U.S. Department
of Transportation
Federal Highway Administration

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

September 4, 1998

Refer to: HNG-14

Mr. Dave Gertz
Director of Engineering
TrafFix Devices Inc.
220 Calle Pintoresco
San Clemente, California 92672

(MIXING OF BARRELS)

Dear Mr. Gertz:

In your August 11 letter to Mr. Richard Powers of my staff, you asked if your TrafFix Devices sand barrels could be mixed within an array of sand barrels manufactured by Energy Absorption, Inc. (Energite III) or by Roadway Safety Service (Fitch). As long as the appropriate weight of sand is in the replacement module or modules and the total array is adequately designed for specific site conditions, we consider the different makes of sand barrels to be approximately equal and they may be used interchangeably.

In response to your second question, I am enclosing a copy of a July 17, 1987, Federal Highway Administration memorandum: "Inertial Crash Cushions - Avoiding Problems With Frozen Sand" that addresses the issue of pea gravel as a filler material in lieu of sand. The recommended grading roughly corresponds to an AASHTO Size Number 89 gradation which is similar to the Illinois Number 12 Aggregate cited in your letter. You will note, however, that the use of an aggregate other than sand is not recommended for general use.

Any additional questions should be addressed to Mr. Powers at (202) 366-1320.

Sincerely yours,

Dwight A. Horne

Dwight A. Horne
Chief, Federal-Aid and Design Division

Enclosure

Enclosure

Memorandum

U.S.Department
of Transportation
Federal Highway Administration

Washington, D.C. 20590

Subject: Inertial Crash Cushions - Avoiding Problems With Frozen Sand

Date: July 17, 1987

From: Director, Office of Engineering

Reply to Attn. of: HNG-14

To: Regional Federal Highway Administrators
Direct Federal Highway Administrator

The Federal Highway Administration has conducted full-scale crash tests of [redacted] inertial (sand) crash cushions to determine the effect of frozen sand. Tests were conducted with an 1,800-pound and a 4,500-pound vehicle impacting both types of inertial systems in which the sand had been frozen, and the results were compared to those from similar tests with unfrozen crash cushions.

Test results indicate that frozen sand significantly reduces the performance and safety of inertial systems. Typically, crash tests of either a small or large vehicle with an inertial system with frozen sand results in larger values of occupant impact velocity and occupant ridedown acceleration than occur with comparable crash tests with unfrozen sand. Additionally, crash tests of barrels with frozen sand typically result in large lumps of frozen sand being scattered around the impact site. In one case a 400-pound lump was thrown approximately 60 feet. In another, smaller lumps were thrown beyond 100 feet. This scattering of frozen debris could lead to other accidents at the impact site.

For those areas where freezing of sand in the inertial systems might occur, steps should be taken to reduce this possibility. Suggested countermeasures are:

1. Use dry, free draining sand to fill the barrels -- a moisture content of 3 percent or less is recommended.

2. Provide positive drainage pathways for moisture in the sand by using weep holes or slots in the sand containment unit and at the bottom of the barrel. Where this might result in a sand leakage problem, the use of an engineering fabric (filter fabric) as a retainer might be considered.

3. Provide rainproof ventilation pathways at the top of the barrel.

   (Tests have shown that countermeasures 2 and 3 are not sufficient to ensure that all sands will dry out within a reasonable time. However, drainage and ventilation are likely to have enough benefit to justify requesting them.)

4. Secure lids to the barrels to prevent dislocation. Replace broken or cracked lids and/or barrels.

5. Where there is evidence that measures beyond those outlined above are needed, one of the following is suggested:

   a. Mix an antifreeze agent with the sand. Use of rock salt (NaCl) mixed at a rate of no more than 5 percent by weight, salt to sand, as an antifreeze agent is suggested. Use of calcium chloride ($CaCl_2$) or other compounds which can bond or cement sand particles together is not recommended.

   b. Use pea gravel for the inertial material. One hundred percent of this material should pass a 1/2-inch sieve, no more than 5 percent should pass a number 50 sieve, and no more than 2 percent should pass a number 100 sieve.

      (An inertial system using pea gravel has been crash tested with a large passenger vehicle and the test results were within the specified occupant injury criteria of NCHRP 230. Test experience indicates the debris scatter pattern will be larger with pea gravel than with sand. Where a crash cushion is close to a travelway, with either sand or pea gravel, severe impacts are likely to scatter debris into adjacent traffic lanes. When this happens vehicles running through the debris may experience problems because of reduced roadway friction. However, prompt action by emergency personnel to control traffic and clear the roadway should alleviate any potential safety problems. Where this is done the use of pea gravel should not create problems significantly different from those with sand. Further, pea gravel will not hold enough moisture to cause a problem under freezing temperature conditions. Thus, we see no reason to preclude the use of pea gravel at this time).

Any questions regarding this memorandum should be directed to the Geometric and Roadside Design Branch.

L. A. Staron
for Ronald E. Heinz