U.S. Department of Transportation
Federal Highway Administration

400 Seventh St., S.W.
Washington, DC 20590

May 7, 2007

In Reply Refer To:
HSSD/SS-135

Mr. Ted Graef, President
All Traffic Solutions
P.O. Box 10085
State College, PA 16805

Dear Mr. Graef:

Thank you for your letter of December 12, 2005, requesting the Federal Highway Administration's (FHWA) acceptance of your company's SPEEDsentry, SS12 and SS15, Radar Speed Displays mounted to a breakaway pole with a slip base as a crashworthy sign support system for use on the National Highway System (NHS). Accompanying your letter was a drawing of the system, system specifications with calculations, and reference to generic crash tests of similar devices. You requested that we find the SPEEDsentry systems acceptable for use on the NHS under the provisions of the National Cooperative Highway Research Program (NCHRP) Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features."

The SPEEDsentry 12 or SS12, is a radar speed display with 12 inch digit height, and the SS15 displays a 15 inch digit height. Both models are constructed of aluminum with a Lexan shield on the front. The SS12 weighs 32 pounds and the SS15 weighs 41.2 pounds with the "YOUR SPEED" display and without the battery. Each unit uses a standard 26Ah sealed battery, which weights 21 pounds for a total weight of 51 pounds and 62.2 pounds respectively. Each radar speed display is attached to a 4-inch diameter pole and the bottom of the unit is mounted at least 60 inches from the ground using 1/2 inch diameter U bolts as shown in the enclosed drawing.

You referenced two FHWA Acceptance Letters, SS-84, dated July 26, 1999, and SS-121, dated December 30, 2003, in which motorist aid call boxes were tested on poles mounted on 4-bolt slip bases. The call boxes were of weights comparable to the SPEEDsentry devices but mounted closer to the ground, near windshield height. In these test programs the occupant impact speeds and decelerations were well within limits, as was occupant compartment deformation (roof crush.) However, in SS-84 the callboxes were mounted on the side of the support post and in SS-121 they were located on the backside of the post. The SPEEDsentry sign units must, of course, be mounted on the post facing oncoming traffic and are therefore more likely to break free from the support post upon impact. The calculations sheet enclosed shows the strength of the bolts is adequate to absorb the anticipated impact.

Based on the results of your calculations and the previous testing referenced above, the SPEEDsentry installations are comparable and likely to meet the breakaway criteria under the

NCHRP Report 350. Therefore, the devices described above and shown in the enclosed drawings for reference are acceptable for use as test level 3 devices on the NHS under the range of conditions tested, when proposed by a State. This acceptance will be limited to a generic four-bolt slip base or a comparable base using crashworthy frangible couplings.

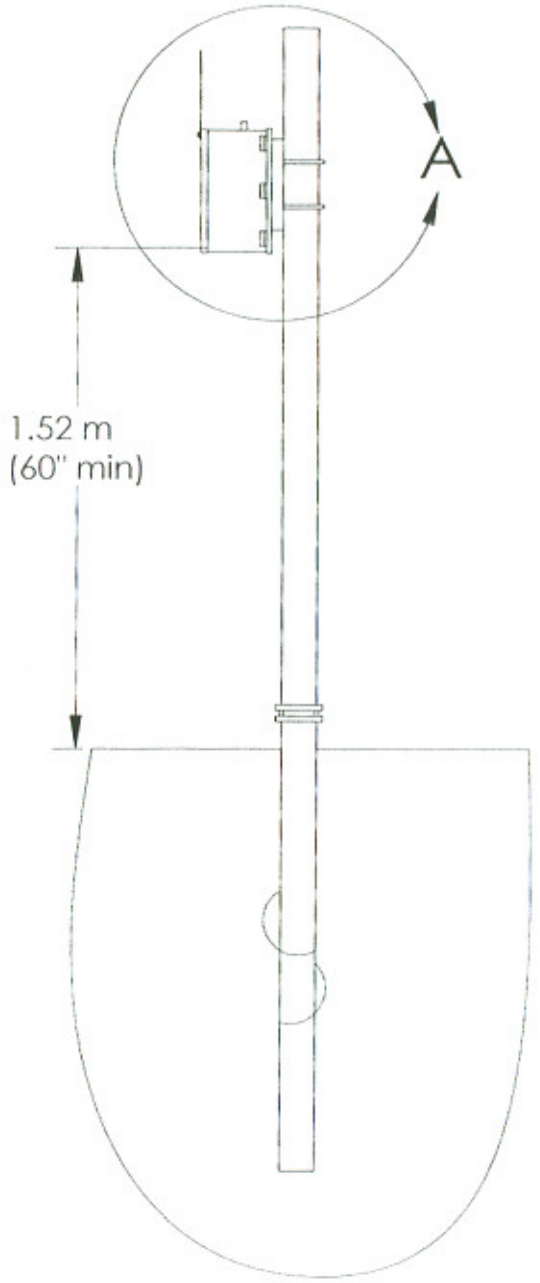
Please note the following standard provisions that apply to the FHWA letters of acceptance:

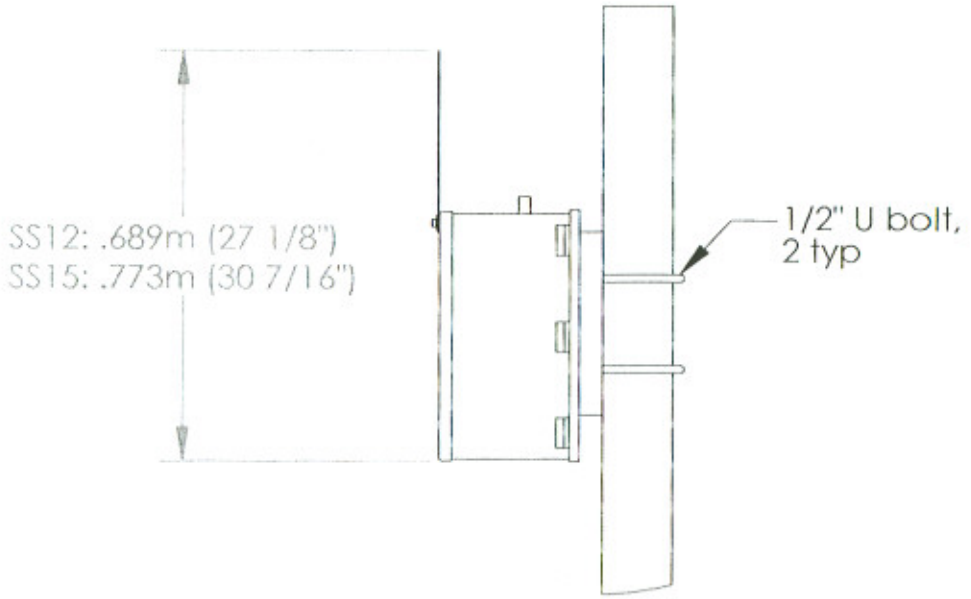
- Our acceptance is limited to the crashworthiness characteristics of the devices and does not cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may adversely influence the crashworthiness of the device will require a new acceptance letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the device being marketed is significantly different from the version that was crash tested, it reserves the right to modify or revoke its acceptance.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- 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, and that they will meet the crashworthiness requirements of the FHWA and the NCHRP Report 350.
- To prevent misunderstanding by others, this letter of acceptance, designated as number SS-135, shall not be reproduced except in full. As this letter and the supporting documentation which support it become public information, it will be available for inspection at our office by interested parties.
- The SPEEDsentry speed displays are patented devices and considered "proprietary." When proprietary devices are *specified by a highway agency* for use on Federal-aid 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 enclosed.
- 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 holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate device, and the FHWA is neither prepared nor required to become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

Sincerely yours,

George E. Rice, Jr.
Acting Director, Office of Safety Design
Office of Safety

Enclosures





DETAIL A
SCALE 1 : 12

Rev.	Description	ECN	Date

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS DECIMALS ANGLES
± 1/64 .XX ± .010 ± 1°
.XXX ± .005

MATERIAL

FINISH

DO NOT SCALE DRAWING

CAD GENERATED DRAWING.
DO NOT MANUALLY UPDATE

APPROVALS

DRAWN JP DATE 11/20/05

CHECKED TG 11/20/05

RESP ENG

MFG ENG

QUAL ENG

ics Intuitive Control Systems
Box 10446 Calder Square
State College, PA 16805 (814) 235 - 7790

Speedsentry mounting for
NCHRP 350, 4" alum pole

SIZE DWG. NO.
A 4820048

SCALE 1:24 SHEET 1 OF 1

Intuitive Control Systems
Calculations for Speedsentry Mounting Hardware
5/9/06
Ted Graef

Goal: To prove that the SPEEDsentry devices will not break free from their support poles upon collision by presenting calculations for the worst-case scenario and based on prior test 474240/087.

Assumptions:

1.) The SPEEDsentry and pole will undergo translational motion and no rotation. This estimation is made because it is the scenario where the bolts will see the most force. In reality, some of the car's force will cause the pole to rotate with the SS near the center of gravity and the SS will have less translational acceleration and thus less force on the U-bolts.
2.) The pole is completely rigid. This can be assumed because its deformation will be very small relative to the deformation of the car.
3.) Constant acceleration is assumed for simplicity.

Givens:

- Diameter of pole = 1/3 ft
- Height of Pole = 20 ft
- Weight of Pole = 183 lb
- Weight of SPEEDsentry 12 = 51 lb
- Weight of SPEEDsentry 15 = 62.2 lb
- Weight of test vehicle = 1,808 lb
- Initial speed of vehicle = 90.4 ft/s
- Change in speed of vehicle = 6.9 ft/s
- Material of U-bolts = 1010 steel
- Ultimate tensile strength of U-bolt = 52,900 psi
- Diameter of U-bolts = ½ in

Force of car on pole

In order to find the force of the car on the pole, the distance that the car traveled during deceleration must be estimated. A high-end estimate would be that the car will fully decelerate in 1/3 ft, the diameter of the pole. In actuality, the car would probably decelerate much slower because its front end would crumple and ease the deceleration.

$A_{car} = (V_2^2 - V_1^2) / (2 \times d_{pole})$
$A_{car} = (83.5^2 - 90.4^2) / (2 \times (1/3))$
$A_{car} = -1800.\ ft/s^2$

$F_{car} = m_{car} \times a_{car}$
$F_{car} = (1808\ lb / 32.2\ ft/s^2) \times (1800\ ft/s^2)$

Force of car on pole = 101,068 lb

Acceleration of System

The force of the car on the pole is resisted by a force from the ground on the pole and the rest is translated into a dynamic force on the SPEEDsentry and pole. However, the worst-case scenario would be if the pole broke away without providing any resistive force on the car. In this situation, the force of the car on the pole equals the dynamic force of the pole and the SPEEDsentry.

$F_{car} = (m_{pole} + m_{SS}) \times a_{sys}$

$a_{sys} = F_{car} / (m_{pole} + m_{SS})$

For SPEEDsentry 12

$a_{sys} = 101{,}068 \text{ lb} / [(183 \text{ lb} + 51 \text{ lb}) / 32.2 \text{ ft/s}^2]$

$a_{sys} = 13{,}908. \text{ ft/s}^2$

For SPEEDsentry 15

$a_{sys} = 101{,}068 \text{ lb} / [(183 \text{ lb} + 62.2 \text{ lb}) / 32.2 \text{ ft/s}^2]$

$a_{sys} = 13{,}272. \text{ ft/s}^2$

Force on U-bolts

The force on the U-bolts is the mass of the SPEEDsentry times the acceleration of the system from rest.

For SPEEDsentry 12

$F_{bolts} = m_{SS12} \times a_{sys}$

$F_{bolts} = (51 \text{ lb} / 32.2 \text{ ft/s}^2) \times 13{,}908 \text{ ft/s}^2$

$F_{bolts} = 22{,}028 \text{ lb}$

For SPEEDsentry 15

$F_{bolts} = m_{SS15} \times a_{sys}$

$F_{bolts} = (62.2 \text{ lb} / 32.2 \text{ ft/s}^2) \times 13{,}272 \text{ ft/s}^2$

$F_{bolts} = 25{,}637 \text{ lb}$

Strength of U-bolts

Each U-bolt is treated as two straight bolts of ½ inch diameter.

$S_{one\_Ubolt} = S_{ut} \times 2 \times ((\Pi/4) \times d^2)$

$S_{one\_Ubolt} = 52{,}900 \text{ psi} \times 2 \times ((\Pi/4) \times 0.5 \text{ in}^2)$

$S_{one\_Ubolt} = 20{,}774 \text{ lb}$

$S_{two\_Ubolts} = 41{,}500 \text{ lb}$

Findings

The strength of the bolts is adequate to absorb the impact of a car, even when a worst-case scenario is estimated. The following is a chart that considers the situations that would occur if it took more distance for the car to fully decelerate.

distance for car to change speeds (in)	Force on the ubolts (lb) for SS12	Safety Factor for SS12	Force on the ubolts (lb) for SS15	Safety Factor for SS15
4	22026.05934	1.88629293	25636.12645	1.620666058
4.5	19578.71941	2.122079546	22787.66796	1.823249315
5	17620.84747	2.357866162	20508.90116	2.025832573
5.5	16018.95225	2.593652778	18644.4556	2.22841583
6	14684.03956	2.829439394	17090.75097	2.430999087
6.5	13554.49806	3.065226011	15776.07782	2.633582344
7	12586.31962	3.301012627	14649.21511	2.836165602
7.5	11747.23165	3.536799243	13672.60077	3.038748859
8	11013.02967	3.772585859	12818.06323	3.241332116
8.5	10365.2044	4.008372475	12064.05951	3.443915373
9	9789.359707	4.244159091	11393.83398	3.646498631
9.5	9274.130249	4.479945708	10794.15851	3.849081888
10	8810.423736	4.715732324	10254.45058	4.051665145

Conclusion:

The worst-case scenario for this type of collision is when a 15 inch SPEEDsentry is mounted to the pole, and the distance for the deceleration to take place is approximated as 4 inches.

In this case, the U-bolts will not break and will have an approximate safety factor of 1.62.

Title 23, Code of Federal Regulations
§ 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 transportation department 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 transportation department 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 transportation department 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.

(f) In the case of a design-build project, the following requirements apply: 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 Request for Proposals document unless the conditions of paragraph (a) of this section are applicable.

[41 FR 36204, Aug. 27, 1976, as amended at 67 FR 75926, Dec. 10, 2002]