U.S. Department
of Transportation

**Federal Highway
Administration**

400 Seventh St., S.W.
Washington, D.C. 20590

NOV 27 1992

Refer to: HNG-14

NOV 27 1992

J. M. Essex, P.E.
Vice President, Sales
Energy Absorption Systems, Inc.
One East Wacker Drive
Chicago, Illinois 60601

Dear Mr. Essex:

This is in response to your November 5 letter requesting that the Federal Highway Administration (FHWA) issue a letter of acceptance for your company's "Triton" water filled barrier. On that date you met with representatives from the FHWA's Office of Research, Office of Engineering, and Office of Safety and Technology Applications to introduce the barrier and show crash test films. You also provided a November 1992 report of the crash testing you conducted and attested to by William H. Kimball, an independent professional engineer.

The Triton barrier consists of 1981-mm long by 813-mm high by 533-mm wide (78-inch by 32.25-inch by 21.5-inch) segments of lightweight polyethylene plastic shells designed to accept water ballast. The plastic barrier shell is supplemented by an internal steel framework to provide additional rigidity during handling and impacts. There is also a cable along the top connecting the joints between barrier segments. This cable provides the barrier's tensile capacity during impacts. The barrier is molded in a shape that interacts with an impacting vehicle to reduce its roll, pitch, and yaw.

The tests were conducted to assess the compliance of the Triton barrier to test level 2 of the National Cooperative Highway Research Program (NCHRP) Report 350, "Recommended Procedures for the Safety Evaluation of Highway Features." Although the NCHRP 350 is not yet published, we accept its use as the guideline for crash testing because of the nature of the device in question. The current guide, NCHRP 230, does not provide test conditions for devices only for temporary use in low speed work zones. Test level 2 of NCHRP 350 is a matrix of tests using a small passenger car and a pickup truck at impact speeds of 70 km/h (43.5 mph). The results of the test level 2 test covered in the report you provided are summarized below:

Test Number	147-043	147-044
Vehicle Mass, kg (wt., lbs.)	1970.5 (4345)	807.3 (1780)
Impact Speed, km/h (mph)	72.3 (44.9)	72.0 (44.7)
Angle, Degrees	25	20

Occupant Risk Values

Impact Velocity, m/s (fps)		
x-direction (longitudinal)	5.8 (19.0)	6.6 (21.7)
y-direction (lateral)	1.9 (6.2)	3.2 (10.5)
Ridedown Acceleration, g's		
x-direction	-3.7	-6.6
y-direction	-2.8	-4.1
Test Article Deflection, m (ft)	3.9 (12.8)	1.0 (3.3)

In both tests, the vehicle came to rest against the barrier so there was no exit angle or speed.

These results meet the change in velocity, occupant risk, and redirection guidelines of NCHRP 350. As these guidelines contain the current consensus advice on testing and evaluating highway features and because they are likely to be formally recognized by the FHWA, the Triton water filled barrier described above is acceptable for use on Federal-aid highway projects, within the range of conditions tested, if proposed by a State.

It is very important to note the speed range limitations and deflection requirements of this barrier. We appreciate that you have been very explicit in proposing uses for this barrier at speeds of approximately 70 km/h or less. We wish to reiterate that this barrier should only be used where operating speed is not expected to significantly exceed the tested 72.3 km/h (45 mph). For example, the Triton barrier may not be appropriate for temporary traffic control zones on highways normally posted at 55 mph but having a temporary posted speed of 45 mph. In most locations of this type, the operating speed would remain at or above 55 mph, obviously exceeding the design speed of the Triton barrier. With regard to deflection, it will be essential that the deflection requirements of the barrier be considered in determining its applicability to a specific site.

Presumably, you will supply potential users with sufficient information on structural design and installation requirements to ensure proper performance. We anticipate that the States will require certification from Energy Absorption Inc., that the Triton barrier segments furnished will have essentially the same composition, mechanical properties, and geometry as those used in the tested barrier.

Usually the choice of work zone traffic control devices is the prerogative of the contractor, within limits established by the State. However, the Triton water filled barrier is proprietary. Thus, if specified by a State for use on a Federal-aid highway project, (a) it must be supplied through competitive bidding with equally suitable unpatented items; (b) the State highway agency must certify that it is essential for synchronization with existing highway

facilities or that no equally suitable alternative exists; or (c) it must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411, a copy of which is enclosed.

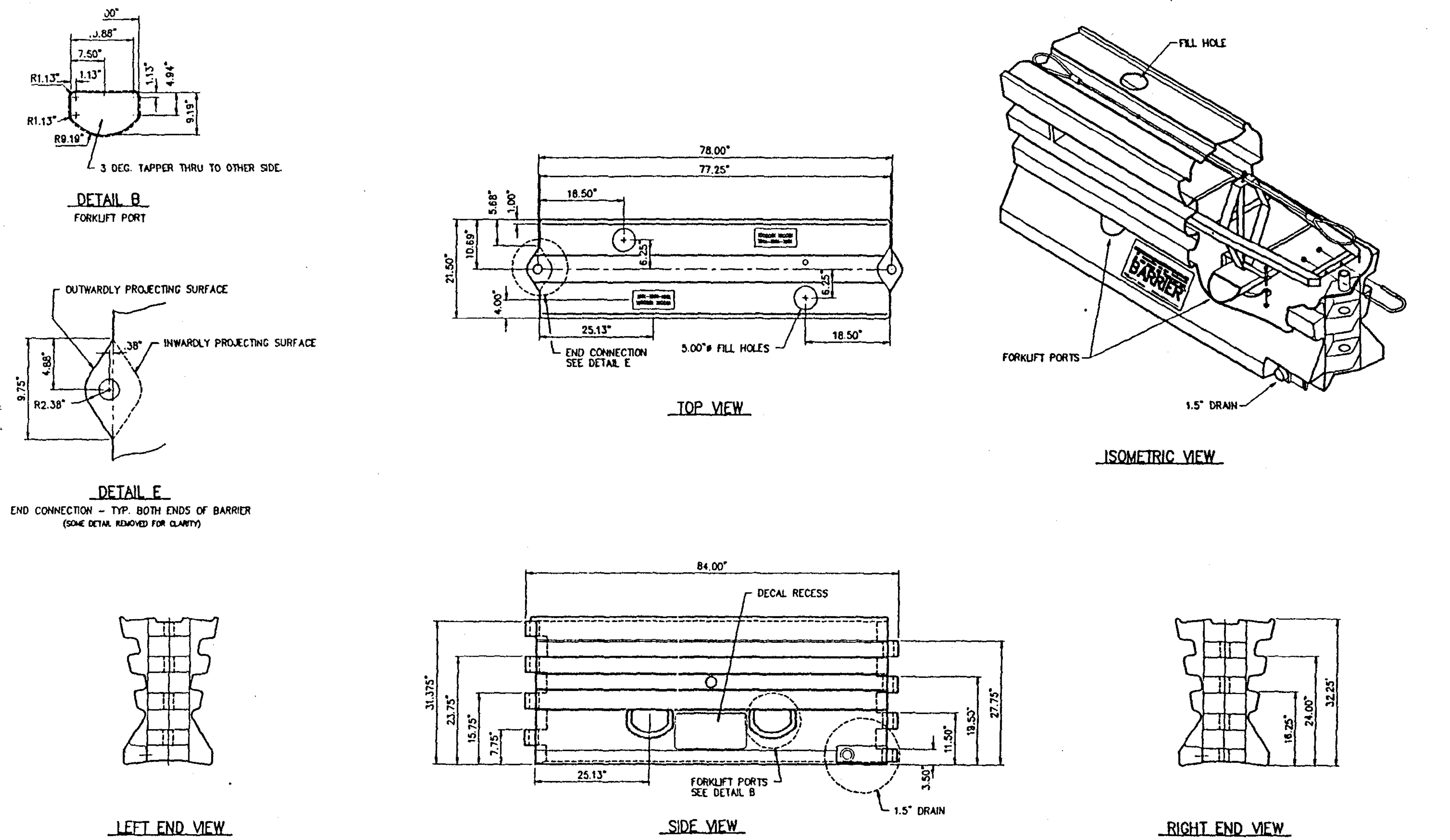
By copy of this letter we are informing the FHWA field offices of this action.

Sincerely yours,

L. A. Staron

Lawrence A. Staron
Chief, Federal-Aid and Design Division

Enclosure



NOTE:

1 RADIUS ALL CORNERS, 0.75" R, EXCEPT WHERE NOTED.

2 DIMENSIONS SHOWN ARE APPROXIMATIONS AND MAY VARY DUE TO SHRINKAGE AFTER MOLDING.

Revisions	Date	Rev.	By	Ckd.	App.

DESIGN SPEED		M.P.H.
AVERAGE G's		
EST. FORCE ON BACKUP STRUCTURE		KIPS
Designed		Date
Drawn	D L Staus	11/13/92
Checked	K. Martinsen	11/13/92
Approved	J.F. LaTurner	11/13/92

REFERENCES

Project No. ________ Sales Order No. ________

Serial No. ________ Color ________

ENERGY ABSORPTION SYSTEMS, INC.

ENGINEERING AND RESEARCH DEPARTMENT

TRITON BARRIER

MOLDED PART

SCALE	SIZE	DWG NUMBER	SHEET	REV
(1/16) 3/4"=1'-0"	C	27-95-04R		

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of Transportation

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JAN 7 1994

400 Seventh St., S.W.
Washington, D.C. 20590

Refer to: HNG-14

J. M. Essex, P.E.
Vice President, Sales
Energy Absorption Systems, Inc.
One East Wacker Drive
Chicago, Illinois 60601

Dear Mr. Essex:

Your December 14, 1993, letter requested the Federal Highway Administration's (FHWA) acceptance of the TRITON Barrier as the barrier's own end treatment. Details of the design and crash tests results were included in your "TRITON Barrier End Treatment Crash Test Report" dated December 1993.

Our review of the crash test data indicated that you successfully completed the tests required for a non-redirective crash cushion for Test Level 2 conditions. These tests are summarized as follows:

NCHRP 350 Test Number	Vehicle Mass (kg)	Impact Speed (km/h)	Impact Angle (degree)	Occ. Imp. Velocity (m/s)	Ridedown Acceleration (g's)
2-40	820	70	0	9.4	-5.9
2-41	2000	70	0	6.3	-7.8
2-42	820	70	15	8.3	-3.6
2-43	2000	70	15	5.7	-6.6
2-44	2000	70	20	6.6	-7.1

Based on the above results, we consider the TRITON barrier end treatment to be an acceptable terminal for the TRITON barrier itself, provided the end, or first section, contains no water and the retaining pin is left out of the exposed end. Under the stated Test Level 2 conditions, the barrier length of need begins at the sixth segment from the end.

This acceptance is given with the understanding that the TRITON end treatment is applicable for use only on the end of a TRITON longitudinal barrier installation and is not appropriate to shield fixed object hazards. It is further understood that, like the barrier itself, it is not acceptable for use

where impact speeds in excess of 70 km/h are likely. Users of this system must be further cautioned that significant vehicular penetration is possible for impacts at or near the end, and that a clear unobstructed runout area is needed behind the terminal sections for optimal performance.

Sincerely yours,

L. A. Staron

Lawrence A. Staron
Chief, Federal-Aid and Design Division

U.S. Department
of Transportation

**Federal Highway
Administration**

400 Seventh St., S.W.
Washington, D.C. 20590

September 27, 1994

Refer to: HNG-14

J. M. Essex, P.E.
Vice President, Sales
Energy Absorption Systems, Inc.
One East Wacker Drive
Chicago, Illinois 60601

Dear Mr. Essex:

Your September 7 and September 19 letters provided crash test data on the TRITON barrier and a summary of encroachment probabilities intended to show that the TRITON could be expected to perform satisfactorily under many work zone conditions. Based on these data, you requested that the Federal Highway Administration (FHWA) accept the TRITON for use at locations where speeds would be as high as 100 km/h. Our original acceptance letter limited its use to locations where expected speeds were under 70 km/h. This acceptance was based on successful completion of the National Cooperative Highway Research Program (NCHRP) Report 350 test series for a Test Level 2 barrier.

We readily acknowledge that the TRITON, like all longitudinal barriers, is capable of containing and redirecting vehicles striking it at higher speeds and lesser angles than those under which it was formally qualified, and that it is a very forgiving barrier when struck. We further acknowledge that in some work zones, the likelihood of high-angle, high-speed impacts, or impacts by large trucks may be low. However, since reliable data on the nature and extent of roadside encroachments in work zones are limited, we are not in a position to offer blanket acceptance of TRITON in all 100 km/h situations. Work zone safety continues to be an FHWA emphasis area and it is in the best interests of all parties that the level of protection given to motorists and workers- in construction and maintenance zones remains high. The TRITON barrier should not be considered an across-the-board substitute for precast concrete barrier, and it should not be used in locations where impacts by trucks heavier than 2000 kg are a significant concern.

In direct response to your request, we shall continue to encourage and support the use of TRITON under any one of the following conditions:

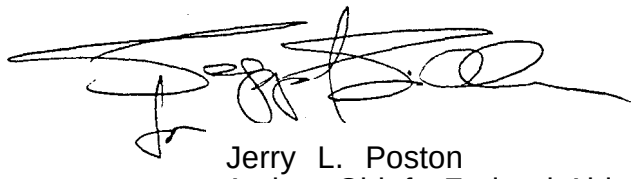
1. In work zones with vehicular speeds of 70 km/h or less.

2. In work zones where the TRITON is used in lieu of cones or plastic drums.

3. In work zones of short duration, regardless of speed, where some risk to motorists and workers is acknowledged, but considered acceptable by the agency conducting the work.

In all of the cases suggested above, the roadside surface condition and the available deflection distance from the barrier to fixed objects, edge drop-offs, and workers must be consistent with TRITON performance characteristics. This determination can be made from the deflection-impact severity curve which was submitted with your request and will be sent to FHWA field offices with a copy of this letter.

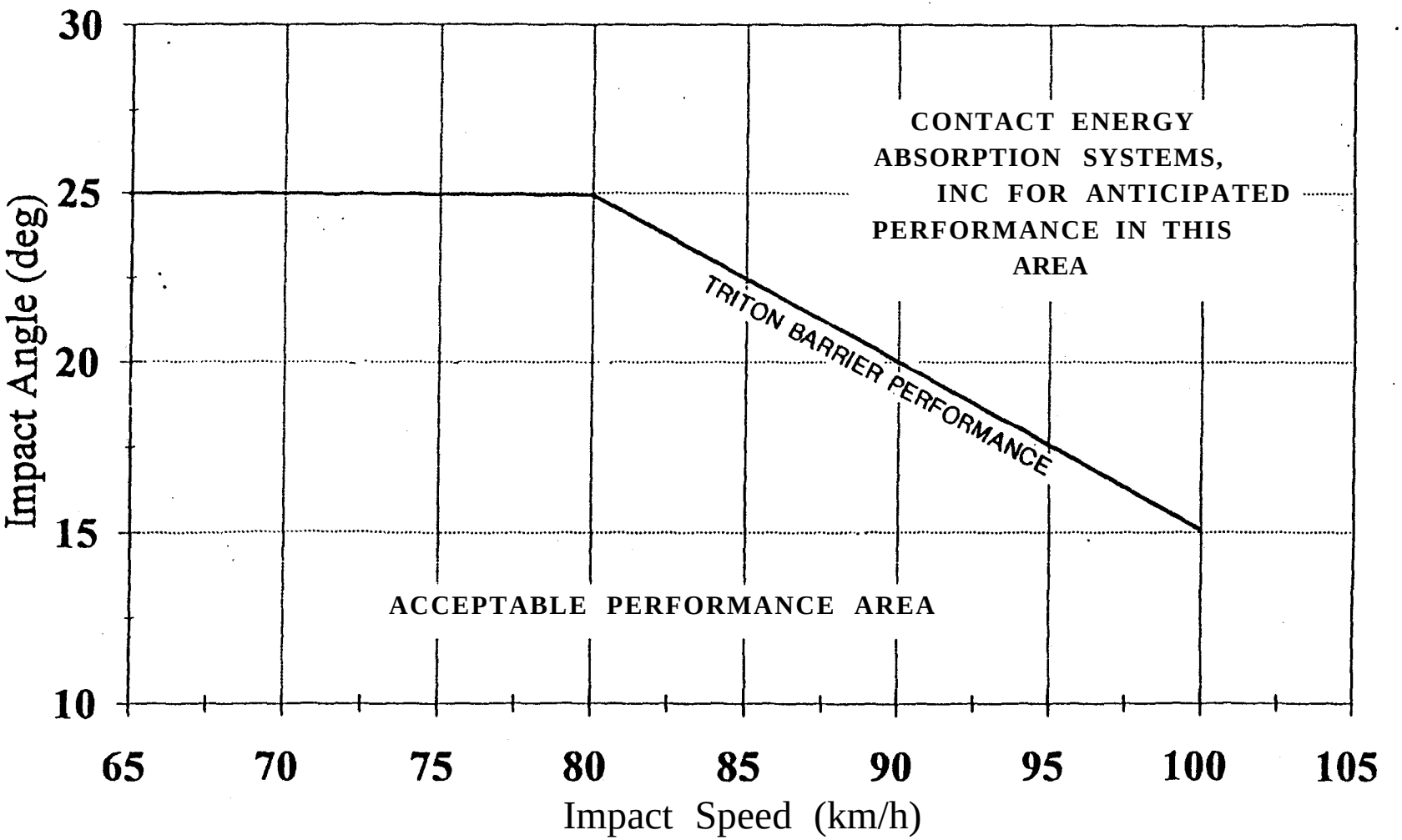
Sincerely yours,



Jerry L. Poston
Acting Chief, Federal-Aid and Design Division

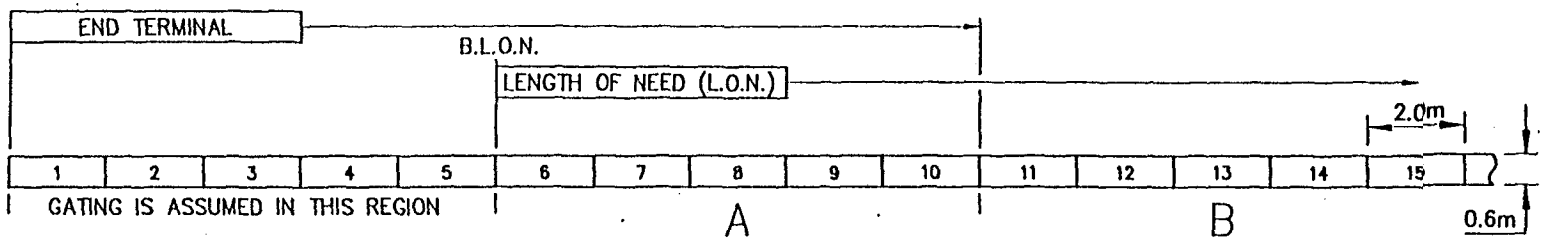
TRITON BARRIER Performance

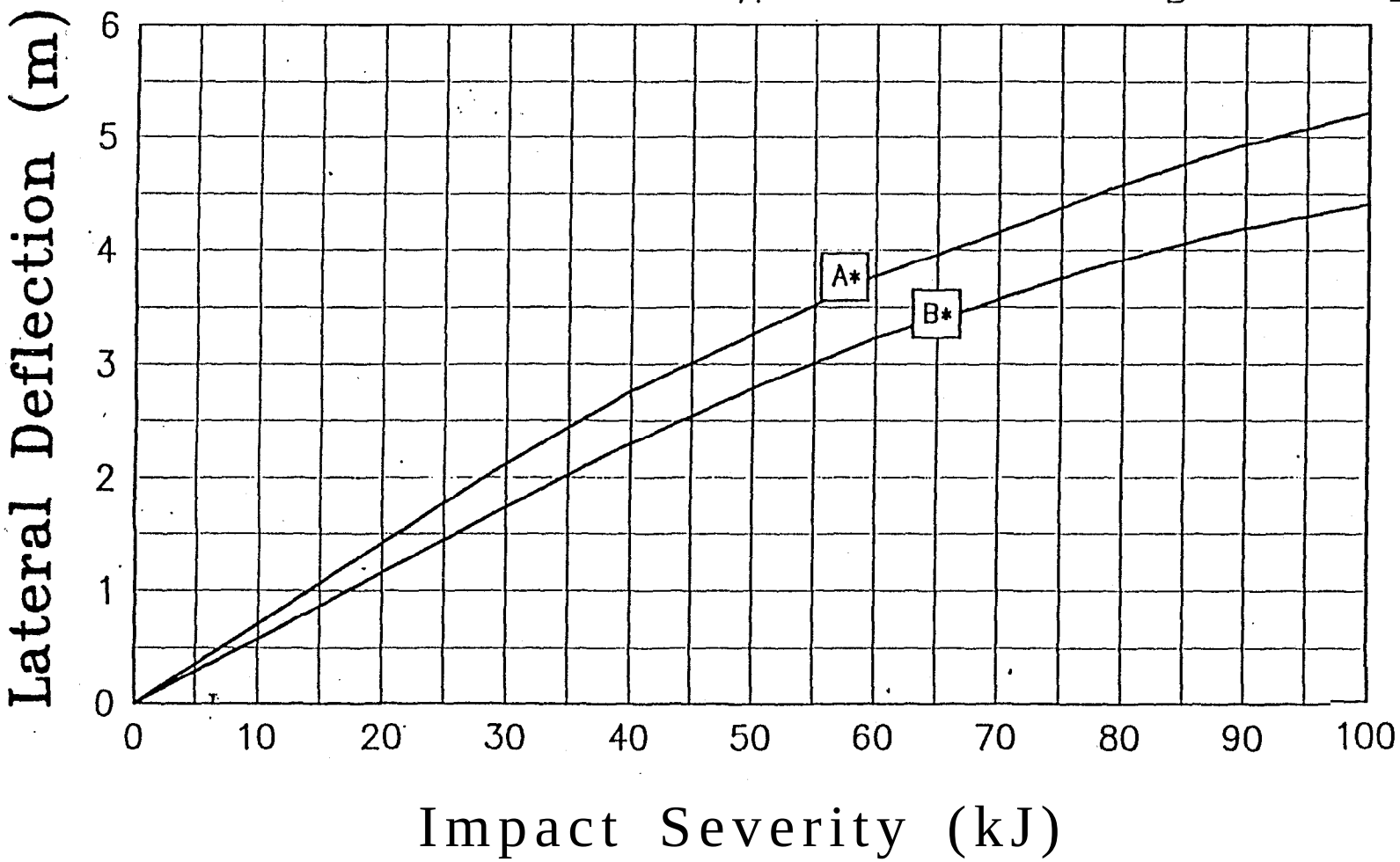
(angled impact test conditions)



9/15/94

TRITON Installation Deflection Curves
Impacts in Regions A and B





* Data for curves A and B were obtained from test conducted on installation positioned on a' clean asphalt foundation with less than 5% cross slope using 820 to 2000 kg vehicles. When setting up work zones, the expected lateral deflection of the barrier should be accounted for to ensure maximum protection of the workers