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## ENGINEERING INSTRUCTION

NEW YORK STATE DEPARTMENT OF TRANSPORTATION

SUBJECT: VEHICLE ARRESTING BARRIER  
(NET TYPE)

Subject Code: 727-1-619

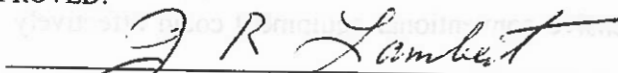
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This Engineering Instruction transmits usage guidelines, Standard Sheet 619-6, and a specification for a Vehicle Arresting Barrier (Net Type) item 15619.999801. These barriers have proven effective in restraining vehicles ranging in weight from motorcycles to 40,000 pound trucks. Once a vehicle is caught in the net, it is safely brought to a full stop, even from highway speed, by releasing the restraining cables on the net at a predetermined resistance. The deceleration rate and final distance traveled before coming to a full stop can be determined from the manufacturer's design formulas accompanying this instruction and should be shown on the plans.

The vehicle arresting barrier (VAB) is approved by the FHWA for use on Federal aid projects.

### USAGE GUIDELINES

A VAB (net type) may be considered for use if one or more of the following situations exist:

1. Where vehicle encroachment into the work area would result in a probable injury to either workers or vehicle occupants. The most obvious example is bridge removal and replacement projects at the bottom of long downgrades where motorists are more likely to lose control of their vehicles.
2. Where vehicle encroachment into the work area would be at high speed, usually not requiring any turning movements to enter the work area. The most obvious example of this situation is a full closure of a high volume expressway, where contractor operations extend over a long period of time, but the roadway must be reopened daily to traffic.
3. Where past accident and operational history indicates that conventional equipment such as Type III barricades, temporary concrete barrier, safety fences, etc. are unable to prevent errant vehicles from entering the work area or are otherwise unsuitable for a particular site.
4. For off-peak or night work where roadway is closed intermittently over a period of days or weeks. (Can be assembled or disassembled, once the concrete anchors are installed, in just 15 minutes).
5. Where vehicles must be brought to a full stop. This system has the potential to accommodate vehicles ranging in weight from motorcycles to a 40,000 lbs. truck. Both can be stopped with relatively low G force.

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A VAB should NOT be used for the following situations.

1. For single lane closure of multilane roadways.
2. Where workers will not be available to periodically check the condition of the various components.
3. Where less costly and less maintenance intensive conventional equipment could effectively be utilized without sacrificing safety.

After the decision has been made to use a VAB, it should always be used in conjunction with Type III barricades, plastic drums, adequate signing, etc. to alert motorists of roadway closure. In addition, the anchor posts should be shielded from impact, possibly by ramping soil up to 2" of the post height, and provisions should be made for performing repairs as quickly as possible. (The specification requires spare parts to be readily available).

The disadvantages of a VAB (net type) are as follows:

1. The units are subject to vandalism or theft.
2. After each impact, maintenance is required which consists of:
  - A. Minor Impact - replace tape assembly.
  - B. Severe Impact - replace most components.
3. The Contractor must be notified quickly for maintenance after each impact since the system has no second hit capability. A battery powered electronic device to notify the contractor in the event of an impact or vandalism is available from the supplier at a cost of approximately three hundred dollars.

The average bid price for each VAB, from Region 10 bidding experience in 1990, was about \$7000 for systems that included 4500 lb. energy absorbers and 75 feet of tape. This price included the purchase (list price = \$5000 in 1990 and \$6500 in 1992), initial installation, and all subsequent removals and installations at the same site. Spare parts cost the Contractor approximately \$1200 a set. Unused sets of spare parts can be returned to the supplier for a \$900 refund. Estimated prices should be adjusted by the designer to consider inflation, quantity used in the contract, and the number of times the Contractor is expected to install and remove the net. A similar system that uses 200 feet of tape instead of 75 feet cost the Contractor \$9000 in 1992.

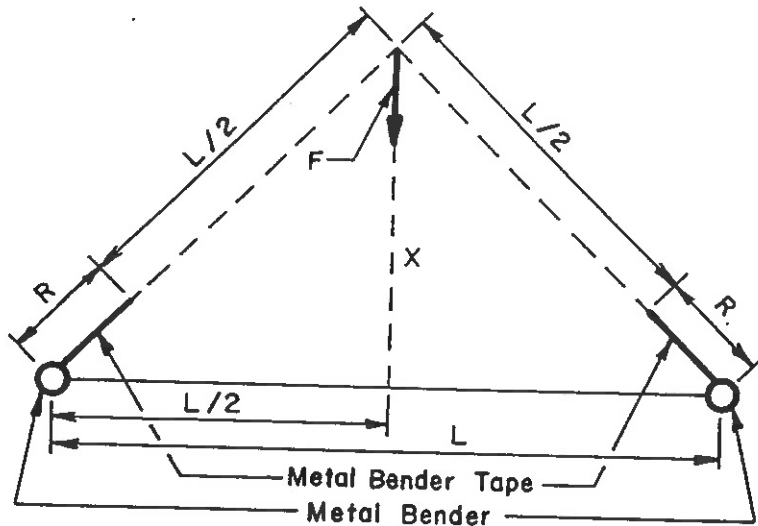
This specification for vehicle arresting barrier (net type) will be available for general use starting with the 11 / 12 /92 letting, and the justification procedures for proprietary items need not be followed since the FHWA found it in the public interest to approve this device when used according to the guidelines stated in this instruction. Any questions concerning the use of this device should be addressed to Richard Stempel at 518-457-4093.

### DESIGN COMPUTATIONS FOR VEHICLE ARRESTING BARRIER

- L = length of net (metal bender to metal bender), feet
- X = travel distance of vehicle after engaging net, feet
- W = weight of vehicle, lbs. (assume 1800 lbs. & 4500 lbs.)
- V = initial velocity of vehicle, ft/sec. (assume 88 ft/sec)
- T = metal bender (energy absorber) tape tension force, lbs. (see available energy absorbers below).
- g = acceleration due to gravity, 32.2 ft/sec.
- F = maximum vehicle stopping force, lbs.
- G<sub>max</sub> = maximum G force on vehicle
- G<sub>avg</sub> = average G force on vehicle
- R = run-out of metal bender (energy absorber) tape, ft. (See available energy absorbers below).

The following manufacturer's design formulas should be computed in the order shown to obtain the travel distance (X) after engaging net, and the deceleration rate (G<sub>avg</sub>) for the system chosen:

- 1)  $R = \frac{WV^2}{4Tg}$
- 2)  $X = \sqrt{R^2 + RL}$
- 3)  $F = \frac{2TX}{R + (L/2)}$
- 4)  $G_{max} = F/W$
- 5)  $G_{avg} = \frac{V^2}{2gX}$



AVAILABLE ENERGY ABSORBERS		
Tension (T)	Run-Out Tape (R)	Usual Guide
4500 Lbs.	75 Feet	Usual Case, Average Vehicle Mix
4500 Lbs.	200 Feet	High percentage of Heavy Trucks

Deceleration rates (G<sub>avg</sub>) should be limited to 3 to 6 G's, when feasible, but in no case should the deceleration rate exceed 10 G's.

**ITEM 15619.999801 VEHICLE ARRESTING BARRIER (NET TYPE)**

**DESCRIPTION.** This item shall consist of furnishing, installing, removing and reinstalling as often as necessary, maintaining and finally removing vehicle arresting barriers (net type) of the size and at the locations shown on the plans or where directed by the Engineer.

**MATERIALS.** Materials shall meet the requirements of the following: Portland Cement Concrete used for bases shall be Class A or C, conforming to the requirements of Section 501, Portland Cement Concrete - General, except that requirements for automated batching shall not apply.

The vehicle arresting barrier (VAB), including energy absorber, fence fabric, support cable, arresting tape, support posts, and anchorage post with tubing shall be fabricated by Roadway Safety Service, 700-3 Union Parkway, Ronkonkoma, N. Y. 11779 (tel.516 588-6200).

**CONSTRUCTION DETAILS.** The VAB shall be installed in accordance with the manufacturer's specifications to form a barrier as shown on the plans and to the satisfaction and approval of the Engineer as often as necessary.

The deceleration distance behind the VAB shall be kept clear of parked vehicles or stored materials at all times. This distance will be shown on the plans.

The VAB, except anchorages, shall be dismantled and removed prior to reopening the road to traffic.

The Contractor shall provide for periodic surveillance of each VAB as shown in the contract documents or as directed by the Engineer. The surveillance shall be by the work crew or by electronic device.

All repairs shall be made and replacement parts furnished by the Contractor. In the event of damage, the entire device shall be restored within 4 hours after notification. No work may be progressed in an unprotected area, and the hazard shall be eliminated or minimized, until restorations have been completed. Therefore, the Contractor shall have at least (S) complete sets of spare parts from the original supplier readily available based on the number (N) of VAB's in the contract, according to the following formula:

$$S = 1 + (N/5) \text{ rounded to the nearest whole number}$$

After the last day of use, the VAB shall be removed from the work site and all areas disturbed by the installation and removal of the anchorage shall be restored with material shown on the plans or to match the surrounding area as ordered by the Engineer.

**METHOD OF MEASUREMENT.** VAB's will be measured by the actual number of locations that VAB's are installed in accordance with the plans and these specifications. If a VAB is reused at a different location, it will be measured for payment, but reinstallation at the same location will not be measured for payment.

**ITEM 15619.999801 VEHICLE ARRESTING BARRIER (NET TYPE)**

**BASIS OF PAYMENT.** The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to complete the work, and shall include the cost of all surveillance, maintenance, spare parts, storage, reassembly as often as necessary, final dismantling and removal of the barrier, and restoration of disturbed areas for the installation and removal of the anchorage.

Payment will be made at the unit price bid for each barrier as follows:

Seventy five (75) percent when the barrier is first installed at each location.

The remaining twenty five (25) percent when the barrier is removed from each location for the last time and the site is restored.

Additional payment shall be made to the Contractor for labor, materials, equipment, overhead and profit to repair each VAB in the contract that was damaged by public traffic accident, less any amounts recovered by the Contractor from the responsible party. The payment shall be an agreed price or by means of force account, computed as indicated in §109-05 Extra and Force Account Work, and shall be paid only after the Contractor has demonstrated reasonable effort to collect the repair costs from the responsible party.