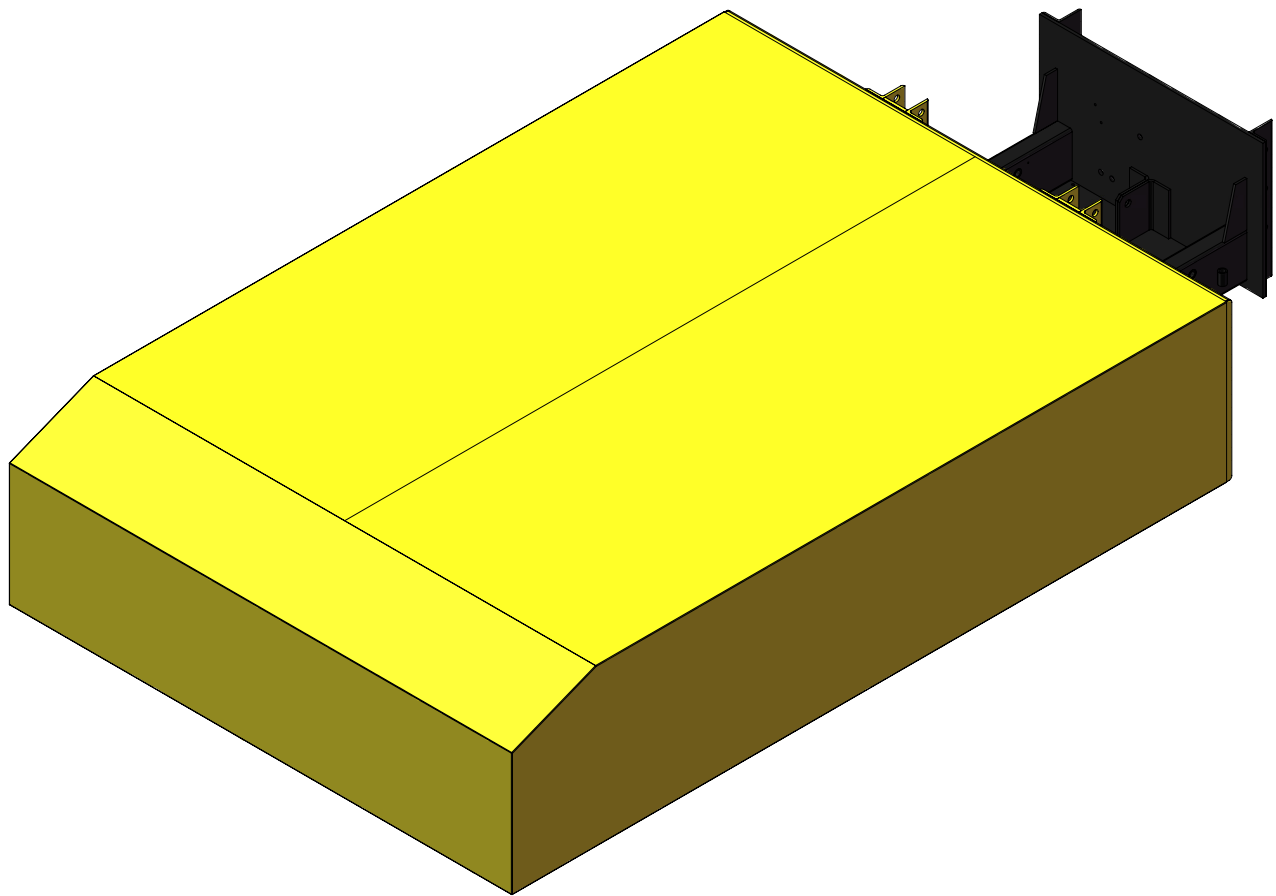


U-MAD® TMA / TRAILER | NCHRP 350 TL-2 AND TL-3

CARTRIDGE REPAIR MANUAL



BARRIER SYSTEMS™
BY LINDSAY



P/N 1620207 Rev A (ECN 37626)

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It is your and your employers' responsibility to comply with all applicable local and national safety codes and standards, including but not limited to the requirements of the U.S. Occupational Safety and Health Administration (OSHA), the National Fire Protection Association (NFPA) (including but not limited to the NFPA 70: National Electrical Code (NEC) and NFPA 70E), and other appropriate governmental and industry accepted guidelines, codes, and standards in their entirety.

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Introduction

This manual describes the protocol for repairs of the U-MAD® Truck Mounted Attenuator (TMA) cartridge. The purpose of the document is to provide guidance and instruction to Users, authorized distributors and Certified Repair Facilities on methods for identification and performing necessary repairs of correctable damage to the U-MAD® cartridge.

Proper repair of the U-MAD® cartridge and attachment devices is critical to maintain the performance of the system during vehicle impacts when in use.

Following any impact, the TMA must go through a thorough inspection of the cartridge as well as the mounting structure.

Please Note: All repair work must be performed in accordance with the guidelines and specifications of Barrier Systems Inc. in order to maintain acceptable crash cushion impact performance and to keep the manufacturer's warranty in effect. When working on a TMA in the upright position, make sure locking pins are installed.

If you need additional information, including Certified Repair Facilities, please contact your distributor or customer service at Barrier Systems Inc. at 1-866-404-5049 or 1-402-829-6800.

Damage Repair Classifications

Any U-MAD TMA unit that becomes damaged in any way, may, depending on the type, location, and severity of the damages, be repaired by:

- The Customer or Distributor
- A Certified Repair Facility
- Or deemed Non-Repairable

A U-MAD TMA Repair Investigation Worksheet, complete with appropriate photographs of the damaged TMA device, must be submitted to Barrier Systems Customer Service to request an evaluation and provide recommendations for repair procedures.

		DAMAGE LEVEL			
		COSMETIC	LEVEL 1	LEVEL 2	LEVEL 3
ZONE OF DAMAGE LOCATION	YELLOW	F	F	C	N
	ORANGE	F	F	N	N
	RED	F	N	N	N

Table Legend: F=Field Repairable; C=Certified Repair Facility Required; N=Non-Repairable

U-MAD Cartridge Damage is classified into four damage levels (Cosmetic and Levels 1, 2, & 3) and three zones on the U-MAD Cartridge (Yellow, Orange, & Red). Reference the table above in accordance with the Damage Location and Damage Level descriptions on the following pages to determine repairability.

The U-MAD must be taken out of service immediately if any non-cosmetic damage to the L-Lift, Mounting System, or Trailer is observed. A U-MAD TMA Repair Investigation Worksheet and pictures must be submitted to Barrier Systems Customer Service for repair evaluation.

U-MAD Cartridge Zones

During initial U-MAD Cartridge damage assessments, location of the damage is critical to determine repairability of the damage. There are three zones, Yellow, Orange, and Red, as indicated in Figure 1. The Orange Zone indicates a keep-out zone for Level 2. Only Level 1 damage can be repaired in the Orange Zone. If Level 2 damage occurs in the Orange Zone, it is non-repairable. Cosmetic damage, as defined in the next section, that falls into the Red Zone may be repaired. For any other non-cosmetic damage in the Red Zone, at any damage level, the unit is non-repairable and will require a cartridge replacement.

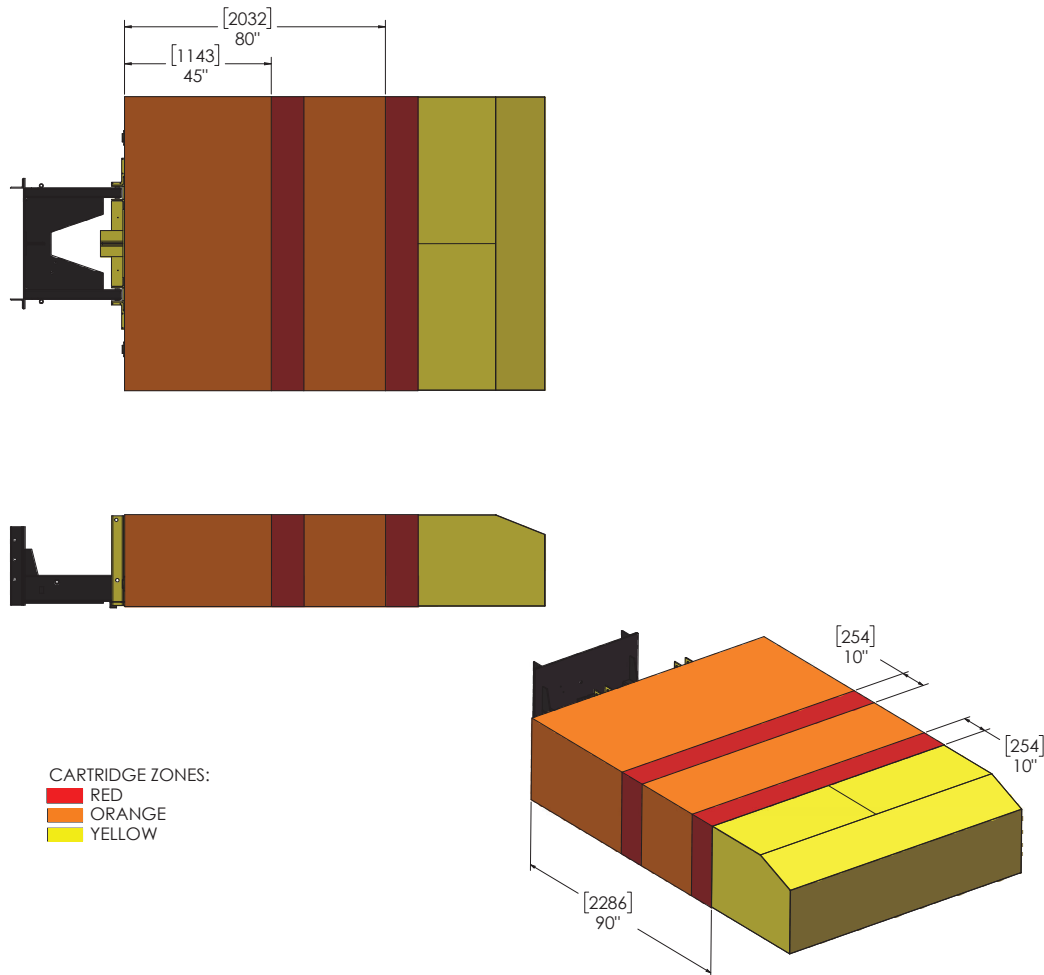


Figure 1: Keep-Out Zones

Cosmetic Damage

Damages to the U-MAD under Cosmetic Damage are classified into two categories: paint and oxidation. Cosmetic Damage can be field repaired by the Customer or Distributor by sanding, priming, and repainting as needed. Any sheet metal work or repairs requiring more than sanding, priming, and repainting should be categorized as at least Level 1 Damage. Please contact Barrier Systems Customer Service for further information.

- Paint – Scuff marks, paint transfer, cracking and hairline fractures in paint.
- Oxidation – Visible on bolts or on parts missing paint, cracking around site due to oxidation, pitting at oxidation site, missing material at oxidation site.

Level 1 Damage

Damages to the U-MAD under Level 1 are classified into 2 categories: denting and material separation. The Red Zone is a keep-out zone for this damage level. Field repairs can be made for Level 1 Damage outside the Red Zone by the Customer or Distributer using Barrier Systems, Inc. repair kits. Please contact Barrier Systems Customer Service for further information.

Denting

- Dents that have NO visible penetration into attenuator cavity with a maximum square dent size of 6" x 6" [150mm x 150mm] with a depth of 2" [50mm] is allowable for Level 1 repairs. Dents should be measured as follows:
 - Using a tape measure, measure and note the widest part of the dent, then also measure at 90 degrees to that measurement so that you have measured both the maximum length and maximum width of a rectangle that entirely surrounds the dent.
 - Place a straight edge or other rigid item across the dent in a manner to create a reference to the undented surface; measure the depth of the dent.

Material Separation and/or Tearing

- In the instance of material separation at the joints or due to a tear, there shall be no moisture intrusion.
- Separation at the joints of U-MAD skin with a max allowable separation of 2" [50mm] in length and a cross-sectional separation width of ½" [13mm]
- Tears in U-MAD skin smaller than 3" [80mm] in length with a cross-sectional separation width of up to ½" [13mm] maximum.

Level 2 Damage

Damages to the U-MAD under Level 2 are classified into 2 categories: denting and material separation. The Red and Orange Zones are keep-out zones for this damage level. Field repairs are not advised for Level 2 Damage. Repairs must be performed by a Certified Repair Facilities. Please contact Barrier Systems Customer Service for further information.

Denting

- Dents with a maximum square dent size larger than 6"x6" [150mm x 150mm] with a depth no greater than 2" [50mm] is allowable for Level 2 repairs. Dents should be measured as follows:
 - Using a tape measure, measure and note the widest part of the dent, then also measure at 90 degrees to that measurement so that you have measured both the maximum length and maximum width of a rectangle that entirely surrounds the dent.
 - Place a straight edge or other rigid item across the dent in a manner to create a reference to the undented surface; measure the depth of the dent.

Material Separation and/or Tearing

- Separation at the joints of U-MAD skin larger than 2" [50mm] in length. Max cross-sectional separation width of 1" [25mm].
- Tears in U-MAD skin larger than 3" [80mm] in length with a cross-sectional separation width of up to 1" [25mm] maximum.
- Crack growth at bolt holes or rivet points.
- Tear outs at bolt holes or rivet points.

Level 3 Damage

Damages to the U-MAD under Level 3 are non-repairable damages and require the unit to be replaced. These damages include:

- Impact damage that exceeds the scope of Level 2 Damage.
- Punctures to the outer skin that penetrates the moisture barrier.

Cartridge Repair Matrix

Damage Level	Damage Type	Description	Repair Method	Keep Out Zones
Cosmetic	Paint	Scuff marks, paint transfer, cracking and hairline fractures in paint	Sand, prime, and paint.	None
	Oxidation	Visible on bolts or on parts missing paint, cracking around the site due to oxidation, pitting at oxidation site, missing material at oxidation site.		
	Hardware	Cracked/broken reflectors	Replace	
Level 1	Denting	Denting without visible penetration into attenuator cavity. Max square dent size of 6" x 6" [150mm x 150mm] with max depth of 2" [50mm].	Use Panel Repair or Corner Repair Kit. Flatten area with mallet, prepare surface, drill, tape, rivet, and caulk. Allow 3" [80mm] minimum material overlap from edge of dent. See Repair Procedures for detailed instructions. Note in the instance of material separation or tearing there should be no moisture intrusion.	Red
	Tearing	Tears in sheet metal smaller than 3" [80mm] in length with a cross-sectional separation width of up to 1/2" [13mm].		
	Material Separation	Separation at the joints of sheet metal casing with a max allowable separation of 2" [50mm] in length and a cross-sectional separation width of 1/2" [13mm].		
Level 2	Denting	Dents larger than 6" x 6" [150mm x 150mm] with max depth of 2" [50mm].	Must be repaired by a Certified Repair Facility. Contact Barrier Systems Customer Service: 1(888)800-3691	Orange, Red
	Tearing	Tears in sheet metal larger than 3" [80mm] in length with a max cross-sectional separation width of 1/2" [13mm].		
	Material Separation	Separation at the joints of sheet metal casing larger than 2" [50mm] in length with a max cross-sectional separation width of 1" [13mm].		
Level 3	Denting	Any damage exceeding the scope of Level 2 Damage.	Non-Repairable	All Zones
	Tearing or Material Separation			
	Impact			
	Punctures or Missing Material	Punctures to sheet metal casing that penetrate the moisture barrier.		

Repair Kits

For Level 1 damage repair, Panel Repair and Corner Repair kits are available. These kits contain the materials and instructions to make Level 1 repairs. Required with each repair kit is also a Patching Kit that contains paint, adhesive and caulking that is required to perform the repairs. The kits are required to be used as is, do not cut the material to size. There is also an optional Hardware Kit that contains necessary tools that will help perform the repairs.

Repair Procedures

Field Repairable Procedures

1. Flatten damaged area and prepare surface.
 - a. Use rubber mallet to straighten and flatten damaged area until it is flush to the U-MAD skin, with no portions protruding beyond its profile.
 - b. Locate any localized cracks in the U-MAD skin where repairs are to be made. The end of the crack should be located, drilled and reamed into a smooth circular shape. This prevents the crack from propagating.

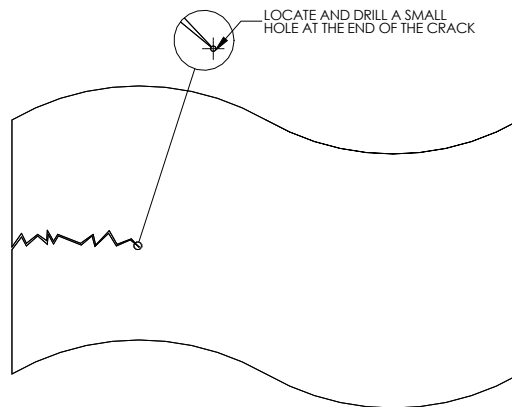


Figure 2: Example of a crack in the material.

Please Note: When drilling, do not penetrate the aluminum skin beyond ½" [13mm] past the surface; drilling further will risk damage to internal components and compromise the structural integrity of the U-MAD. When working on a TMA in the upright position, make sure locking pins are installed.

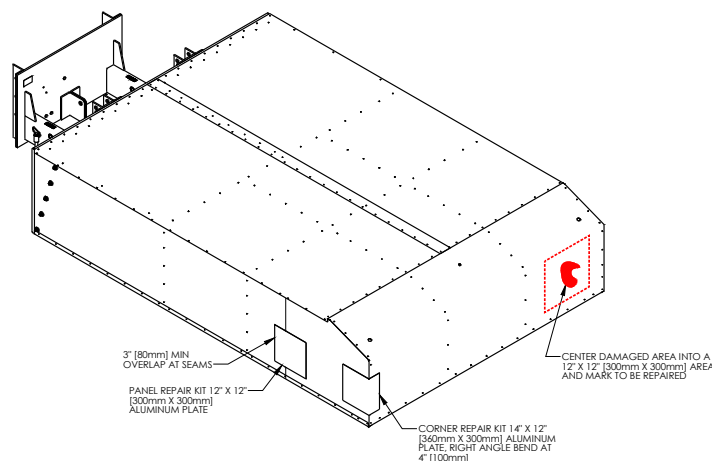


Figure 3: Repair Kit Applications.

- c. Center the damaged area across a 12"x12" [300mm x 300mm] square section and mark/ outline this area to be prepped for patching. If repairing a corner or edge, the patched area shall be 10"x12" [230mm x 300mm] at one side and 4"x12" [100mm x 300mm] on the other. See Figure 3 for examples.
 - d. Use the sandpaper provided to sand away the paint until underlying aluminum is exposed. Wipe away any debris from the sanded area with clean cloth.
 - e. Apply caulking to any gaps, tears, or cracks and wipe away any excess.
2. Layout and Prepare Aluminum Patch.
- a. Place aluminum sheet over sanded area to determine placement of rivets. Mark for drilling. Please note: a minimum of 4 (equally spaced) rivets along each 12" [300mm] length should be used. Rivet holes should be placed no less than $\frac{3}{4}$ " [20mm] from the edge of the aluminum sheet.
 - b. Scuff the unpainted side of the aluminum sheet and apply butyl tape around the inner perimeter of the sheet. apply a second application approx. 1" [25mm] in from the perimeter as shown in Figure 4.
 - c. Repeat the procedure for the area on the U-MAD skin surface that the aluminum sheet will be applied to.
3. Attach the Aluminum Sheet.
- a. Press aluminum sheet into prepared surface. Hold secure.
 - b. Using a size F drill bit (6.6mm), drill rivet holes into aluminum sheet as needed. When drilling, do not penetrate the U-MAD skin beyond $\frac{1}{2}$ " [13mm] past the surface; drilling further will risk damage to internal components and compromise the structural integrity of the U-MAD.
 - c. Caulk each rivet hole and fasten aluminum sheet to U-MAD with rivets supplied in the Repair Kit.
 - d. Apply caulking around the perimeter of the sheet and allow time for drying.
 - e. Apply touch up paint as needed.
4. Allow 24 hours or longer for paint, adhesive, and caulking to cure.

Certified Repair Facility Procedures

Available for a Certified Repair Facility. Please contact Barrier Systems Inc. Customer Service Department at 1(866)-404-5049 for further information.

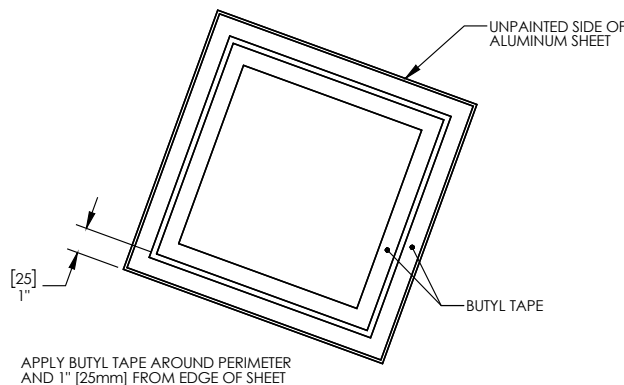


Figure 4: Butyl tape applied to aluminum sheet.

Revisions

Date	ECN	Published ECN	Rev	Description
02/25/2020	37626	37626	A	Initial Release



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Please contact Lindsay Transportation Solutions to confirm that you are using the most current installation manual and instructions.

Additional information is available from Lindsay Transportation Solutions. © Lindsay Transportation Solutions