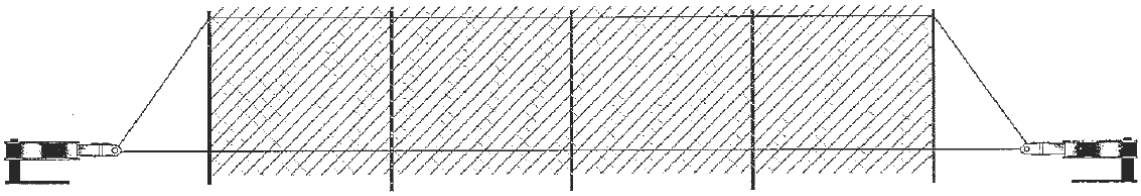
DRAGNET®

VEHICLE ARRESTING BARRIER (VAB)
for
WORK ZONES

INSTALLATION MANUAL



Manufactured & Distributed By:

CUSHION & BARRIER

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CUSHION & BARRIER, LLC

EXECUTIVE SUMMARY

Cushion & Barrier, LLC has been a manufacturer and distributor of commercially available vehicle arresting systems known as the **Dragnet Vehicle Arresting Barrier (Dragnet) (VAB)** for over 18 years. The **Dragnet** technology is non-lethal and safely decelerates and stops a vehicle.

BACKGROUND

The **Dragnet** is derived from a system used to bring high-speed aircraft to a controlled stop with minimal damage. The system uses metal bending as a principle of energy absorption. The **Dragnet** has low inertia properties and can arrest vehicles by applying a constant force at all velocities.

The **Dragnet** Vehicle Arresting Barrier derived its name from the first commercial application of the product. This application was the stopping of a speeding drag racer when the braking parachute failed to deploy. The **Dragnet** concept has been in use for over thirty years and is now a well-established and thoroughly tested system.

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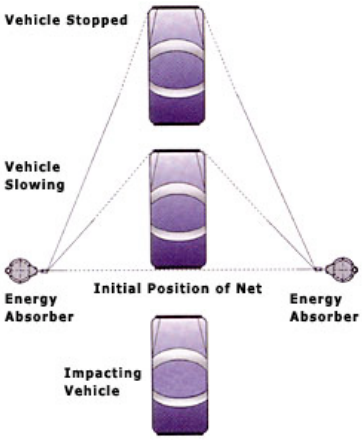
THE DESIGN PRINCIPLE

The **Dragnet** Vehicle Arresting Barrier uses a net assembly to span the roadway. The net has a continuous cable running through it near the top and bottom, the ends of which are attached to customized "energy absorbers," self-contained units housing spools of specially selected and lubricated steel alloy tapes. This tape is wound through a series of offset pins, contained in the energy absorber. When a vehicle hits the net assembly, the steel tape is pulled through the pins and out of the absorber; this bending of the tape creates sufficient drag to bring a vehicle to a safe stop.



The system requires as little as 4,500 pounds of force to activate the energy absorbers. The **Dragnet** can safely stop vehicles weighing up to 90,000 pounds and traveling at speeds exceeding 90 mph. Local conditions such as weather, slope, or impact angle are of little significance to the **Dragnet**.

GENERAL DESCRIPTION

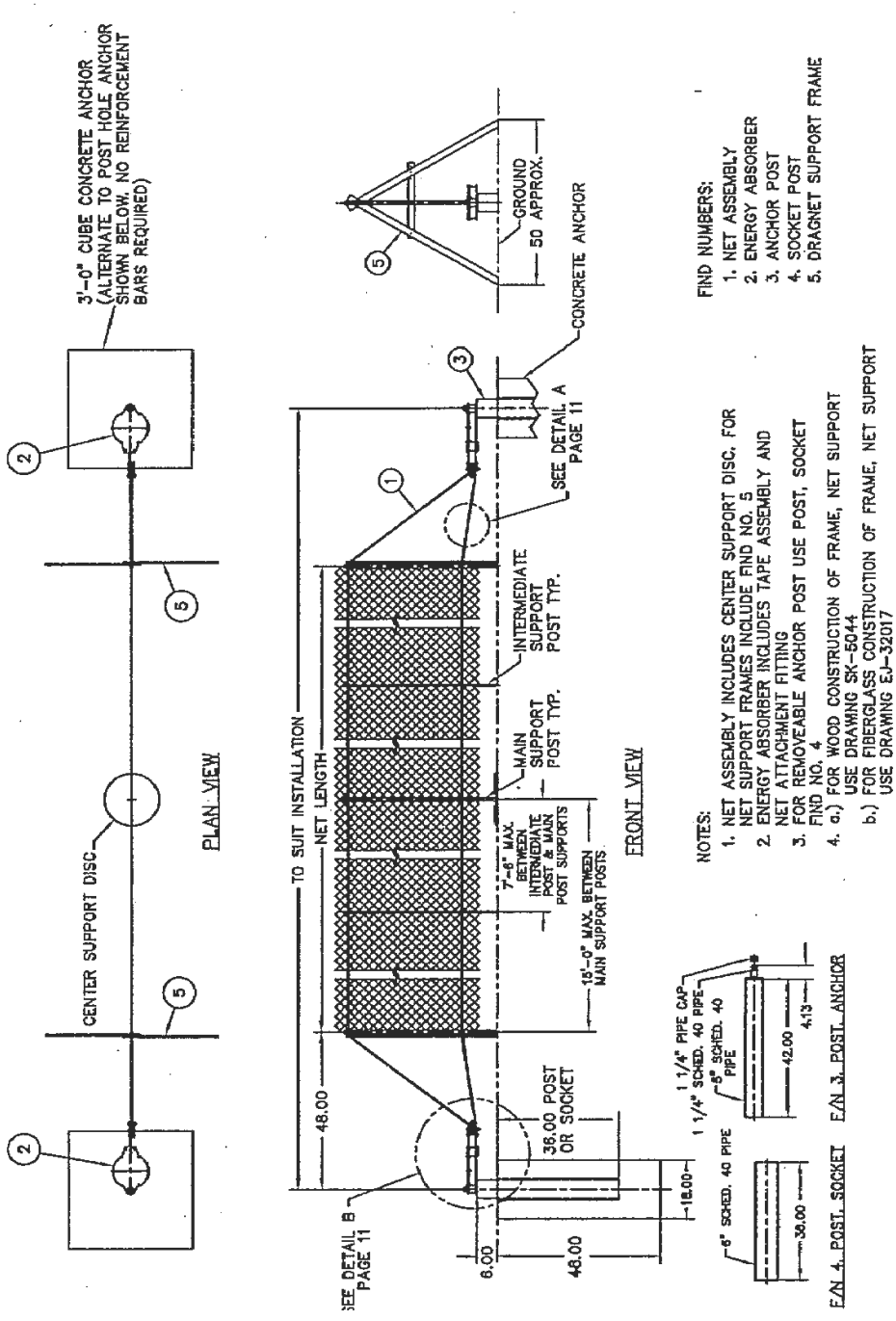
The **Dragnet** Vehicle Arresting Barrier has many applications. The simplest is our work zone protection system, primarily used to safely stop an 1,800- to 4,500-pound vehicle traveling at approximately 62 mph. A typical system comprises two (2) 4,500-pound, 75-foot energy absorbers, 1 chain link net, and 2 anchor posts and sleeves. System test performance satisfied the guidelines as presented in the National Cooperative Highway Research Program Report 350 (NCHRP 350). This system is used in road construction projects throughout the United States.

PRINCIPLES OF OPERATION

The system includes a net assembly attached at each end to an energy absorber, which is supported by anchor posts embedded into concrete footings. The nets are held across the road in a vertical position by support brackets positioned at each end.

Each energy absorber is a stainless steel chamber containing a 75-foot-long steel tape. When the barrier is struck, the steel tape is pulled from the energy absorbers over a series of five offset pins, imparting a restraining (bending) force to the steel tape, which in turn slows and stops the vehicles. The steel tape **MUST** be replaced after each vehicle impact.

DRAGNET ASSEMBLY – STANDARD CONFIGURATION



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INSTALLATION INSTRUCTIONS

Anchoring Options*

The standard **Dragnet** energy absorber has a pull force requirement of 4,500 lbs. and has a 75-foot tape. There are two absorbers in the system, and each requires an anchor. The anchor is typically a post-and-socket combination encased in a concrete block, but anchors can be attached to or enclosed within a concrete median barrier, or concrete or asphalt pavement, or any combination thereof, as long as each anchor exceeds the rated pull-out force of the energy absorber.

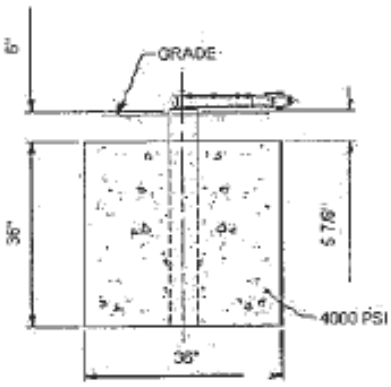
Important: Have the anchoring method approved by Cushion & Barrier, LLC, your authorized **Dragnet** distributor (or a certified Professional Engineer) prior to installation.

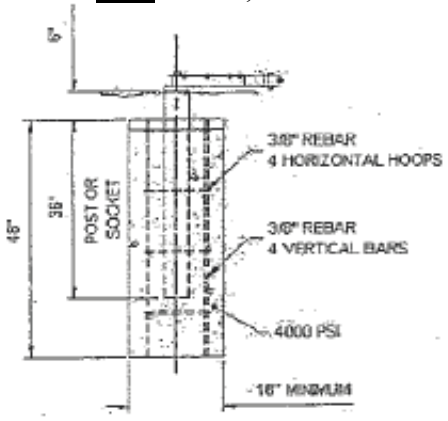
➢ **Post and Socket Installations**

There are three different applications for this anchor.
Please note: Use a safety device to protect errant vehicles from hitting the anchor.

- Concrete Block

The most common anchor shown here, is a 3-foot cube of unreinforced concrete in which a 6-inch diameter steel pipe is embedded with its top surface flush with the top of the concrete cube. Close the pipe at the bottom with a ¼-inch thick plate, thus forming a socket for a 5-inch diameter anchor pipe, which you slide into the socket. On top of the 5-inch pipe, which projects up from the flush concrete surface by 6 inches, install a 1-¼-inch pipe nipple weldment and mount the energy absorber on this. **Note:** Use 4,000 PSI concrete.





- Concrete Cylinder

As an alternate, you can use an 18-inch diameter cylinder of concrete, 4 feet deep, with four No. 6 reinforcing rods positioned around the socket pipe. Slide the 5-inch pipe into the socket.
Note: Use 4,000 PSI concrete.

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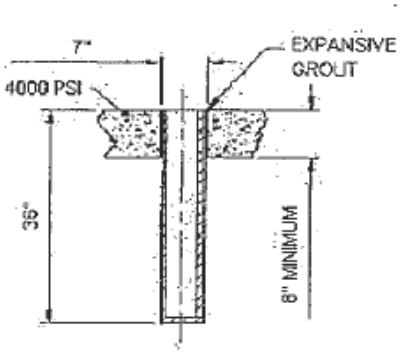
INSTALLATION INSTRUCTIONS



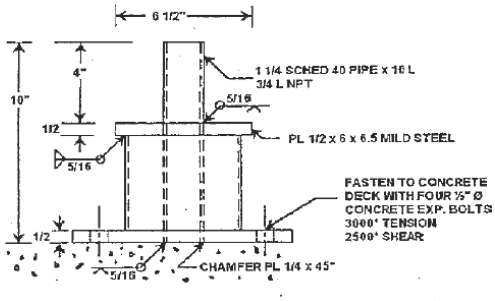
- Trough Concrete Slab

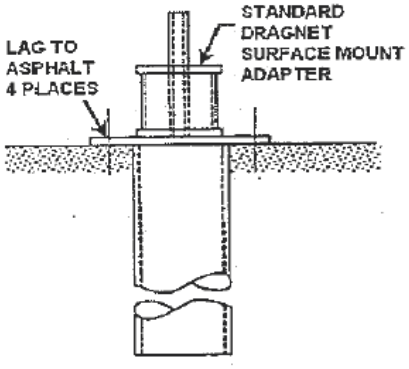
You can also install the post and socket on a paved 8-inch thick concrete surface. Core the concrete 7 inches in diameter to a depth of 3 feet. Drop the 6-inch diameter socket into the hole and fill the small space between the socket pipe and the core hole with expansion grout. Slide the 5-inch pipe into the socket. **Note:** Use 4,000 PSI concrete.

➢ Surface Mount Anchor

- Mount on Concrete

Bolt this anchor to a paved 8-inch thick concrete surface using a minimum of four standard ½-inch diameter concrete expansion bolts. If you use female expansion bolts, you can remove the surface mount weldment, leaving a perfectly flush paved surface.



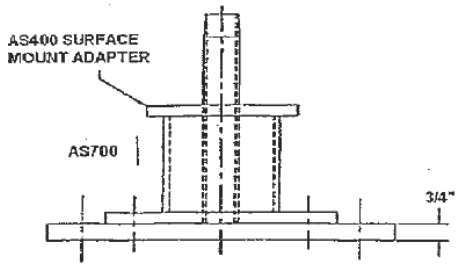


- Core Asphalt

You can use the standard surface mount adapter in combination with a surface plate and mounted to an asphalt surface. Core the asphalt and subgrade 7 inches in diameter, four feet deep. Drop into the hole a weldment consisting of a 6-inch diameter pipe and a 12 x 14-inch surface plate, then fill the gap with expansion grout. Drill and tap the surface plate so the standard surface mount adapter can then be bolted to the surface plate of the weldment. You can use 18-inch threaded roads to install the mount on asphalt.

- Mount on Asphalt

Alternately, you can mount the standard surface mount to the asphalt surface using a ¾-inch 12 x 15-inch steel plate lagged to the asphalt surface with eight 18-inch threaded rods. Drill and tap the plate to install the standard surface mount adapter.



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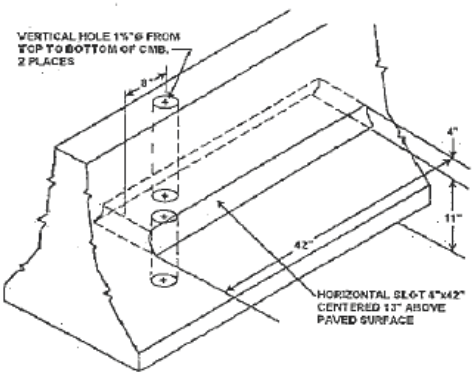
INSTALLATION INSTRUCTIONS

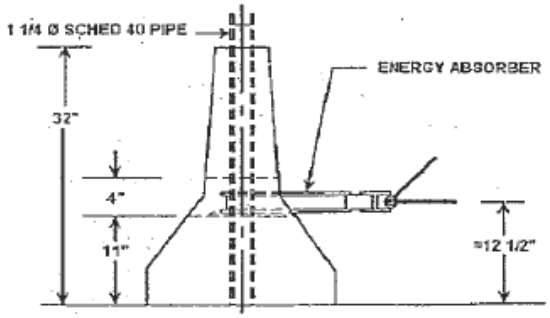
- **Dragnet Anchor to Concrete Median Barrier (CMB)**

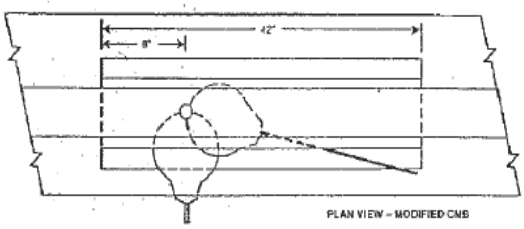
  There are two methods of anchoring the energy absorbers to a concrete median barrier, an internal mount and an external mount.

  - Internal Mount

    Modify the concrete median barrier (CMB) to include a longitudinal slot, 4 inches in height and 42 inches long. Center this slot about 13 inches above the paved surface. Provide a vertical hole in the CMB, 1¾ inches in diameter, for a 1¼ inch pipe to secure the energy absorber.



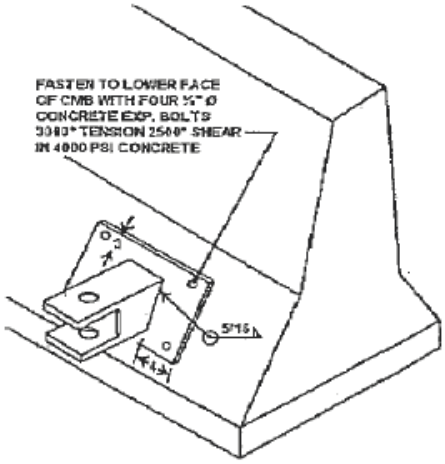




  - External Mount

    Bolt a specially constructed weldment to the exterior face of the CMB. Drill holes for the CMB mounting anchors using a ½-inch diameter bit. Drill the holes 4 inches deep. Embed the anchor to a depth of 3½ inches. Torque to 75 ft-lbs, dry. The energy absorbers fit neatly between the horizontal flanges of the weldment. Secure them by short pipe nipples with pipe caps on either end.

    Note: The concrete median barrier (CMB) should be constructed of 4,000 PSI concrete and anchored to the road surface.



*Anchors used with concrete barrier wall or concrete slabs must be secured with Hilti mechanical expansion anchors, coil anchors or chemical anchors. All anchors are to be torqued to 124 ft. lbs. with Hilti RE-500 Series epoxy.

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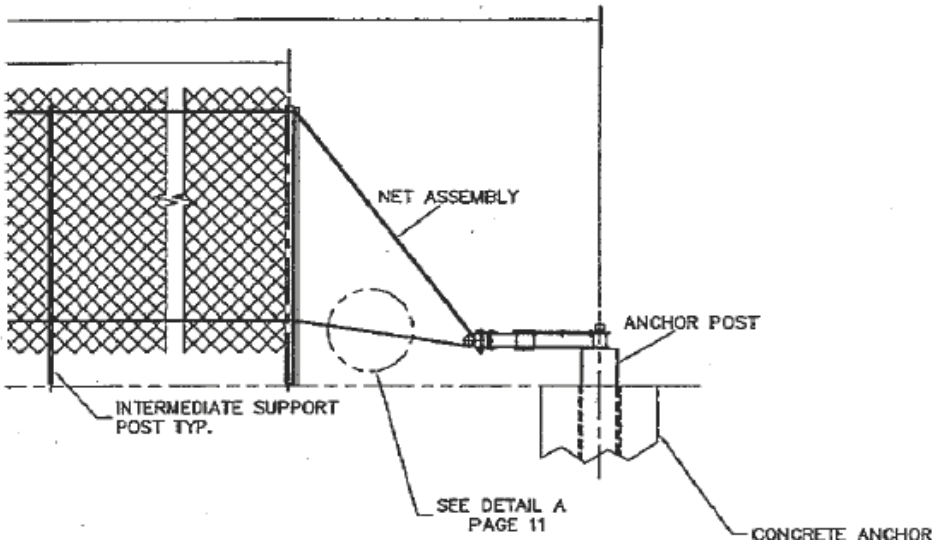
INSTALLATION INSTRUCTIONS

Energy Absorber Installation



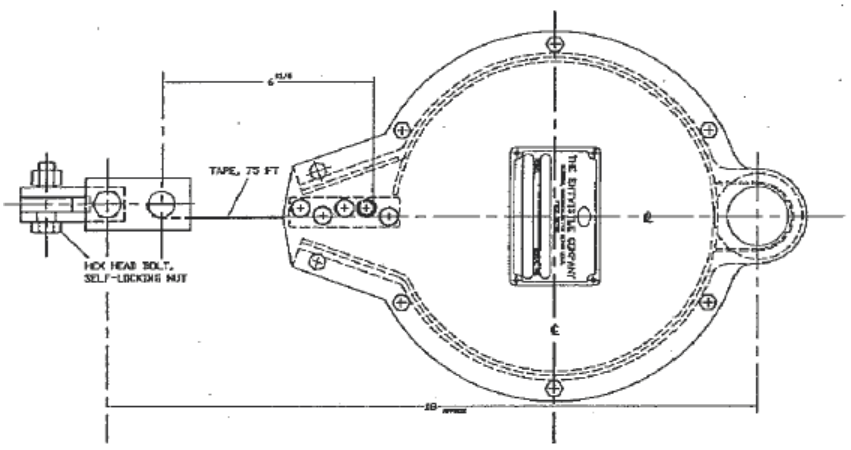
- To install the energy absorber on the concrete block, concrete cylinder, trough concrete slab, or surface mount anchoring systems:

1. Unscrew the pipe cap from the 1.25-inch pipe nipple.

2. Place the energy absorber on the pipe, fitting the 1.75-inch hole in the energy absorber chamber over the 1.25-inch pipe.

3. Screw the pipe cap to the nipple.

Note: Install all energy absorbers parallel to the ground.



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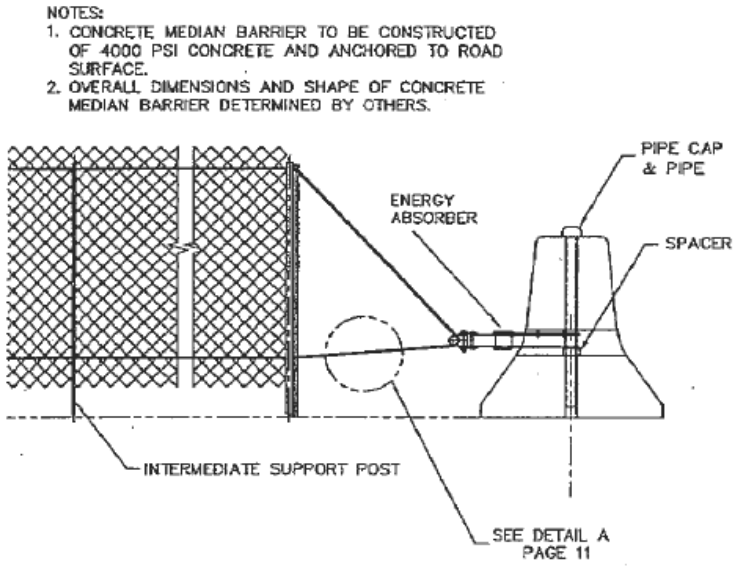
INSTALLATION INSTRUCTIONS

Energy Absorber Installation



- To install the energy absorber on the modified CMB anchor:

1. Connect the pipe cap to the top of the pipe.

2. Insert the energy absorber into the slot of the concrete median barrier with the spacer underneath.

3. Line up the spacer and the energy absorber mounting hole with the hole in the top of the concrete barrier.

4. Insert the pipe with the cap through the holes in the concrete barrier, energy absorber, and spacer.

Note: Install all energy absorbers parallel to the ground.

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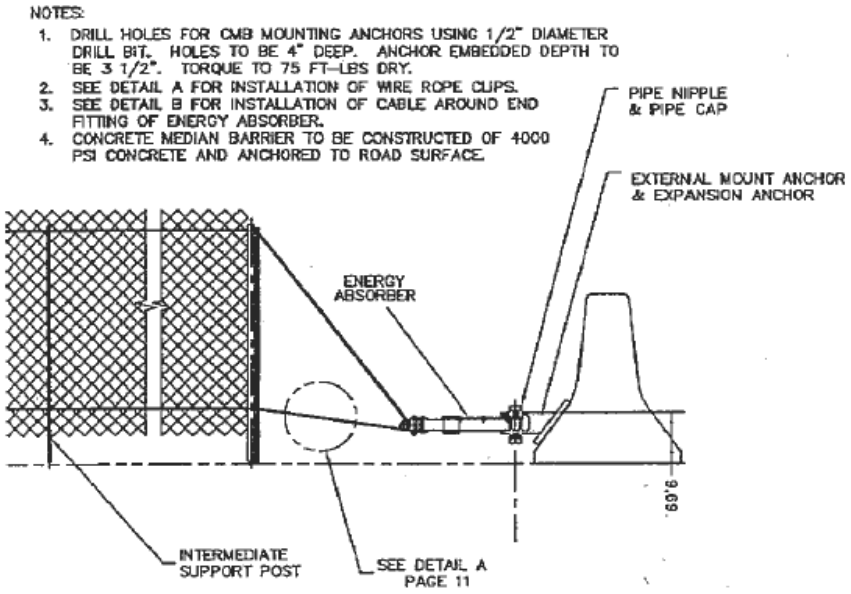
INSTALLATION INSTRUCTIONS

Energy Absorber Installation



- To install the energy absorber on the external CMB mount:

1. Unscrew the pipe caps on the pipe nipple.
2. Line up the energy absorber with the holes in the flanges of the CMB external mount anchor.
3. Insert the pipe nipple into and through the holes of the CMB anchor.
4. Screw the pipe cap onto the top of the nipple.
5. Screw the pipe cap onto the bottom of the nipple.

Note: Install all energy absorbers parallel to the ground.

➢ Asphalt Foundations

The **Dragnet** Surface Mount Anchor may be installed on any of the following foundations using the specified anchorage:

- **Foundation A: Concrete Pad or Roadway**
  Foundation: 150 mm [6”] minimum depth Portland Cement Concrete (P.C.C.)
  Anchorage: MP-3 with 180 mm [7”] studs, 140 mm [5.5”] embedment

- **Foundation B: Asphalt over P.C.C.**
  Foundation: 75 mm [3”] minimum Asphalt Concrete (A.C.) over 75 mm [3”] minimum (P.C.C.)
  Anchorage: MP-3 with 460 mm [18”] studs, 420 mm [16.5”] embedment

- **Foundation C: Asphalt over Subbase**
  Foundation: 150 mm [6”] minimum (A.C.) over 150 mm [6”] minimum Compacted Subbase (C.S.)
  Anchorage: MP-3 with 460 mm [18”] studs, 420 mm [16.5”] embedment

- **Foundation D: Asphalt Only**
  Foundation: 200 mm [8”] minimum (A.C.)
  Anchorage: MP-3 with 460 mm [18”] studs, 420 mm [16.5”] embedment

- **Foundation Specifications for Foundations A, B, C & D Mentioned Above**
  A.C. (Asphalt Concrete) AR-4000 A.C.
  (per ASTM D3381 ‘83) .75” Maximum, Medium (Type A or B) aggregate

Sieve Size	Operating Range (%) Passing
1”	100
3/4”	95-100
3/8”	65-80
No. 4	49-54
No. 8	36-40
No. 30	18-21
No. 200	3-8

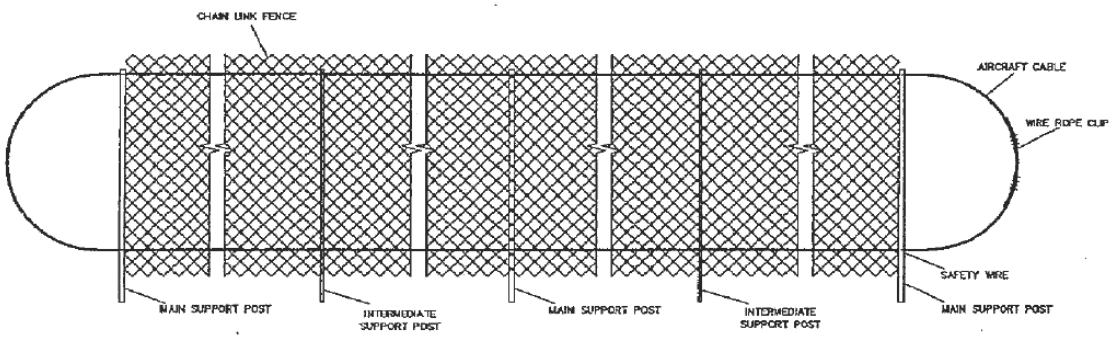
- **P.C.C. (Portland Cement Concrete)**
  Stone aggregate concrete mix, 4000psi minimum compressive strength
  (Sampling per ASTM C31-84 or ASTM C42-84a, testing per ASTM C39-84)

- **C.S. (Compacted Subbase)**
  150 mm [6”] minimum depth 95% compaction , Class 2 aggregate

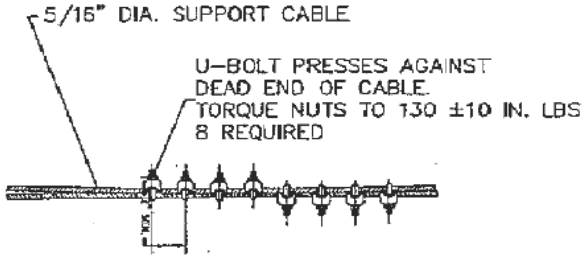
Sieve Size	Moving Average (%) Passing
3”	100
2-1/2”	90-100
No. 4	40-90
No. 200	0-25

Net Assembly

1. Lay net flat.
   Unroll the net assembly across the road, laying it flat on the ground with each end next to an energy absorber tape end.

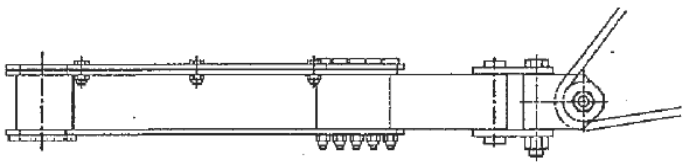


2. Install cable.
   Loosen all the cable clamps forming the cable loop.
   Remove the bushing from the tape end and pass the cable behind it and reinstall. (Detail A)



DETAIL A

Remove the roller from the tape end, pass the cable behind it, and reinstall the roller with the cable captured between the plates of the tape end fitting. (Detail B)



AT INSTALLATION —

1. REMOVE BUSHING FROM NET ATTACHMENT FITTING AND INSTALL NET CABLE AROUND BUSHING AS SHOWN IN DETAIL B. REINSTALL BUSHING ON ENERGY ABSORBER.
2. AFTER NET CABLES HAVE BEEN INSTALLED ON BOTH NET ATTACHMENT FITTINGS, LOOSEN CABLE CLAMPS AND ADJUST CABLE LENGTH. AFTER CABLE LENGTH HAS BEEN ADJUSTED FOR INSTALLATION TIGHTEN CABLE CLAMPS AS SHOWN IN DETAIL A

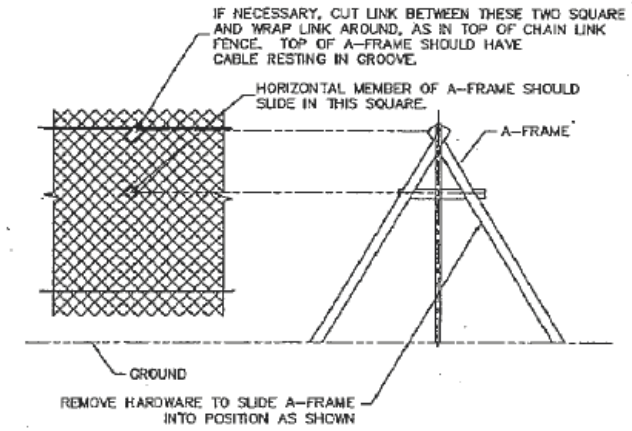
DETAIL B

Net Assembly

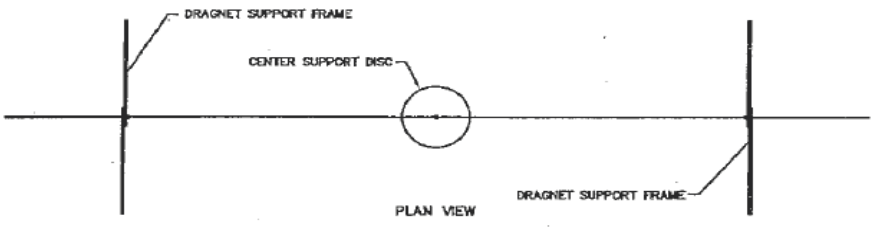
3. Tension cable.
   With both ends of the net attached to the energy absorbers, and with the net still flat on the ground, apply tension to each end of the cable using vise grips. When the cable is snug, but not taut, tighten one or two of the U-bolt clamps.

4. Test cable tension.
   With one person at each end of the net, rotate it to the vertical position and test the tension. If the net can not be easily brought to the vertical, there is too much tension in the cable. If the vertical net sags out of the vertical plane, there is not enough tension. Adjust the tension until the net can be rotated to vertical without any noticeable sag in the center. Then tighten all the cable clamps, applying 130 inch-lbs to each nut. Make sure to apply cable clamps as shown in Detail A on the previous page.

5. Install A-frames.
   With the next in the vertical position, install the A-frames under the top cord of the cable at each end, as shown below, holding the net erect.



6. Install wooden discs.
   Install the round wooden discs with the dowel rod projections into each post.



7. Make final check.
   Check tightness of all fasteners. The system is now ready for use.

SCHEDULED MAINTENANCE

Weekly Inspection

The purpose of this inspection is to spot any unusual conditions that would prevent the system from functioning as designed. For the energy absorbers, these conditions include pulled out tapes. For the net, these conditions include loose fasteners, cable damage, corrosion, vandalism, etc.

Check the barrier net for proper tension and proper height. The barrier net should be perpendicular to the roadway within 30 degrees.

Check for any buildup of trash or dirt around the energy absorbers that could interfere with proper operation.

Yearly Inspection

Open the energy absorber housing and inspect for severe corrosion. Excessive corrosion means you must replace the tape. Excessive white milky substance on the tape or areas of rust larger than the size of a quarter is cause for replacement of the tape.

REFITTING AFTER VEHICLE IMPACT

The **Dragnet** System is designed with few moving parts and can usually be repaired after impact in less than one hour. Following an arrestment, the system can be quickly returned to service by replacing the net assembly, if damaged (see "Net Assembly"), and the steel tapes inside the energy absorbers.

To remove the barrier net and energy absorbers:

1. Remove the net from the energy absorber by removing the ½-13 bolt and nut at each end of the net with an open-end or box wrench.

2. Remove the pipe from the concrete or asphalt.

3. Lift the energy absorbers out of their slots.

The energy absorbers then need to have new replacement tapes installed in their chambers.

REFITTING AFTER VEHICLE IMPACT

To replace the energy absorber tape:

1. Remove the five 5/16-18 lock nuts from the bottom of the energy absorber and lift the five shoulder bolts from the top of the cover.

2. Remove the fourteen ¼-20 hex-head screws and lock nuts from the energy absorber cover. Lift the cover from the chamber. Remove the expended tape.

3. Remove the single ½-13 bolt and lock nut from the net fitting and save parts for re-use. Discard the expended tape.

CAUTION!
Energy absorber tapes are specially lubricated. Store only in a clean, dirt free, dry environment to ensure proper operation.

4. Install the replacement tape **exactly** as shown in the figure on the next page, in order to provide the designed restraining capability. Note carefully the position of the shoulder bolt holes and the preformed tape-end configuration. Replace the five shoulder bolts and lock nuts (do not tighten at this time) and reinstall the fourteen ¼-20 screws and lock nuts. Replace the salvaged ½-13 bolt, busing and lock nut from the expended tape. Tighten all bolts. Replacement is now complete.

If you have any questions regarding the installation of the tape, call Cushion & Barrier, LLC prior to placing in service.

CAUTION!
The energy absorbers and barrier net described above are part of a highly loaded system, designed to safely stop out-of-control cars and trucks. In order for this system to operate properly, each part must have the form, fit, function, and reliability that was designed and specified by the manufacturer. Replacement parts should always be obtained from the original supplier of this equipment to assure proper operation. Common hardware items procured locally may look the same as those being replaced, but may not perform properly when subject to the loads imposed on the system.

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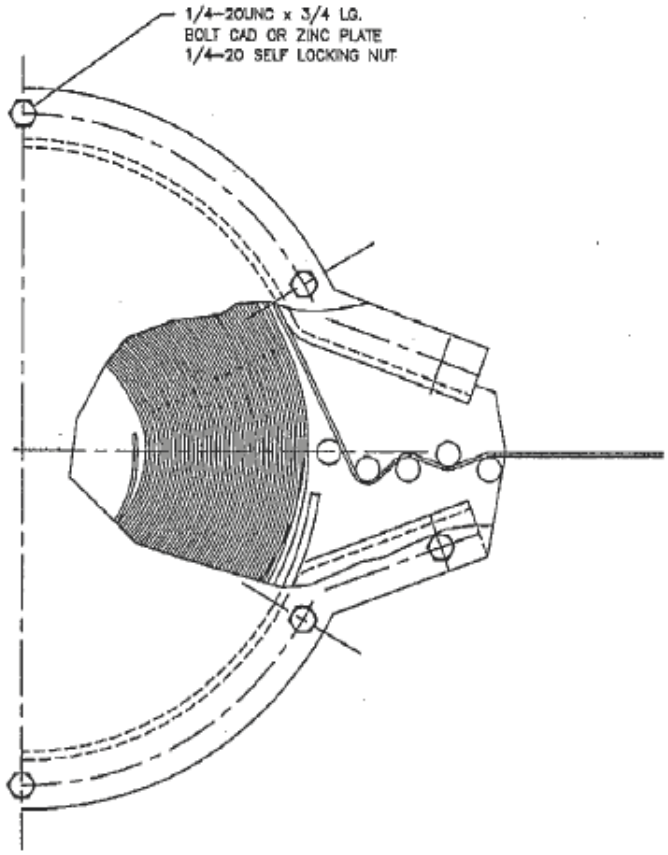

TAPE REPLACEMENT PROCEDURE

1. Remove cover.
2. Discard used tape.
3. Place replacement tape into chamber.
4. Place cover on top and position with (2) ¼-20 bolts.
5. While looking through the first pin hole (pin closest to center of chamber) pull on tape fitting until tape is positioned as shown in diagram. (This step may take (2) people).
6. Slide pin through hole and fasten self locking nut.
7. Assemble the last (4) pins and fasten self locking nut.
8. Secure cover by assembling the remaining ¼-20 bolts and nuts.

WARNING!
PROPER ALIGNMENT OF TAPE THROUGH PINS IS CRITICAL!

LIMITATIONS AND WARNINGS

The **Dragnet** has been tested and evaluated per the recommendations of the National Cooperative Highway Research Program Report (NCHRP) 350 Guidelines* for Test Level 3 (TL-3) Tests 30 and 31. The impact conditions recommended in this guideline are intended to encompass the majority but not all of the possible in-service collisions.

Refer to the Maintenance section of this manual for components needing replacement after partial impacts to ensure the energy absorbing capacity of the system has not been adversely impaired.

Properly installed and maintained, the **Dragnet** is capable of performing its function of stopping and containing the test vehicles in a predictable and safe manner under the nominal NCHRP 350 TL-3 impact conditions of:

Vehicles:	Small car and Pick-up
Mass:	820 and 2000 kg (1810 and 4410 lbs)
Speed:	100 km/h (62 mph)
Angle:	Up to 30 degrees

Impact conditions that differ from those described in NCHRP 350 may result in different crash results than those encountered in testing. Furthermore, impacts in excess of TL-3 impact severity, or the existence (at the site of the installation) of curbs or cross slopes in excess of 8% may yield crash performance which does not meet NCHRP 350 evaluation criteria relative to structural adequacy, occupant risk and vehicle trajectory factors.

*Published reports of the National Cooperative Highway Research Program may be obtained from:

Transportation Research Board
National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Manufactured & Distributed By:

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