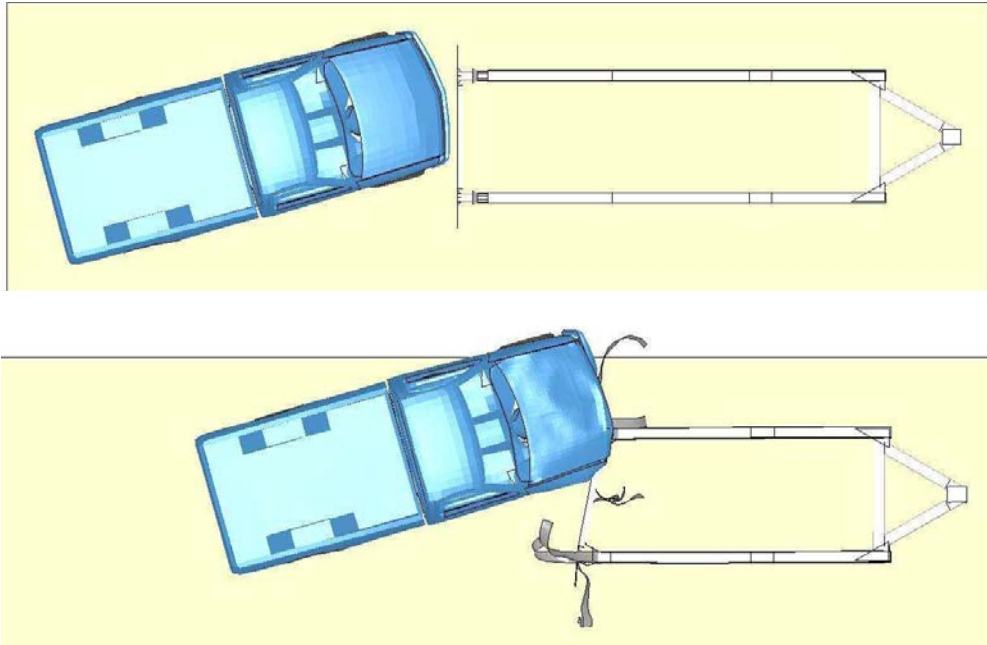


Figure 7. Simulation of Vehicle Disengaging from a Trailer.



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.

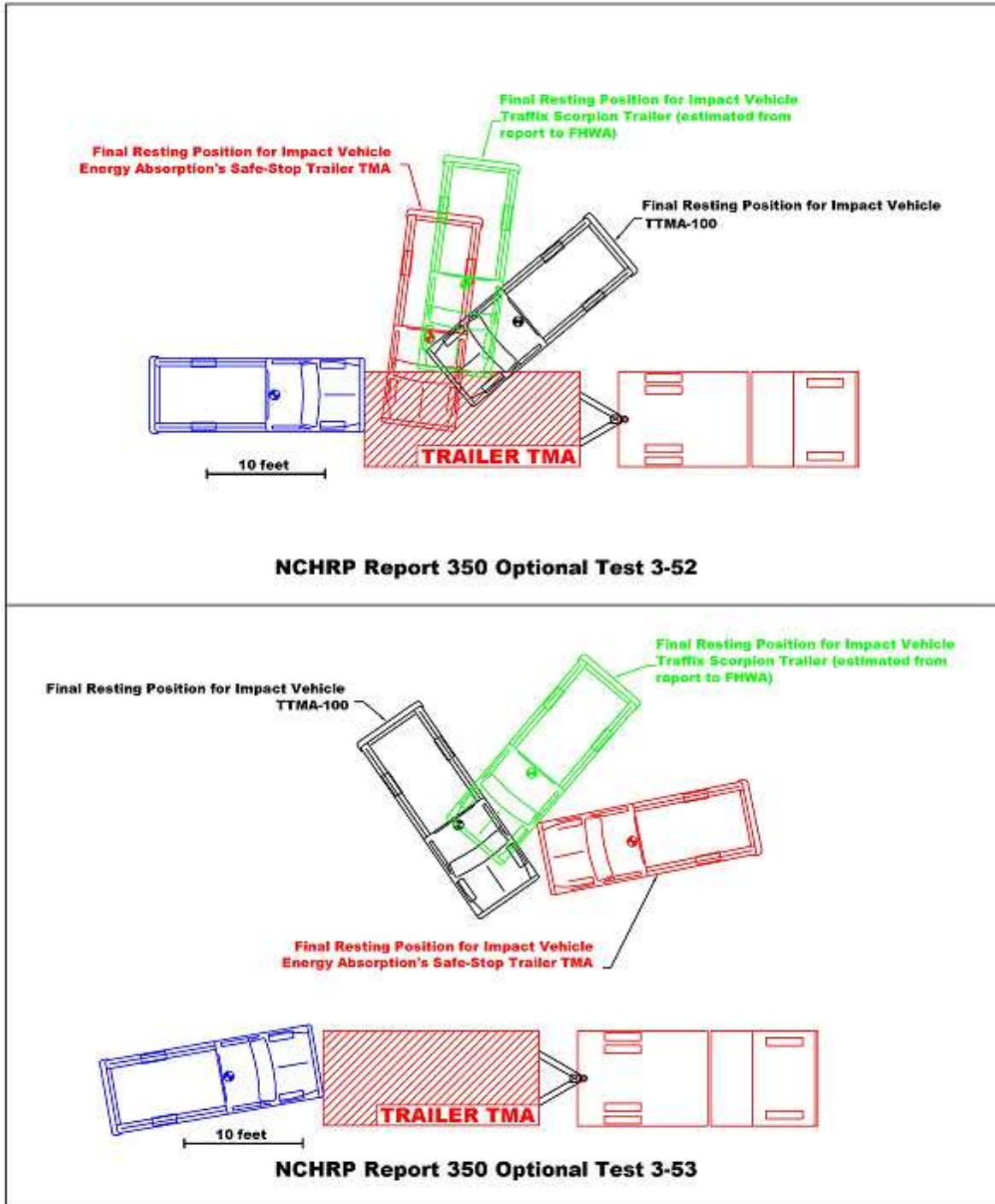


Figure 9. Final Rest Locations of Trailer TMA Systems

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 stationary 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.

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

Tow Vehicle Weight	Traffic Operating Speed	Impact Vehicle Weight			
		4500 lb	10000 lb	15000 lb	24000 lb
10000 lb	65 mph	119 ft	205 ft	261 ft	333 ft
	55 mph	97 ft	158 ft	198 ft	247 ft
	45 mph	77 ft	118 ft	143 ft	174 ft
15000 lb	65 mph	93 ft	161 ft	211 ft	278 ft
	55 mph	78 ft	127 ft	162 ft	209 ft
	45 mph	65 ft	97 ft	120 ft	150 ft
24000 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 5. Calculated Roll Ahead Distances for Stationary Operation

Tow Vehicle Weight	Traffic Operating Speed	Impact Vehicle Weight			
		4500 lb	10000 lb	15000 lb	24000 lb
10000 lb	65	38 ft	103 ft	152 ft	216 ft
	55	27 ft	74 ft	109 ft	155 ft
	45	18 ft	50 ft	73 ft	104 ft
15000 lb	65	22 ft	68 ft	108 ft	166 ft
	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
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

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 TTMATechnicalSupport@gregorycorp.com, 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 long-term 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.

The following preventive maintenance schedule is recommended:

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	••			
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 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.				••

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.

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 www.gregorycorp.com 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 replacement 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 TTMATechnicalSupport@gregorycorp.com 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.