



INSTALLATION MANUAL

A STEP-BY-STEP INSTRUCTIONAL GUIDE FOR THE
INSTALLATION OF THE ZONEGUARD® STEEL
BARRIER SYSTEM



FOR YOUR SAFETY.

This manual follows the guidelines set forth in ANSI Z535 series for alerting you to possible hazards and their potential severity.



This is the safety alert symbol. This manual uses this symbol to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.



DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.



NOTICE indicates messages not related to personal injury, such as property damage.

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1. INTRODUCTION

1.1 PREFACE

The safety of motorists and road workers can be jeopardized by the inadequate installation of roadside safety hardware. Therefore, it is recommended that the contractor who performs the installation of the Zoneguard® steel barrier system be properly approved by the owner and trained by Hill & Smith Inc. Please contact a Hill & Smith Inc. representative for more information about the Zoneguard® Installation training program.

1.2 SYSTEM OVERVIEW

Zoneguard® is a portable steel traffic barrier that is easy to transport and quick to install. The main use of the system is to provide positive protection for workers in a work area. The system can also be used to separate travel lanes or shield hazards such as drop offs or inadequate barrier systems.

Zoneguard® has been extensively crash tested, having undergone testing to both NCHRP-350 (National Cooperative Highway Research Program Report 350) and MASH (Manual for Assessing Safety Hardware) standards, as well as the similar European standard EN-1317. It has received eligibility from the Federal Highway Administration to be used on the National Highway System.

The Zoneguard® cross section is shown in Figure 1. Standard units are supplied to the jobsite in 50'-0" lengths. Custom lengths can be provided, if required. Standard units can be installed in two different configurations, namely, the Standard system and the Minimum Deflection System. The only difference in the two system configurations is the quantity of anchoring, resulting in different levels of deflection performance. The Standard System is anchored at the end of each barrier run, while the Minimum Deflection System adds intermediate anchors spaced every 33'-4".

Zoneguard® units are connected by a patented speed joint system.

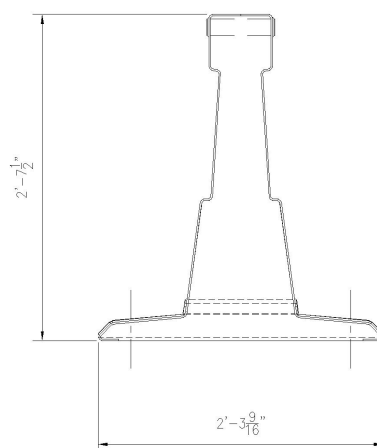


Figure 1
Zoneguard® Cross-Section



Improper installation can result in serious injury or death.

2. SYSTEM PERFORMANCE & DESIGN

2.1 STANDARD SYSTEM

The Zoneguard® Standard System is anchored at the end of each barrier run. This configuration provides deflection characteristics similar to that of most freestanding portable concrete barrier systems.

Details on the configuration and anchoring of the system are shown on E-1020 (see Appendix A). This configuration has received eligibility letters from the FHWA for NCHRP-350 TL-3 and TL-4, and MASH TL-3. The minimum run length of the Standard System is 250'-0.

2.2 MINIMUM DEFLECTION SYSTEM

The Zoneguard® Minimum Deflection System is also anchored at the end of each barrier run, adding intermediate anchors spaced every 33'-4. This configuration provides a solution for applications where the design requires low deflections.

Details on the configuration and anchoring of the system are shown on E-1020. This configuration has been accepted by the FHWA to NCHRP-350 TL-3 and MASH TL-3. The minimum run length of the Minimum Deflection System is 250'-0.

2.3 END CONDITIONS IN UNIDIRECTIONAL TRAFFIC FLOW

In unidirectional traffic, the approach end of the Zoneguard® run should be shielded as specified by the governing requirements. The two most common methods are the use of a crash cushion (aka impact attenuator) and flaring the run out of the clear zone.

Depending on the model of crash cushion, a connection may be required between the crash cushion and Zoneguard®. Contact the crash cushion manufacturer or Hill & Smith Inc. for connection requirements. See Section 3 for instructions on the method to flare the Zoneguard® out of the clear zone.

2.4 END CONDITIONS IN BIDIRECTIONAL TRAFFIC FLOW

In bidirectional traffic, the end of the Zoneguard® run must be shielded as specified by the governing requirements. The most common method will be the use of a crash cushion.

In bidirectional installations, a special transition that connects the crash cushion to Zoneguard® will likely be required. Transitions are used to protect from snag points and blunt ends on a reverse angle impact. Consult with the crash cushion manufacturer or a Hill & Smith Inc. representative on the transition method used to connect the crash cushion to the end of the Zoneguard® run in a bidirectional application.



Improper installation and/or absence of system anchors can result in serious injury or death.

Improper installation and/or absence of crash cushion connections and transitions can result in serious injury or death.

2.5 DELINEATION

Delineation requirements vary widely from state to state. In most instances, adhesive reflectors can be used. If the governing specifications do not allow for adhesive-attached delineation, contact a Hill & Smith Inc. representative. Drilled holes in any part of the system without approval by Hill & Smith Inc. may affect the performance and durability of the system.

2.6 CURVES

Runs of Zoneguard® using standard 50'-0 units can be curved down to a radius of 800'-0. For tighter curves, shorter Zoneguard® units can be supplied, which will allow installation on curves down to 250'-0 radius. For tighter curves and radii, contact Hill & Smith Inc. for other special lengths or custom fabricated units. See Section 3 for installation guidelines for installing Zoneguard® on curves.



NOTICE

Drilled holes in any part of the system without approval by the manufacturer may affect the performance and durability of the system.

Care must be taken when lifting and pulling standard units to avoid damage to the speed joints.

3. SYSTEM INSTALLATION

3.1 PRE-INSTALLATION PLANNING (weeks to months prior to installation)

In the pre-installation planning process, it's important to consider all the project details that may affect the barrier layout. Without proper planning, your installation could be delayed. Please review the questions and items below, to help facilitate a smooth installation.

- 3.1.1 **Anchoring Locations** – Determine what anchoring configuration, Standard or Minimum Deflection, is being employed. If the project specifies an “anchored,” “bridge-mounted” or “limited deflection” barrier, the Minimum Deflection System anchoring configuration should be installed. If the project specifies “freestanding” concrete barrier, the Standard System can be installed. Exact anchoring locations are shown on E-1020.
- 3.1.2 **Anchor Types** – Determine the road surface (i.e. asphalt, concrete or bridge-mounted) and consult E-1027 or a Hill & Smith Inc. representative to decide which anchor type is appropriate.
- 3.1.3 **End Conditions** – Determine the specified or appropriate end conditions for the barrier layout. If a crash cushion is required, determine what model is to be installed and if traffic is unidirectional or bidirectional. Contact crash cushion manufacturer and/or Hill & Smith Inc. to determine appropriate connection/transition.
- 3.1.4 **Unique Layout Details** – Review the barrier layout for any curves, tight radiuses or other parameters that may require shorter barrier units.
- 3.1.5 **Expansion Units** – Expansion units can be used for projects where thermal expansion and contraction caused by extreme temperature changes is a concern. For more information, contact a Hill & Smith Inc. representative.
- 3.1.6 **Space Constrictions** – Review the project plans to determine if any space constrictions at the jobsite will affect the installation. Careful consideration must be given to the width available on site, and the width needed for lifting equipment.



Improper installation and/ or absence of system anchors can result in serious injury or death.

Improper installation and/ or absence of crash cushion connections and transitions can result in serious injury or death.

3.2 INSTALLATION PREPARATION (1-2 weeks prior to installation)

As the installation approaches, it's important to review what tools, equipment and procedures will be required or helpful.

- 3.2.1 **Adequate Anchor Quantity** – Make sure you have the correct number of anchors.
- 3.2.2 **Proper Alignment of Units** – It's important that all Zoneguard® units are aligned the same way on every truck. For most installations, the B speed joints should face the front of the truck, and A speed joints should face the back.
- 3.2.3 **Lifting Equipment** – Ensure that the lifting equipment can lift 3,100 lbs. in the extended position for unloading and placing each unit.
- 3.2.4 **Rigging Apparatus**—Ensure that all chains, slings or cables are certified to lift the required weight and suitable for lifting and placing Zoneguard®.
- 3.2.5 **Taglines** – It is vital that taglines (i.e. rope, straps, etc.) are attached to both ends of each Zoneguard® unit when unloading and loading.
- 3.2.6 **Wrench** – A ¾" wrench (socket wrench recommended) is required to tighten the vertical engagement assembly ("slider") into place.
- 3.2.7 **Drill** – A Drill with 1 ½" drill bit for pins and 1 ¼" bridge anchors; a 1" drill bit is used for 7/8" bridge anchors.
- 3.2.8 **Compressed Air** – Compressed air can be used for drilling and is required for blowing out holes for adhesive bridge anchors.
- 3.2.9 **Other items** – Other items that may come in handy are: piece of lumber, spud bar, mallet/hammer (for vertical engagement bars) and broom (for debris that impedes barrier placement)

REQUIRED INSTALLATION ITEMS

& ITEMS THAT MAY COME IN HANDY

1 LIFTING EQUIPMENT

2 RIGGING APPARATUS

3 TAGLINES

4 WRENCH

5 COMPRESSED AIR

6 DRILL

7 LUMBER

8 MALLET

9 SPUD BAR

10 BROOM



3.3 INSTALLATION

The planning is complete and preparations have been made. Now it's time to install. Follow these step-by-step instructions for how to install Zoneguard®.

3.3.1 **Site Approach & Setup** – Prior to work zone entry, ensure that:

- Traffic management is in place
- The work area is safe
- The truck is properly identified with equipment required by governing specifications, such as beacons, signage, etc.
- Crews are wearing appropriate PPE

3.3.2 **Unloading**

- Unloading Preparation – Prior to unloading, check for overhead cables and structures and ensure that the vehicle and load are stable.
- Unloading Sequence—The truck will be loaded as shown in Figure 2. Each layer will be separated by two pieces of steel dunnage. The sequence of unloading, per layer, should be as follows (refer to E-1009).
 - 1) A or B
 - 2) A or B
 - 3) C or D
 - 4) C or D
 - 5) E
- Rigging Units—When rigging an inverted section, secure a chain or sling, around the feet at the bottom of the section (Figure 3, Detail 2). When rigging an upright section, secure a chain or sling around the lifting bar, located through the access hole on the top of the section (Figure 3, Detail 1; refer to E-1008). It is recommended to use two pick points.

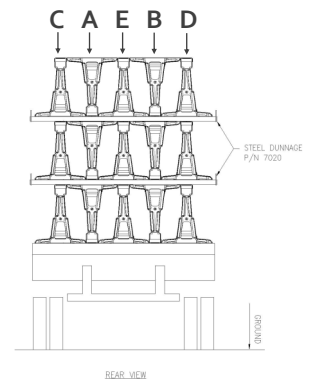


Figure 2
Unloading Sequence

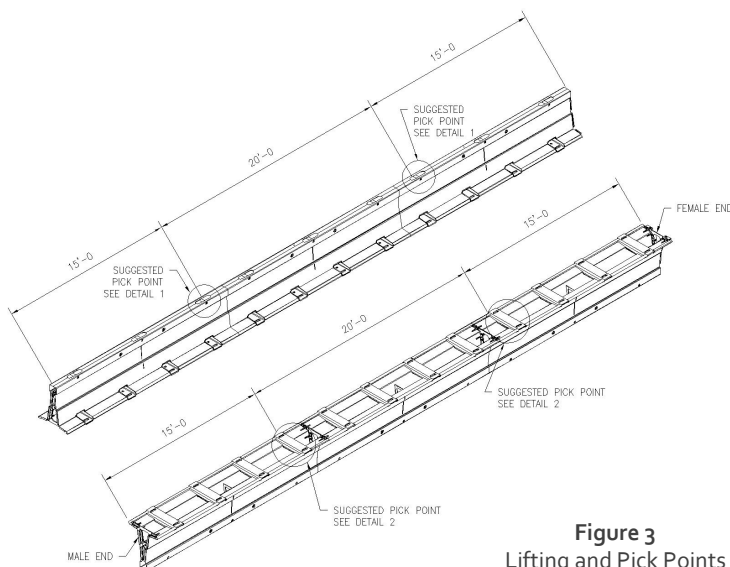
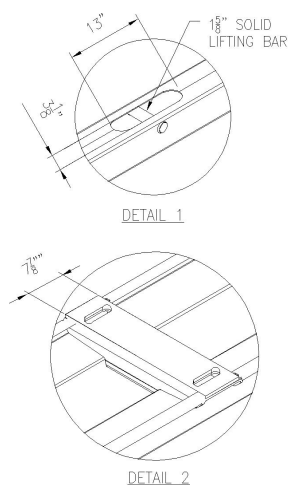


Figure 3
Lifting and Pick Points



Do not:

- ♦ Initiate lifts near overhead cables
- ♦ Swing lift over personnel
- ♦ Allow personnel to walk under lift

Do not:

- ♦ Allow lift to swing over live traffic lane
- ♦ Exceed safe working load of equipment

- d) Attaching Taglines – To prevent units from swinging or rotating when lifted, taglines should be attached; two taglines are recommended. Using rope or straps, securely attach each tagline to the end of the barrier.
- e) Mounting and Dismounting Load – To rig units and attach taglines, safely mount the load of barrier. Once unit has been rigged and taglines attached, safely dismount the load prior to lifting the unit.
- f) Righting Inverted Units – When flipping an inverted section, ensure that the drop area is clear and lower the section. As the section is lowered to the ground, it will rotate onto its side. Disconnect the rigging from the bottom of the section and reattach it to the top of the section. Lift the section to its upright position.

3.3.3 **Connecting Units** – Most runs will begin with the upstream unit first. Place the unit in line, with the B end facing downstream.

After the first unit is in place, ensure the vertical engagement assembly (“slider”) is placed into the end of the unit and pushed back completely inside. Rig the next piece on the load and maneuver it close to the first piece on the ground.

- a) Speed Joint Connection—Suspend the piece so that the bottom of the suspended upper speed joint of the A end aligns with the top of the upper speed joint of the B end that is on the ground. Lower the suspended unit until it locks in place and the top of both units are flush. See Figure 4 for the speed joint connection detail and Figure 6 for speed joint connection sequence.
- b) Vertical Engagement Assembly (“slider”) Engagement – Once the units are completely engaged, reach into the lifting bar access hole adjacent to the connection and slide the vertical engagement assembly, so it spans the joint and engages both units. Using a $\frac{3}{4}$ ” wrench, tighten the bolt on the assembly to lock it into place.

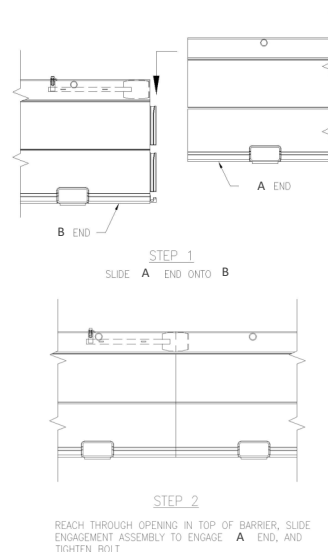


Figure 4
Connection Detail

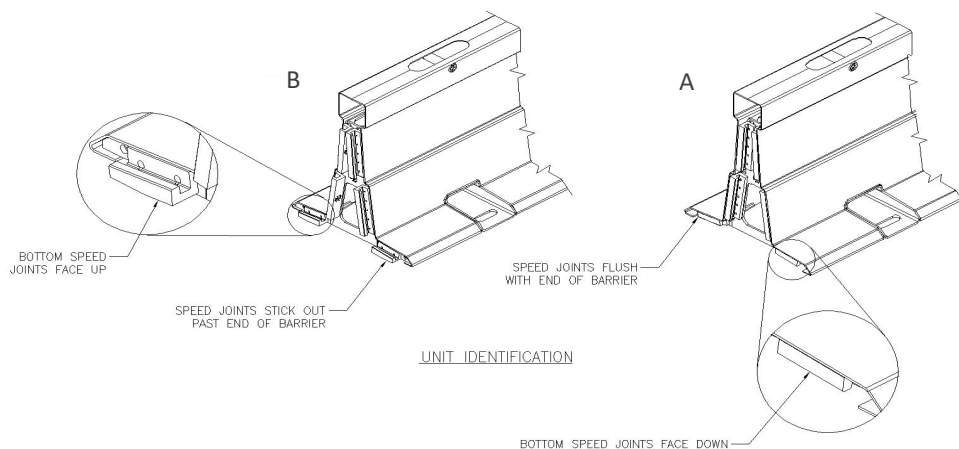


Figure 5
Speed Joint Identification



WARNING

Use caution when rigging units and attaching taglines



CAUTION

Ensure hands, fingers and feet are clear of the end of units when making connection

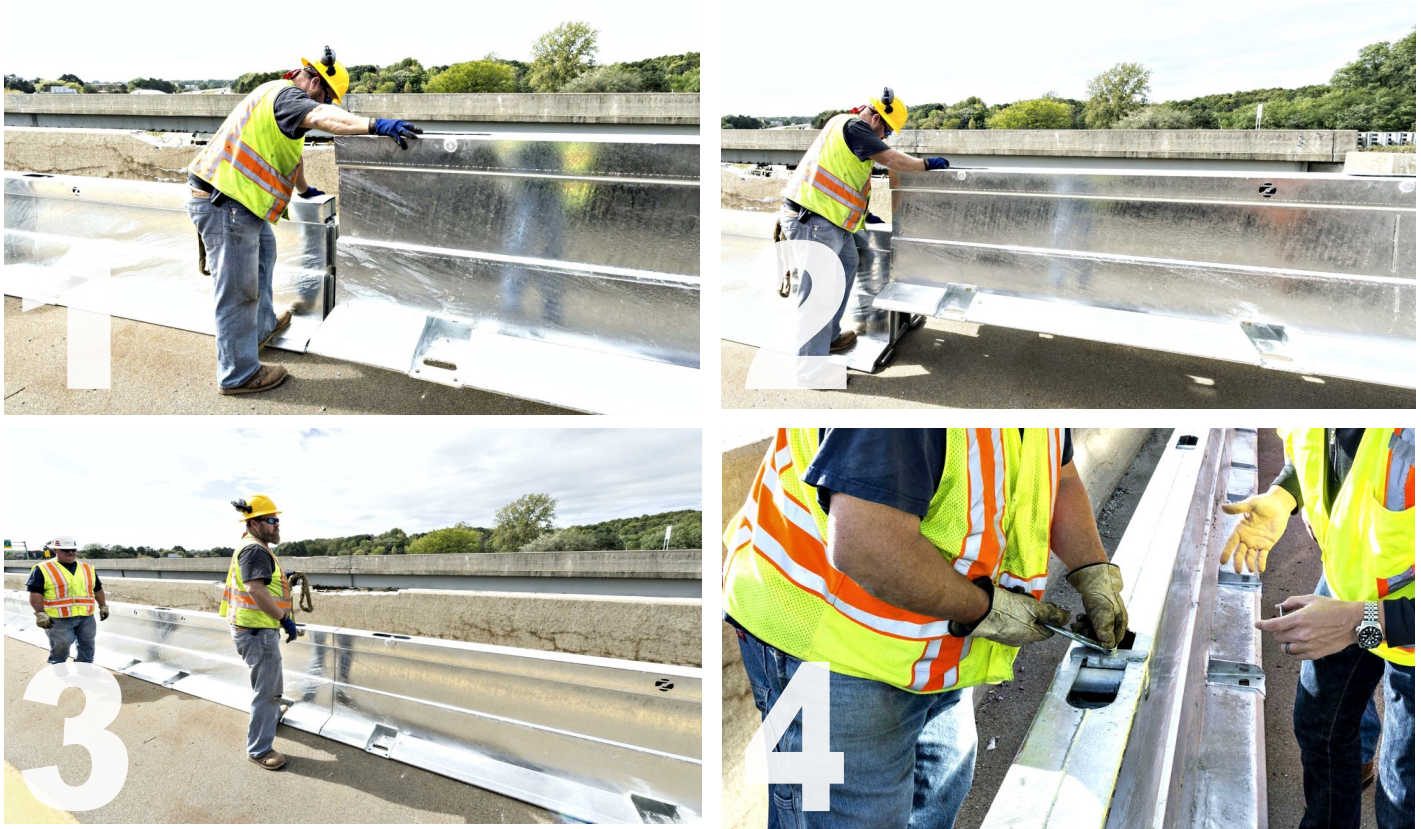


FIGURE 6
Connection of Zoneguard® units

CONNECTION TIPS



- Make sure suspended units are level, or parallel to ground when lowering.
- Make sure suspended unit is aligned with unit on the ground (not being connected at an angle).
- Once suspended unit is 3/4 lowered, and vertical speed joints are engaged, lower suspended unit into place.
- If unit isn't flush, use lifting equipment to lift up and lower quickly or "bounce" connecting unit
- If unit still isn't flush, attach rigging equipment to lifting bar on upstream unit and lift up
- Do not use lifting equipment or sledgehammer to force barrier connection, as it will cause damage



An inadequate connection may affect the performance of the system.

3.3.4 **Aligning Units for Curves or Tapers** – Install and connect at least four units before starting to pull a curve or flared taper. After the fourth unit is installed, connect a chain to the lifting bar at the end to be curved or flared. Lift the end of the unit and pull until desired curve or flare is achieved.

3.3.5 **Anchoring** – Determine anchor locations per drawing E-1020, for the Standard and Minimum Deflection Systems. Guidelines for anchor installation can be found on drawing E-1027.

- a) **Anchoring into Asphalt or Concrete Roadway** – Using the holes in the feet as a template, drill a 1 ½" diameter hole to the proper depth required by the length of the pin (see Figure 7). Once the holes are drilled, clear the debris from the hole. Insert the pin into the hole of the foot. If necessary, drive the pin using a hammer until the top of the pin is firmly against the foot of the Zoneguard®. If the head of the pin is not firmly against the foot of the Zoneguard®, remove the pin and drill the hole deeper.
- b) **Anchoring into Concrete Structure or Bridge** – When anchoring into a concrete structure or bridge deck, threaded adhesive anchors should be installed. Drawing E-1027 provides further guidance regarding the recommended anchor types and sizes. Standard all-thread rod can be used with adhesive (see E-1027 for adhesive requirements). The Left Hand Kelianchor, manufactured by Kelken Construction Systems, can also be used. The Kelianchor is a removable anchor option that prevents the need to core out or cut off anchors.

For both anchor options, use the holes in the feet as a template, drill a 1 ½" diameter hole (for 1 ¼" anchors) or 1" diameter hole (for 7/8" anchors) to the proper depth required by the length of the anchor. Once the holes are drilled, clear the debris from the hole, check depth of hole to ensure proper embedment, then inject adhesive per manufacturer's instructions. Install nut on end of the anchors. Insert the anchor through the washer (and plate washer for 7/8" anchors) and push nut/anchor assembly down until the plate washer is firmly against the foot of the Zoneguard® and hand tighten. Allow adhesive to cure per manufacturer's instructions, then tighten nut snug tight.

For more detailed directions on how to install, remove and reuse the Kelken Left Hand Kelianchor system, see Drawing E-1027.

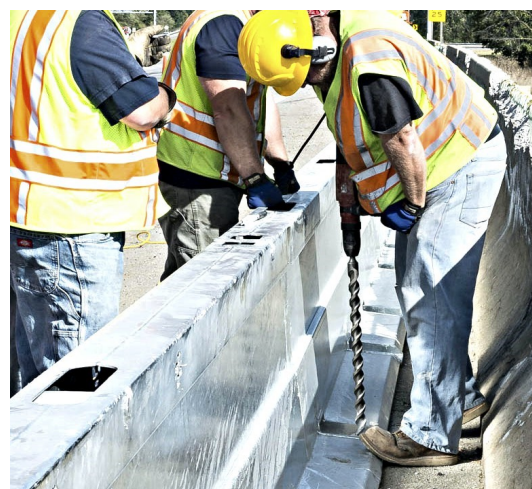


Figure 7
Drilling Anchor Holes

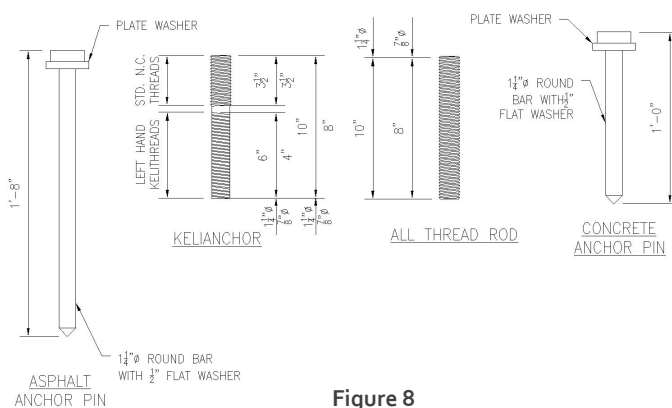


Figure 8
Anchor Types

NOTICE

Care must be taken when lifting and pulling standard units, to avoid damage to the speed joints.

! DANGER

Ensure locations of utilities are determined prior to drilling holes.

! WARNING

Ensure proper PPE is worn at all times when drilling holes and handling, mixing and placing adhesive.

3.3.6 **Inspection** – Upon completion of installation, inspect the run(s) and ensure that:

- Alignment of barrier is proper
- Approach end of the run is protected per the governing specifications
- Anchors are in the proper location according to the system being installed
- All joints are properly aligned
- Vertical engagement assemblies (“sliders”) are properly engaged and bolts tightened at all connections

Periodic inspections should be performed to check for damage to the units, as well as to ensure that units are properly aligned.

3.3.7 **Evaluating Damage**—The majority of impacts into Zoneguard® do not damage the barrier and are detected through the observation of paint and tire blemishes. More severe impacts may result in barrier damage and deformation that could compromise the integrity/performance of the barrier. When an impact occurs causing damage or deformation (permanent bends, tearing or buckling), the barrier should be evaluated and considered for replacement.

Contact Hill and Smith for assistance in evaluation of the extent of damage and the best method to repair/replace the affected barrier. When providing evaluation documentation, it’s important to include pictures and any details about the collision/occurrence that took place.

3.4 REMOVAL

3.4.1 **Anchor Removal** – The process for removing anchors depends on the type of anchor installed.

- a) Left Hand Kelianchor— Place an additional nut on the top of the existing nut. When driven by an impact wrench with a socket deep enough to cover both nuts, in a clockwise direction (which would normally tighten a bolt), the Left Hand Kelianchor will instead back out of the hole. For more information, see Drawing E-1027.
- b) Pins—Pins can often be removed by hand. Pins may also be extracted by lifting the barrier, which can be done during barrier removal.

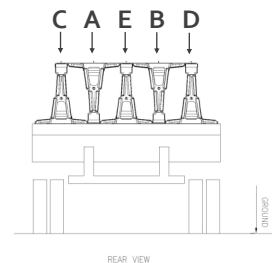
3.4.2 **Disengage Vertical Engagement Assembly** – Prior to barrier removal, the vertical engagement assemblies (“sliders”) must be disengaged. Using a ¾” wrench, loosen the bolt on the assembly and slide the assembly back into its disengaged position. To prevent assembly displacement during barrier relocation, tighten the bolt.

3.4.3 **Disconnect Speed Joint**—After the vertical engagement assemblies have been disengaged, lift up on each unit so the A end of the unit disconnects from the B end of the adjacent unit. If barrier does not immediately disconnect, try to dislodge by lowering and lifting or “bouncing” the unit. If barrier still does not disconnect, lift the units, place a piece of lumber under the A end and lower to separate the units.

3.4.4 **Loading**—As the units are removed, attach taglines and follow this loading sequence:

- 1) E
- 2) C or D
- 3) C or D
- 4) A or B
- 5) A or B

Repeat sequence for middle and top layers. Use two pieces of steel dunnage to separate layers one from two and two from three. If steel dunnage isn’t available, wood timber is acceptable, if staggered.



NOTICE

Failure to disengage vertical engagement assemblies prior to removal of units may cause damage to units.

WARNING

Use caution when loading barrier back onto truck, ensuring to use taglines.

APPENDIX A

To locate the drawings referenced in this manual, as well as other drawings, installation videos and FHWA Eligibility letters, please visit the Installation page on our website, which can be found at www.hillandsmith.com/installation or contact a Hill & Smith Inc. representative.

DRAWING NUMBER	DRAWING DESCRIPTION
E-1008 R1	Lifting Locations
E-1009	Truck Loading Details
E-1020	Anchoring Locations
E-1021	Speed Joint Identification
E-1023	50'0 Standard Unit Dimensions
E-1024	Connection Detail
E-1025	Profile Dimensions
E-1027 R1	Anchoring Types & Installation Details

REVISION HISTORY

REVISION	DATE	DESCRIPTION	AFFECTED PAGES
0	2/23/18	Issued for use	All
1	3/20/19	Evaluating Damage section added; Revision History added; MDS min. run length modified	Pgs. 2, 10, 11

PHOTO CREDIT

Photos of installation process (cover page, pgs. 8, 9) provided by the Michigan Department of Transportation. Battle Creek, MI MDOT project. Copyright © 2017.

STILL HAVE QUESTIONS?

Visit our website at www.hillandsmith.com to view installation videos and other installation documents.

Or contact your Hill & Smith Inc. representative or call our office at (614) 340-6294.



ZONEGUARD®

STEEL BARRIER

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