TRACC

Trinity Attenuating Crash Cushion

Installation and Repair Manual

An NCHRP Report 350 Crash Cushion

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Table of Contents

Figures and Tables

CUSTOMER SERVICE

CSP Pacific is committed to the highest level of customer service. Comments regarding the quality and workmanship of our products, their installation procedures, supporting documentation, and roadside performance are welcome. Our goal is to enhance highway safety through continuous improvement and innovation. More information can be obtained in the following ways:

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TRACC DESIGN - General Information

The TRACC (Trinity Attenuating Crash Cushion) is a fully redirective, non-gating, bi-directional, energy absorbing crash cushion designed to protect motorists from impacting concrete barriers, bridge parapet rail, bridge piers and other hazards in both permanent and temporary work zone locations. The product is accepted by the U.S. Federal Highway Administration for use on the National Highway System regardless of design or posted speed.

The TRACC System is available in various sizes. The compact Test Level 2 SHORTRACC is an economical solution for applications where the speed is 45 mph (70 kph) or lower. The standard Test Level 3 TRACC is acceptable for all speeds above 45 mph (70 kph). The FASTRACC is a Test Level 3 crash cushion that provides additional capacity for high-speed impacts. The WIDETRACC can be designed to shield hazards of any width.

The TRACC System is a very low maintenance roadside safety feature. Except for repairs due to impact, there is virtually no maintenance required for the system. It is recommended that an annual drive-by inspection be performed to ensure that no minor impacts went undetected and that debris has not accumulated around the system.

More information on TRACC System Design and Application can be found in a separate publication entitled, TRACC DESIGN MANUAL.

TRACC INSTALLATION

Parts Inventories

This section shows the inventory items for the TRACC and SHORTRACC system. It also directs the reader to appropriate drawings and bills of material for the most popular TRACC System options.

TRACC or SHORTRACC System

Quantity	Product Code	Item
1	935A	Compact SHORTRACC System (fully assembled galvanized steel structure)
OR . . .		
1	970A	Standard TRACC System (fully assembled galvanized steel structure)
8	6707G	3/16” Plated Machine Screw
8	6708G	3/16” Plated Hex Nut
8	6709G	3/16” Plated Washer w/ ¾” O.D.
1	6826B	Plastic Nose-Wrap
4	6825B	Reflective Tape
1	--	TRACC Installation and Repair Manual

Many installation options exist for the TRACC System. Listed below are anchorage, backup, and transition options that may or may not apply to a particular installation location. Drawings referred to in the sections that follow may be found in the Appendix or online at www.highwayguardrail.com.

Anchorage Options

Concrete Anchorage Option

The TRACC or SHORTRACC can be anchored to several combinations of asphalt and concrete. Refer to the section entitled *Anchoring to Foundation* on page 13 for more information.

Please refer to the following drawing located in the Appendix or online at www.highwayguardrail.com for a Bill of Materials and inventory items:

SS452, TRACC Anchoring Options

Asphalt Anchorage Option

The TRACC or SHORTRACC can be anchored to several combinations of asphalt and concrete. Refer to the section entitled *Anchoring to Foundation* on page 13 for more information.

Please refer to the following drawing located in the Appendix or online at www.highwayguardrail.com, for a Bill of Materials and inventory items:

SS452, TRACC Anchoring Options

Backup Options

Square Backup Option

The last frame of a TRACC or SHORTRACC can be attached to a square concrete backup. Please refer to the following drawing located in the Appendix or online at www.highwayguardrail.com, for a Bill of Materials and inventory items:

SS456, TRACC Transition to Vertical Wall

Concrete Barrier Backup Option

The last frame of a TRACC or SHORTRACC can be attached directly to a concrete barrier. Please refer to the following drawings located in the Appendix or online at www.highwayguardrail.com, for Bills of Materials and inventory items:

SS461, TRACC Transition to Concrete Safety Shape Barrier
Plan, Elevation & Sections
SS462, TRACC Transition to Concrete Barrier Single Slope
Plan, Elevation & Sections

Guardrail Backup Option (Base-Plated Post)

The last frame of a TRACC or SHORTRACC can be attached to a base plate post located at the end of a section of guardrail. Please refer to the following drawings located in the Appendix or online at www.highwayguardrail.com, for Bills of Materials and inventory items:

SS455, TRACC Transition to W-beam Median Barrier
Plan, Elevation & Sections
SS463, TRACC Transition to Thrie Beam Median Barrier
Plan, Elevation & Sections
SS464, TRACC Transition to Thrie Beam Median Barrier All Wood Post
SS458, Crash-Cushion Attenuating Terminal 23 Foundation Plan

Guardrail Backup Option (Driven Post)

The last frame of a TRACC or SHORTRACC can be attached to a soil mounted post located at the end of a section of guardrail. Please refer to the following drawings located in the Appendix or online at www.highwayguardrail.com, for Bills of Materials and inventory items:

SS453, TRACC Transition to W-beam Median Barrier Soil Post Option
SS454, TRACC Transition to Thrie Beam Median Barrier, Soil Post Option
SS457, Crash-Cushion Attenuating Terminal 22 Foundation Plan

Transition Options

Vertical Wall Transition

When the last frame of a TRACC or SHORTRACC is attached to a vertical wall in a location that allows a reverse-direction impact, a transition will be required. Please refer to the following drawing located in the Appendix or online at www.highwayguardrail.com, for a Bill of Materials and inventory items:

SS456, TRACC Transition to Vertical Wall

Concrete Barrier Transition

When the last frame of a TRACC or SHORTRACC is attached to a concrete barrier in a location that allows a reverse-direction impact, a transition will be required. Please refer to the following drawings located in the Appendix or online at www.highwayguardrail.com, for Bills of Materials and inventory items:

SS461, TRACC Transition to Concrete Safety Shape Barrier Plan, Elevation & Section
SS462, TRACC Transition to Concrete Barrier Single Slope Plan, Elevation & Sections

Guardrail Transition (Thrie Beam)

When a TRACC or SHORTRACC is attached to a thrie beam guardrail barrier in a location that allows a reverse-direction impact, a transition will be required. Please refer to the following drawings located in the Appendix or online at www.highwayguardrail.com, for Bills of Materials and inventory items:

SS463, TRACC Transition to Thrie Beam Median Barrier Plan, Elevation & Sections
SS464, TRACC Transition to Thrie Beam Median Barrier All Wood Post
SS454, TRACC Transition to Thrie Beam Median Barrier, Soil Post Option

Guardrail Transition (W-Beam)

When a TRACC or SHORTRACC is attached to a W-beam guardrail barrier in a location that allows a reverse-direction impact, a transition will be required. Please refer to the following drawings located in the Appendix or online at www.highwayguardrail.com, for Bills of Materials and inventory items:

SS455, TRACC Transition to W-beam Median Barrier - Plan, Elevation & Sections
SS453, TRACC Transition to W-Beam Median Barrier, Soil Post Option

Recommended Tools and Equipment

1. Forklift or Crane (3000 pound / 1,400 kilogram capacity)
2. Lifting Slings or Chains
3. Air hammer/drill 35/50# and appropriate power source
4. Rock drill bit ¾"x 16" (m20x400mm) with 30" (760mm) extender
5. Socket and Ratchet Set or Flat Wrenches - 3/8" to 1-1/4" (10mm to 32mm)
6. Straight Blade Screwdriver
7. Torque Wrench
8. Traffic control equipment
9. Gloves, safety goggles, and back protection for lifting
10. Spray paint or chalk for marking anchor holes
11. Long-neck funnel for pouring chemical grout

Safety Instructions

Always use appropriate safety precautions when operating power equipment, mixing chemicals, and moving heavy equipment. Gloves, safety goggles and back protection should be used.

Safety measures incorporating appropriate traffic control devices should also be used to protect personnel while at the installation site. Trinity Industries, Inc., offers an economical and effective truck mounted attenuator, the MPS-350, for the protection of workers in work zones.

Installation of System

Preparing the System for Installation

To facilitate accurate communication regarding the parts of the TRACC or SHORTRACC, Figure 1 shows the system with its side panels removed and with its major parts labeled.

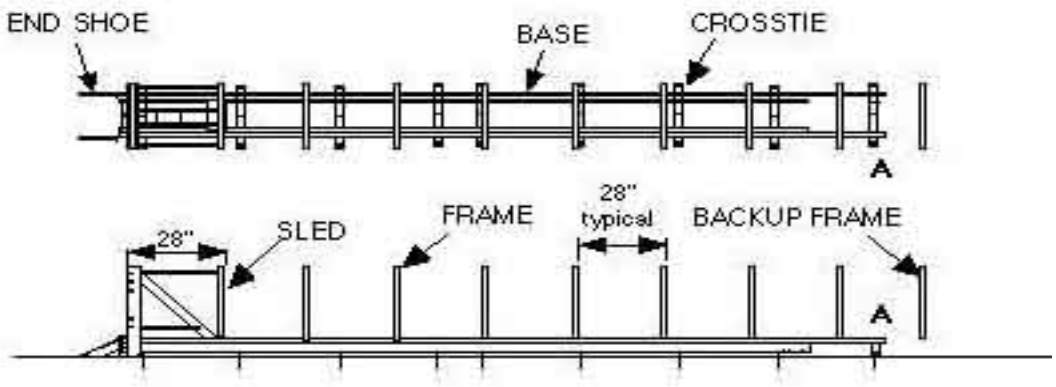

Figure 1. Major Components of the TRACC. (The side panels have been removed from the outside of the system for clarity.)

Prior to installing the TRACC or SHORTRACC, it is important that the system be extended to its full length. From the backup frame to the front of the sled, the TRACC is 21 feet (6.4m) long and the SHORTRACC is 14 feet (4.3m) long. If there is slack in the side panel slots, it will be necessary to stretch the system. This can be done by attaching a hand winch to the base at location **A** as indicated in Figure 1. The other end of the winch should be threaded through the frames and attached to the sled. The sled can then be pulled downstream until the cutter is fully engaged in the rip plate as shown in Figure 2.

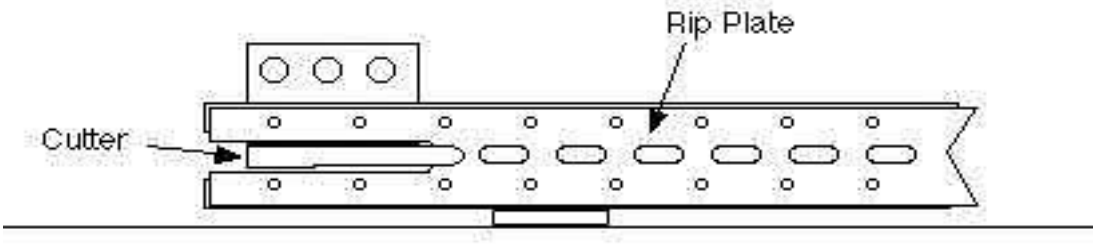

Figure 2. Cutter Engaged in Slot (parts removed for clarity)

The frames, which are rigidly attached to the side panels can then be pulled downstream in succession starting with the one nearest the sled. All the slack in the system can be removed using this method. Note that for the TRACC the second, fifth, and seventh frames are not attached to the ends of side panels. For the SHORTRACC, the second and fourth frames are not attached to the ends of the side panels. The frames should be approximately centered between their neighboring frames. It may be necessary to loosen the attachment hardware located in the center of each side panel to facilitate the length adjustments.

The second step in preparing the system for installation involves readying the backup frame for attachment to the downstream structure. This step is necessary only if the system is being attached to a concrete safety shape. In such a case, the barrier adaptors should be attached to the backup frame prior to transporting the system to the installation location. More detail of the adaptor and safety shape attachment is shown in drawing SS461 located in the Appendix.

Lifting the System

TRACC Systems can be lifted as complete units by attaching lifting chains or slings To the second and fourth frames (counting from the sled.) The slings can be threaded directly through the tops of the frames. If only one sling is available, the TRACC can be lifted from the third frame as long as someone guides the end of the system to maintain control. Figures 3 and 4 show the TRACC lifting points. Corresponding lifting points for the SHORTRACC are shifted toward the sled by two frame spacings. Care should be taken to ensure that the system can be handled safely prior to moving.

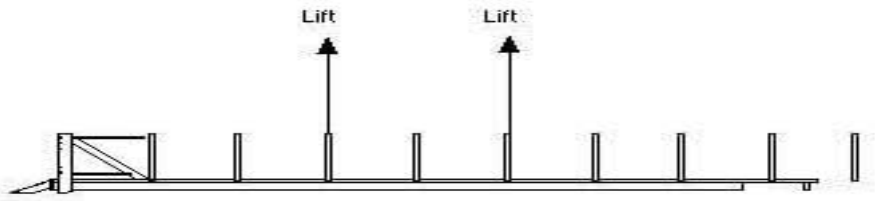

Figure 3. TRACC Lifting Points for Two Slings. (Sides removed for clarity.)

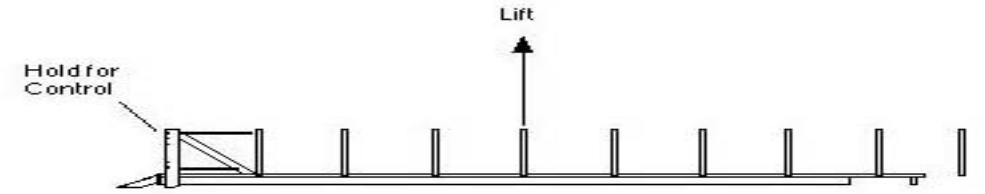

Figure 4. TRACC Lifting Point for Single Sling. (Sides removed for clarity.)

Anchoring to Foundation

The TRACC and SHORTRACC can be installed on combinations of asphalt and concrete. Table 1 shows the types of foundations that can be used and the anchoring studs that are required. In general, concrete installation can be performed using 7.5 inch (190mm) anchor studs while asphalt installation requires 18 inch (455mm) anchor studs. Holes should be drilled 1.5 inches (38mm) less than the overall length of the anchor stud to ensure proper embedment.

The TRACC or SHORTRACC can be placed directly onto the foundation as a complete unit. The system should be aligned within 1^{O} of the downstream barrier according to the approach and downstream zone requirements set forth in the Design Manual. Holes for the anchor studs can be drilled into the foundation using the system as a template. Because of the open design of the TRACC systems, it is not necessary to disassemble any portion of the system in order to drill the anchoring holes.

After the holes are drilled, the polyester resin can be mixed and poured into each anchor hole using a long-necked funnel. Each anchor stud should be suspended by its nut and washer through the crosstie and into the hole containing the polyester resin. Figure 5 shows how the anchor stud should pass through the crosstie suspended by its nut and washer. The stud should hang in the uncured resin with no threads showing above the nut. Twenty-four hours after installation the polyester resin will be cured enough to allow final tightening of the anchor nuts.

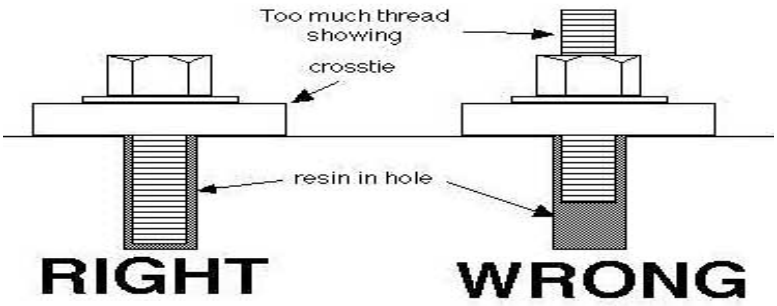

Figure 5. Suspending the Anchor Studs in the Uncured Polyester Resin.

Table 1. Anchor Stud Selection Table

Foundation	Anchor Stud Size
6” (150mm) Reinforced Concrete	5/8 d x 7.5 long (m16x190mm)
8” (200mm) Unreinforced Concrete	5/8 d x 7.5 long (m16x190mm)
3”(75mm)min Asphalt on 3”(75mm)min Concrete	5/8 d x 18 long (m16x455mm)
6”(150mm) Asphalt on 6”(150mm) Compact Subbase	5/8 d x 18 long (m16x455mm)
8” (200mm) Minimum Asphalt	5/8 d x 18 long (m16x455mm)

NOTE: If asphalt is located over a minimum of 6-inches (150mm) of concrete, the 18-inch (455mm) anchor studs can be cut off to a total length equal to the asphalt thickness plus 7.5 inches (190mm). This may eliminate some drilling in locations with thick concrete and relatively thin asphalt overlays.

Anchoring to Backup Options

During an end-on impact, stopping forces are transmitted directly through the TRACC System structure into the foundation BELOW the system. Stopping forces are not transmitted into the structure directly behind the TRACC System. The downstream structure to which the TRACC or SHORTRACC is attached serves as a platform for the support of the side panels and required transition panels. No direct stopping forces are transmitted into the backup.

The TRACC or SHORTRACC can be attached directly to any type of structure. A square concrete block can be used to support the backup frame as shown in Appendix drawing SS456. A vertical wall can also serve as an appropriate backup. Figure 6 shows a concrete safety shape that has been tapered over an adequate distance from its standard barrier shape to a vertical wall. This design is particularly useful when reverse-direction impacts are possible.

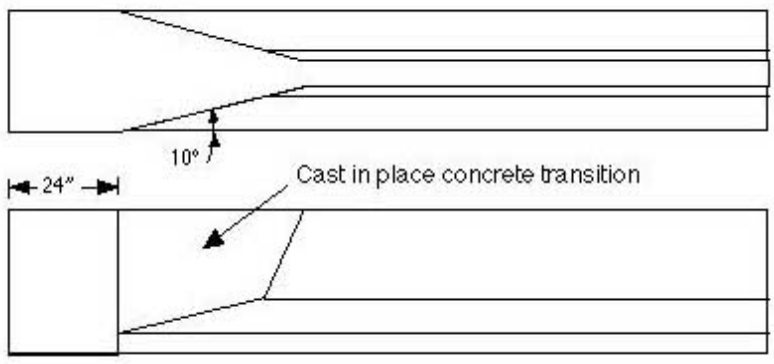

Figure 6. Concrete Safety Shape Tapered to Vertical Wall.

The TRACC or SHORTRACC can be attached directly to a safety shape by using special adaptors that are available. Appendix drawing SS461 shows such a detail in conjunction with transition hardware where reverse-direction impacts are possible. When located at the end of a guardrail barrier, the TRACC System backup frame can be attached to a pair of posts that are either bolted to the concrete foundation or driven directly into the soil downstream of the system foundation. Details are shown in Appendix drawings SS455 and SS463.

Installation of Transition

When the possibility exists for a reverse direction impact, it will be necessary to smoothly transition the TRACC System into the downstream barrier system. Concrete barriers can be transitioned by tapering the width as shown previously in Figure 6. Vertical walls and tapered concrete barriers require a modified bridge-end-shoe transition as shown in Appendix drawing SS456. Thrie beam guardrail can be transitioned according to the details of SS463 and SS464. W-beam guardrail transition details are shown in SS455. Assembly details are shown in the Appendix drawings and are available online at www.highwayguardrail.com.

Attachment of Plastic Nose and Delineator

The TRACC System is intended for use on either shoulder or in the median in both unidirectional and bi-directional traffic situations. To provide the greatest level of safety, the delineation of the plastic nose section can be customized for any particular location. Four pieces of reflective tape are provided with each TRACC System and can be used to delineate left shoulder, right shoulder, and gore applications. All four identical pieces of reflective tape can be used to create the three designs as shown in Figure 7. The plastic nose should be attached to the front of the TRACC System using the machine screws, washers, and nuts provided. Details of the attachment are shown in Appendix drawing SS450.

Gore Area Right Shoulder Left Shoulder

Figure 7. Nose Delineation Options.

NOTE: Consult local transportation authorities for delineation requirements.

TRACC REPAIR AFTER IMPACT

Low-Risk Repair Philosophy

The TRACC System has been designed for rapid replacement as a complete unit after most impacts. This design philosophy is a direct result of Trinity' desire to ***protect the highway worker*** and the motorist by limiting the amount of time that traffic must be disrupted. Once the system has been removed from the roadway, repair can be done conveniently and accurately in the safety of the maintenance yard. Many of the TRACC components remain undamaged after most impacts making refurbishment simple and economical.

NOTE: THE TRACC IS **NOT** A DISPOSABLE SYSTEM. COMPLETE REPLACEMENT ON THE ROADSIDE AFTER IMPACT PROTECTS WORKERS BY LIMITING EXPOSURE TO TRAFFIC. UP TO **98%** OF THE TRACC IS REUSABLE AFTER DESIGN IMPACTS. REPAIRS SHOULD BE MADE IN THE SAFETY OF THE MAINTENANCE SHOP.

Field Repair

The TRACC System can be repaired in the field if the damage is minimal or of a cosmetic nature. Side panels can be replaced and the plastic nose can be repaired in the field without complete removal of the system.

Repair of the system after any end-on impact that causes the sled to move should be done in the safety of the maintenance facility. Field replacement of the first stage of rip plates on either side of the system is possible but is not recommended.

Types of Damage

TRACC Systems are designed to withstand end-on impacts and redirecting side impacts. Side impacts, depending on the severity, may only cause cosmetic damage to the system. Any system that has been impacted along its side should be examined to make sure that the damage is only cosmetic and that any damage that might hinder subsequent function of the system is repaired.

During some severe high-speed redirecting impacts with heavy vehicles, a TRACC System may be damaged as shown in Figure 8. If the deformation of the base is greater than the 3/4-inch (20mm) maximum indicated in the figure, replace the damaged components with new or refurbished parts.

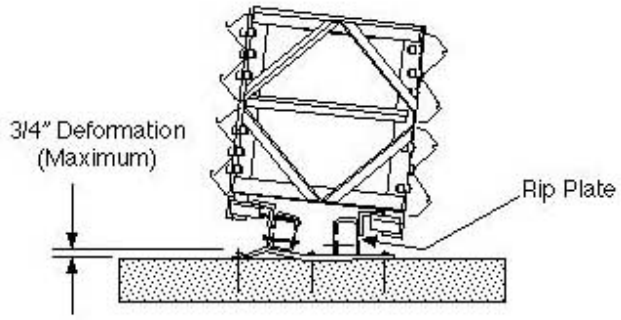

Figure 8. Damage Due to Uncommonly Severe Redirecting Impact.

Removal / Replacement of System

The TRACC or SHORTRACC can be removed from its foundation by releasing the anchor nuts that hold the crossties down. Flat wrenches may be required to access the anchor studs under the displaced frames and sled. Once released, the system can be lifted as a unit and transported back to a maintenance facility for repair. A new or reconditioned TRACC or SHORTRACC can be positioned on the existing anchor studs and firmly attached using the appropriate nuts and washers.

In some impacts, a small number of anchor studs may become bent or fractured. In these cases it will be necessary to remove the old anchor, drill out the polyester resin in the old hole, and replace the removed anchor with a new anchor and polyester resin. Damaged anchors can generally be removed by backing the lower portion of the stud out of the polyester resin with a wrench. Gripping the top of the anchor stud can be done by welding a nut on or by tightening two nuts against one another.

Removal of Side Panels and Frames

The TRACC System side panels and frames will be compressed into a small bundle during an end-on impact as the frames translate forward and the side panels retract. The bundle of frames and side panels can slide off the downstream end of the base to make disassembly easier.

Side panels can be removed from the support frames beginning at the upstream end and proceeding downstream. As the hardware for each frame is removed, the side panels will release from the sides of the bundle. Disassembly of the entire bundle of TRACC System frames and side panels can be accomplished in about 30 minutes by one experienced technician.

Side panels and frames should be inspected for damage.

Removal of Sled

The TRACC System sled can be removed by pulling it back toward the nose of the system. The end-shoes which hold the top and bottom sections of the base together should be removed to allow complete removal of the sled off the nose-end of the system.

Removal of Rip Plates

For a TRACC System that has been damaged in an end-on impact, it will be necessary to repair the base by replacing the damaged rip plates, or, the owner of the system may opt to replace the entire base of the system with a factory-assembled base. Factory-assembled bases for the TRACC (P/C 33366A) and SHORTRACC (P/C 33460A) are readily available and will result in a shorter overall repair time after an end-on impact.

If the rip plates are to be replaced, each of the attaching bolts should be removed. Note that the top bolt is 4.5 inches (115mm) long and the bottom attachment bolt is 4 inches (100mm) long. Hardware details are shown in Appendix drawing SS451.

The TRACC System rip plates are divided into three separate stages. An impact that causes any part of a stage to be consumed will require that the entire stage be replaced. For example, an impact that strokes the TRACC system eight feet (2440mm) will progress into (but not through) the second stage of rip plates. All of stages one and two will require replacement in such a case. Disassembly of a damaged TRACC or SHORTRACC base can be completed in about 30 minutes by two experienced technicians.

Replacement of Damaged Parts

All parts that are damaged should be replaced with new or refurbished parts. Product Codes for the SHORTRACC are shown on the Bill of Materials in Appendix Drawing SS467 and for the Standard TRACC in Appendix
Drawing SS451.

Assembly of System

The TRACC System can be reassembled using Appendix drawing SS451 or SS467 as an assembly guide.

The base should be assembled very carefully ensuring that the rip plates are located properly (see Figures 9 and 10) and that the correct hardware is used for attachment as shown in Appendix Drawings SS451 and SS467. Tighten all the base hardware taking special care not to over tighten as this may cause the channels which support the rip plates to deform. A complete base can be assembled by two experienced technicians in about two hours.

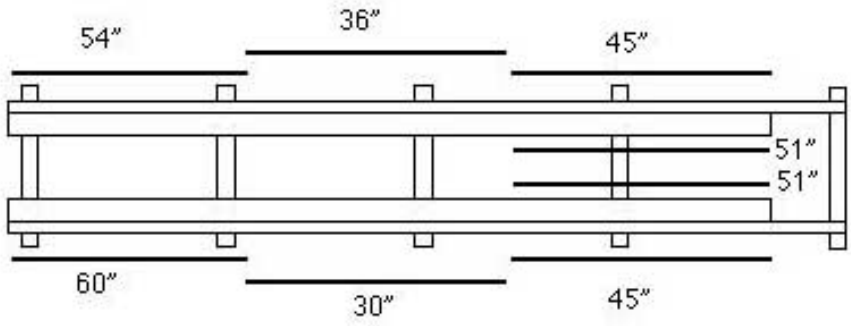

Figure 9. Exploded Overhead View of SHORTRACC Base Showing Rip Plate Lengths (NOT TO SCALE).

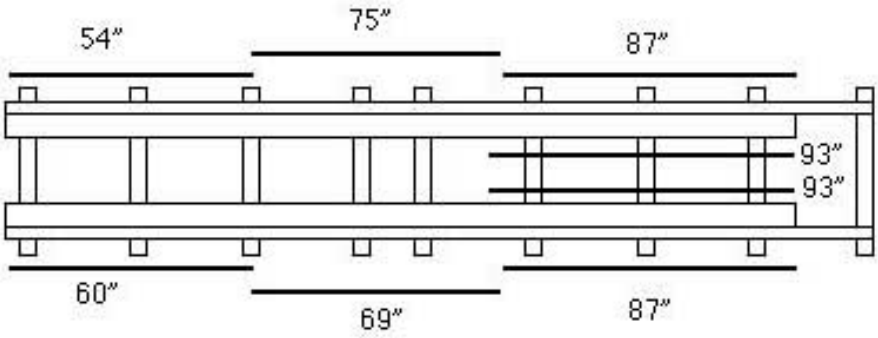

Figure 10. Exploded Overhead View of TRACC Base Showing Rip Plate Lengths (NOT TO SCALE).

With the base completely reassembled, the sled and support frames can be slid into place. All of these components are spaced 28 inches (710mm) apart. Note that the backup frame (farthest downstream) cannot be slid into place as the base of the system does not extend that far downstream. The backup frame can be attached directly to the side panels after they have been attached to the other support frames.

With the sled in place, the end-shoes can be replaced. Some of the end-shoe attachment bolts may need to be located in the base prior to sliding the sled into its final location.

Side panels should be replaced beginning at the downstream end and overlapping the panels while proceeding upstream. The center section of the standard TRACC uses shorter one-bay side panels while all the rest of the system is covered by two-bay side panels. Only two-bay side panels are required for the SHORTRACC. With all the side panels and hardware in place as shown in Appendix drawing SS451 or SS467, make sure that the system is fully extended and that no slack exists along the length. Refer to the section entitled, Preparing the System for Installation, for more detail on extending the system. Tighten all the upper TRACC System hardware after the system is fully assembled and extended. Assembly of the upper section can be accomplished by two experienced technicians in approximately one and one-half hours.

With the components reassembled and all the hardware tightened correctly, the repaired TRACC System is ready for installation where it can save another life.

APPENDIX

SS450, Crash-Cushion Attenuating Terminal - TL-3 Plan, Elevation & Sections
SS451, Crash-Cushion Attenuating Terminal Plan, Elevation & Sections, Shop Assembly Details
SS452, TRACC Anchoring Options
SS453, TRACC Transition to W-Beam Median Barrier Soil Post Option
SS454, TRACC Transition to Thrie Beam Median Barrier Soil Post Option
SS455, TRACC Transition to W-beam Median Barrier Plan, Elevation & Sections
SS456, TRACC Transition to Vertical Wall
SS457, Crash-Cushion Attenuating Terminal 22’ (6700mm) Foundation Plan
SS458, Crash-Cushion Attenuating Terminal 23’ (7000mm) Foundation Plan
SS459, Crash-Cushion Attenuating Terminal 24’ (7315mm) Foundation Plan
SS461, TRACC Transition to Concrete Safety Shape Barrier Plan, Elevation & Sections
SS462, TRACC Transition to Concrete Barrier Single Slope Plan, Elevation & Sections
SS463, TRACC Transition to Thrie Beam Median Barrier - Plan, Elevation & Sections
SS464, TRACC Transition to Thrie Beam Median Barrier All Wood Post
SS466, TRACC - TL-2 Plans, Elevation & Sections
SS467, TRACC - TL-2 Shop Assembly Details
SS468, TRACC - TL-2 Foundation Plans

Any of above mentioned drawings will be sent upon request