

March 19, 2004

Refer to: HSA-10/B-125

Rick McColl, P.E.
Safety Barriers, Inc.
10440 Lexington Drive
P.O. Box 22517
Knoxville, TN 37933

Dear Mr. McColl:

In your recent letter to Associate Administrator A. George Ostensen, you requested Federal Highway Administration (FHWA) acceptance of a water-filled plastic barrier called the Model SB-1-TL. To support your request, you also sent a copy of the Texas Transportation Institute's (TTI) February 2004 test report entitled "Testing and Evaluation of Safety Barriers, Inc. Water-Filled Barriers" and a digitized video showing the crash test that was conducted.

Each of your barrier segments is made from 0.25-inch thick recyclable, virgin, linear low-density polyethylene (LDPE) with UV stabilizers and anti-oxidants, and is ballasted with water. Empty modules weigh approximately 164 pounds with the aluminum pipes in place and filled units are approximately 1840 pounds in weight. The base width of each segment is 2 feet, the vertical height from the ground is approximately 8 inches and the sides of the modules then taper inwards to a top width of 8.25 inches. Total height is 42 inches and, when the barrier is assembled, each segment is effectively 84-inches long. Two schedule 10 2-inch diameter aluminum pipes are cast into each side of each segment and four 5/8-inch diameter 6x25 steel cables are threaded through these pipes to connect all segments together to form the barrier. Special foam-filled end pieces and steel anchor plates at each end of an installation are used to terminate the cables and to remove slack from them. These details are shown in Enclosure 1.

The test installation consisted of 20 individual segments of SB-1-TL modules and two end assemblies for a total installation length of approximately 140 feet. The barrier was impacted 4 feet upstream of the joint between segments 7 and 8, or approximately 45 feet from the beginning of the installation. The pickup truck, impacting at 99.4 km/h and 25.4 degrees, was captured by the barrier, which deflected 15.7 feet. If the barrier were struck nearer to either end of the test installation, the deflection likely would have been even greater. Modules in the immediate impact area shattered, spreading pieces of plastic over a wide area behind the impact zone. Enclosure 2 is the test summary sheet from the TTI test report.

Although the truck was not redirected as is normally seen with a permanent traffic barrier, it was contained by the SB-1-TL modules. Other water-filled barriers have produced similar post-impact results. Section 5.2 of NCHRP Report 350 states that "a primary concern for (temporary longitudinal barriers) ... is the deflection they undergo during a vehicular impact. Because the amount a given installation can deflect without adverse consequences depends on site conditions... it is important to accurately measure and report barrier displacement that occurs during the test so that a user agency can make an objective assessment of the appropriateness of the barrier for its intended application." Thus, as long as potential users are aware that the SB-1-

TL barrier can deflect up to 16 feet in a high-speed, high angle crash and conclude that this displacement will not endanger either motorists or workers behind the barrier, it can be an appropriate choice for use at a specific worksite. The second issue noted in the TTI test report was that of debris scatter. Modules in the immediate impact area shattered, and pieces of plastic were scattered over an area of approximately 100 x 100 feet behind the barrier. While this was an unexpected and generally undesirable occurrence, the debris consisted mostly of relatively small pieces of plastic. Section 5.3 of Report 350 addresses this issue as follows: "Fragments and debris from an impact with a traffic control device in a construction zone may or may not pose a hazard to workers in the zone, depending on their location relative to the device and the impact conditions. Consequently, it is not practical to establish absolute limits on test article trajectory, debris scatter, or barrier displacement. Rather, it is important to accurately record and report (these data) so that a user agency can make an objective assessment of the appropriateness of the safety feature for the intended application." Again then, it is of utmost importance that potential users of the SB-1-TL barrier be aware of its crash characteristics to avoid using it in an unsafe setting.

Based on the above analysis, I agree that the SB-1-TL Barrier, as tested, may be considered a test level 3 (TL-3) temporary barrier. However, its use must be limited to sites where the deflection and debris scatter noted above and in the TTI test report are known and acceptable to the using agency and will not pose an obvious danger to motorists or workers, nor give either group a false sense of security. You may also wish to consider anchoring the ends of the barrier to reduce its dynamic deflection and using a different plastic formulation to eliminate the shattering and subsequent debris scatter seen in the test. These modifications would warrant an additional test to verify their affect on barrier performance.

Please note that the following standard provisions apply to this letter of acceptance:

- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- FHWA acceptance is limited to the assumed crashworthiness characteristics of the device and does not cover other structural features, durability, or conformity with the Manual on Uniform Traffic Control Devices.
- Any future design changes to the Model SB-1-TL barrier may require full scale crash testing before a new FHWA acceptance letter will be written.
- Should FHWA discover that an in-service performance evaluation reveals unacceptable safety problems, or that the device being marketed is significantly different from the version that was accepted for use on the NHS, it reserves the right to modify or revoke its acceptance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for acceptance.
- To prevent any misunderstandings, this letter of acceptance shall not be reproduced except in full. This letter is considered public information. All such letters and any documentation upon which it was based may be reviewed at our office upon request.

- The Model SB-1-TL barrier is considered proprietary. If proprietary devices are specified for use on Federal-aid projects, except exempt, non-NHS projects, they: (a) must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with existing highway facilities or that no equally suitable alternative exists or; (c) they 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 attached as Enclosure 3.
- This acceptance letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented device for which the applicant is not the patent owner. The FHWA acceptance is limited to the crashworthiness characteristics of the candidate device, and this office is neither prepared nor required to resolve issues concerning patent law. Please note that FHWA reserves the right to withdraw an acceptance letter if the applicant's submission is later shown to misrepresent the issue, either intentionally or unintentionally, or contains errors of fact or omission.
- The Model SB-1-TL barrier units alone are not acceptable for use on the NHS as barriers, barricades, channelizing devices or delineators unless they have been successfully crash tested in accordance with current FHWA guidelines for such devices.

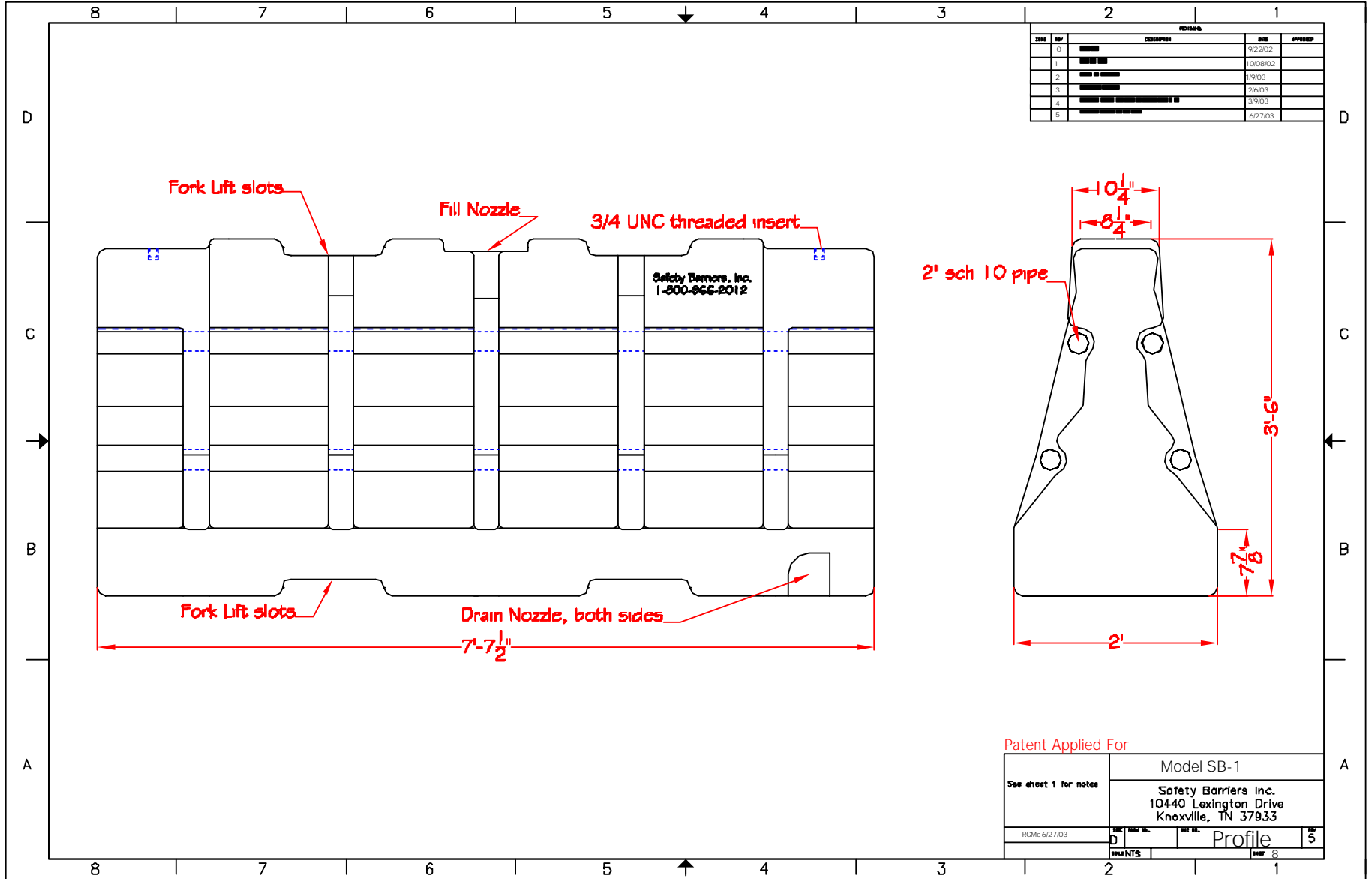
Sincerely yours,

(original signed by Hari Kalla)

for:

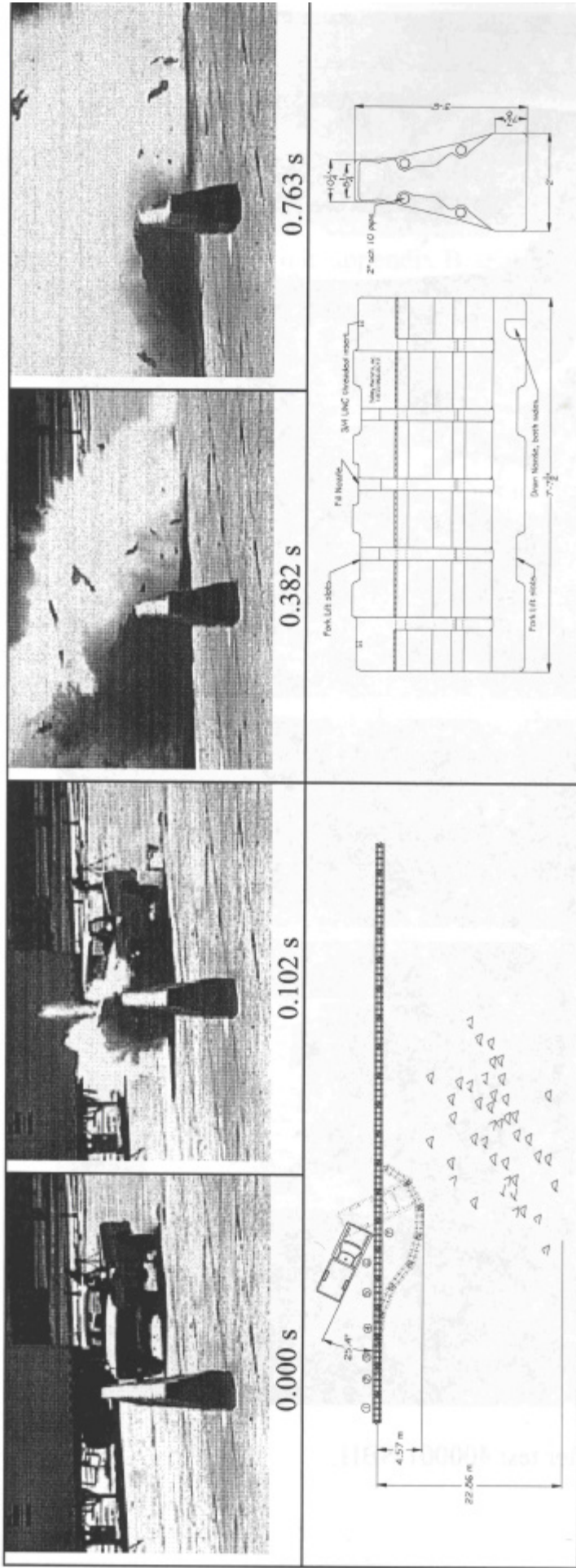
John R. Baxter, P.E.
Director, Office of Safety Design
Office of Safety

3 Enclosures



REV	NO	DESCRIPTION	DATE	APPROVED
1	01	ISSUED FOR CONSTRUCTION	9/22/03	
2	01	ISSUED FOR CONSTRUCTION	10/08/02	
3	01	ISSUED FOR CONSTRUCTION	1/9/03	
4	01	ISSUED FOR CONSTRUCTION	2/6/03	
5	01	ISSUED FOR CONSTRUCTION	3/9/03	
6	01	ISSUED FOR CONSTRUCTION	6/27/03	

Patent Applied For		Model SB-1	
See sheet 1 for notes		Safety Barriers Inc. 10440 Lexington Drive Knoxville, TN 37933	
RGM: 6/27/03	DATE	Profile	SHEET 5
QUANTITY	8		



General Information
 Test Agency..... Texas Transportation Institute
 Test No. 400001-SB11
 Date..... 12/18/2004
Test Article
 Type..... Longitudinal Barrier
 Name..... Safety Barriers, Inc. Water-Filled Barrier
 Installation Length (m)..... 42.0
 Material or Key Elements..... Recyclable, Virgin, Linear Low Density, Polyethylene Plastic Shell Filled with Water
 Concrete Pavement, Dry
Soil Type and Condition.....
Test Vehicle
 Type..... Production
 Designation..... 2000P
 Model..... 1998 Chevrolet 2500 Pickup Truck
 Mass (kg)
 Curb..... 2130
 Test Inertial..... 2054
 Dummy..... N/A
 Gross Static..... 2054

Impact Conditions
 Speed (km/h)..... 99.4
 Angle (deg)..... 25.4
Exit Conditions
 Speed (km/h)..... Stopped
 Angle (deg)..... N/A
Occupant Risk Values
 Impact Velocity (m/s)
 Longitudinal..... 8.3
 Lateral..... 1.1
 THIV (km/h)..... 29.9
 Ridedown Accelerations (g's)
 Longitudinal..... -7.2
 Lateral..... -7.0
 PHD (g's)..... 8.4
 ASI..... 0.56
 Max. 0.050-s Average (g's)
 Longitudinal..... -6.1
 Lateral..... 2.6
 Vertical..... 3.0

Test Article Deflections (m)
 Dynamic..... 4.78
 Permanent..... 4.57
 Working Width..... 4.78
Vehicle Damage
 Exterior
 VDS..... 01FD4
 CDC..... 01FDEW2
 Maximum Exterior
 Vehicle Crush (mm)..... 280
 Interior
 OC DI..... FS0000000
 Maximum Occupant
 Compart. Deformation (mm)..... 0
Post-Impact Behavior
 (during 1.0 sec after impact)
 Max. Yaw Angle (deg)..... 30.4
 Max. Pitch Angle (deg)..... 6.1
 Max. Roll Angle (deg)..... -10.7

Figure 8. Summary of results for NCHRP Report 350 test 3-11 on Safety Barriers, Inc., water-filled barriers.

Sec. 635.411 Material or product selection.

(a) Federal funds shall not participate, directly or indirectly, in payment for any premium or royalty on any patented or proprietary material, specification, or process specifically set forth in the plans and specifications for a project, unless:

(1) Such patented or proprietary item is purchased or obtained through competitive bidding with equally suitable unpatented items; or

(2) The State highway agency certifies either that such patented or proprietary item is essential for synchronization with existing highway facilities, or that no equally suitable alternate exists; or

(3) Such patented or proprietary item is used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes.

(b) When there is available for purchase more than one nonpatented, nonproprietary material, semifinished or finished article or product that will fulfill the requirements for an item of work of a project and these available materials or products are judged to be of satisfactory quality and equally acceptable on the basis of engineering analysis and the anticipated prices for the related item(s) of work are estimated to be approximately the same, the PS&E for the project shall either contain or include by reference the specifications for each such material or product that is considered acceptable for incorporation in the work. If the State highway agency wishes to substitute some other acceptable material or product for the material or product designated by the successful bidder or bid as the lowest alternate, and such substitution results in an increase in costs, there will not be Federal-aid participation in any increase in costs.

(c) A State highway agency may require a specific material or product when there are other acceptable materials and products, when such specific choice is approved by the Division Administrator as being in the public interest. When the Division Administrator's approval is not obtained, the item will be nonparticipating unless bidding procedures are used that establish the unit price of each acceptable alternative. In this case Federal-aid participation will be based on the lowest price so established.

(d) Appendix A sets forth the FHWA requirements regarding (1) the specification of alternative types of culvert pipes, and (2) the number and types of such alternatives which must be set forth in the specifications for various types of drainage installations.

(e) Reference in specifications and on plans to single trade name materials will not be approved on Federal-aid contracts.