U.S. Department of Transportation
Federal Highway Administration

1200 New Jersey Ave., SE
Washington, D.C. 20590

April 2, 2010

In Reply Refer To:
HSSD/SS-163

Mr. Gary ODell, President
Information Display Company
10950 SW 5th Street, Suite 330
Beaverton, OR 97005

Dear Mr. ODell:

Thank you for your letter of September 14, 2009, requesting the Federal Highway Administration's (FHWA) acceptance of your company's Speed Check models VSC-1520 and VSC-1820 radar speed displays mounted to a breakaway pole as a crashworthy sign support system for use on the National Highway System (NHS). Accompanying your letter was an engineering analysis report that included calculations verifying the display connection strength, reference to previous crash tests of similar devices, and drawings of the system. You requested that we find the Speed Check 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 Speed Check VSC-1520, is a radar speed display with 15 inch digit height, and the VSC-1820 has a display with 18 inch digit height. The VSC-1520 weighs 51 pounds and the VSC-1820 weighs 62 pounds. The models are described in further detail in the enclosed engineering analysis report. Each radar speed display is attached to a 4-inch diameter pole and the bottom of the unit is mounted at least 84 inches from the ground using a minimum of 3/8-inch diameter U bolts made of A307 steel as shown in the enclosed report.

You referenced 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 slightly heavier than the Speed Check 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 call boxes were mounted on the side of the support post and in SS-121 they were located on the backside of the post. The Speed Check sign units will be mounted on the post facing oncoming traffic and are therefore more likely to break free from the support post upon impact. The enclosed report with calculations 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 Speed Check 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 breakaway base using crashworthy, frangible couplings or frangible bases.

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-163, 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 Speed Check 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,

David A. Nicol, P.E.
Director, Office of Safety Design
Office of Safety

Enclosures

THE BEST IN THE BUSINESS
SPEEDCHECK™
An Information Display Company Product

September 14, 2009

Nicholas Artimovich, II
Highway Engineer, Office of Safety Design
Federal Highway Administration HSSD
1200 New Jersey Avenue SE, Room E71-322
Washington, DC 20590

Dear Mr. Lupes:

Please accept the attached submittal of our product for NCHRP-350 approval. We have included the engineer's analysis along with drawings of all the pertinent components for the standard installation of our products.

We are submitting this analysis to be valid when our product is installed as described in the engineering analysis, using an AASHTO or FHWA approved break-away base such as described in, but not limited to, the referenced Pelco descriptive data sheet. I believe this is consistent with other similar approved products' mounting methods and approvals.

If you need additional information, please do not hesitate to contact me.

Thank you and best regards,

Gary ODell

Gary ODell
Information Display Company
800-421-8325 ext. 4
gary@informationdisplay.com

TITAN ENGINEERING

Crashworthiness Evaluation
IDC Speed Check™ Radar Speed Display Devices
Models VSC-1520 and VSC-1820
by Gary P. Gauthier, PE

INTRODUCTION:

Information Display Company (IDC) manufactures two radar speed display devices, Speed Check™ models VSC-1520 and VSC-1820. The 1520 features 15"-high digits in the display and the 1820 has 18"-high digits. (See attached detail drawings[1,2]). These devices are mounted on steel posts installed on the roadside. Where required, they can be connected to a breakaway base that allows a run-off-the-road vehicle to impact the post and separate it from the base. The vehicle will experience only minor deceleration with no flying parts posing a hazard. These roadside crashworthy safety features meet the requirements of *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals* and *National Cooperative Highway Research Program (NCHRP) Report 350*. This document demonstrates in detail that these two products meet these requirements.

CRASHWORTHINESS REQUIREMENTS:

The Federal Highway Administration (FHWA) and other transportation agencies require a clear recovery zone on designated routes. The clear recovery zone of a roadway is an offset distance from the shoulder that allows a run-off-the road vehicle to regain control or stop with minimal damage or injury to occupants. The zone usually is free of fixed obstructions and may also have slope limits and other requirements. Any fixed objects in this zone must be shielded by barriers or crash cushions, or yield, fracture or break away upon impact without serious consequences to the vehicle and occupants. Signs, luminaires, callboxes, traffic signals, speed display devices and other similar devices often must be installed within this zone. Hence, they may be required by the FHWA or transportation agency to be crashworthy. Constructing barriers or crash cushions to shield these installations can be expensive and may actually introduce more of a roadside hazard. In these situations devices fastened to posts are installed on base supports that separate upon impact. This allows the errant vehicle to pass through with minimal damage and change in velocity. The crashworthiness requirement for such devices is set by the AASHTO standard referenced above. To meet this requirement the device must pass two *NCHRP Report 350* crash tests and not reduce the impacting vehicle's speed by more than 16 fps.

The IDC 1520 and 1820 models will be installed on breakaway or slip base post supports to meet this crashworthiness requirement. The two *NCHRP Report 350* tests required for evaluation of these products are test 3-60 and test 3-61. These tests involve 820-kg small sedans impacting the device at a speed of 35 km/h (3-60) and 100 km/h (3-61). The evaluation criteria for *NCHRP Report 350* tests are divided into three basic categories: structural adequacy, occupant risk and vehicle trajectory. Tests 3-60 and 3-61 are evaluated in only the first two categories with the following criteria:

<u>Structural Adequacy</u>: The test article should readily activate in a predictable manner by breaking away, fracturing or yielding.

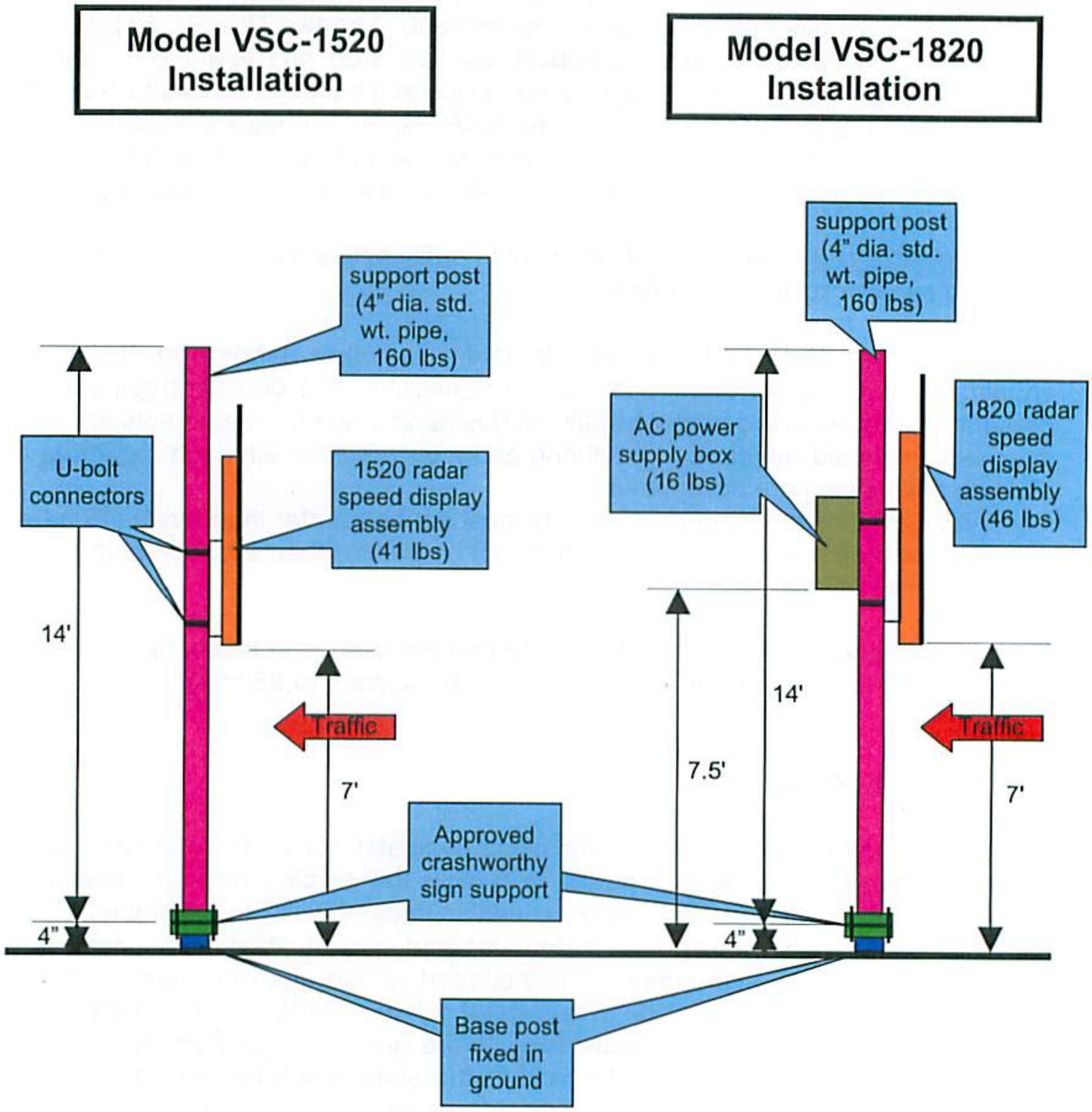
<u>Occupant Risk:</u> Detached elements, fragments or other debris from the test article should not penetrate or show potential for penetrating the occupant compartment, or present an undue hazard to other traffic, pedestrians or work zone personnel.
The vehicle should remain upright during and after collision, although moderate rolling, pitching and yawing are acceptable.
The longitudinal occupant impact velocity must not be greater than 5 m/s (16.4 fps) and the occupant ridedown accelerations must not be greater than 20 g's in both lateral and longitudinal directions.

In addition, the AASHTO standard requires that the change in test vehicle velocity after impact in both tests be no greater than 16 feet per second (4.88 m/s).

PRODUCT DESCRIPTION:

The two models mentioned above are being evaluated for crashworthiness. Both are basic configurations using AC power with only the display unit and power supply attached to the posts (the 1520 power supply is integral with the assembly). Each will be mounted on a 4" nominal diameter standard weight steel pipe attached to an approved crashworthy sign support. The support will be one of several breakaway or slip bases that have already been accepted by the FHWA. The support will be attached to a post or other structure fixed in the ground. Upon vehicular impact the entire installation attached to the top half of the support will be released and pushed away by the vehicle. Only the bottom half of the suport will remain fixed and standing at a height no more than 4" above the ground.

The total weight of the 1520 installation including the post above the support is 201 lbs; the 1820 is 222 lbs. The speed display assemblies will be attached to the posts with brackets and U-bolts. The power supply box for the 1820 will be attached using U-bolts or metal strapping. It will be oriented on the post opposite of the display assembly, facing downstream of the traffic flow.



NOTE: Drawings are schematic and not to scale

Figure 1: Product configurations evaluated

CRASHWORTHINESS ANALYSIS:

Both products under evaluation are very similar to other products that have been crash tested and accepted by the FHWA. Two call box products were tested and evaluated under the requirements explained above and accepted for use on the National Highway System by the FHWA.

On July 26, 1999, as stated in letter SS-84[3], the Comarco Wireless Technologies TTY call box support system was accepted by the FHWA. This system featured a 4-bolt slip base welded to a 4" diameter steel post 14' high from the slip base. The total test article weight was 227 lbs. The call box was located with its center approximately 44" above the ground. It passed tests 3-60 and 3-61 with occupant impact velocities of 1.49 m/s and 2.3 m/s, and vehicle change in velocities of 1.18 m/s and 1.95 m/s. These are well below the maximums allowed. The slip base released properly, leaving only the lower half in place 3" above the ground. Vehicle damage and occupant compartment deformation were acceptable.

In FHWA letter SS-121[4], the MTC SAFE Call Box support system was accepted. This system featured a 4-bolt slip base welded to a 4" diameter steel post 20' high from the slip base. The total test article weight was 256 lbs. The call box was located with its center approximately 44" above the ground. It passed tests 3-60 and 3-61 with occupant impact velocities of 1.0 m/s and 1.9 m/s and vehicle change in velocities of 1.2 m/s and 2.11 m/s. These are also well below the maximums allowed. The slip base released properly, leaving only the lower half in place 3" above the ground. Vehicle damage and occupant compartment deformation were also acceptable.

In addition to the above products, two similar radar speed display devices have also been accepted by the FHWA. In letter SS-135[5], the SPEEDsentry 12 and 15 radar speed display devices were compared to the call box crash tests described above. An analysis showing the devices would not separate from the posts upon impact was also provided. The weights of these display assemblies are higher than the IDC products at 51 lbs and 62 lbs. The minimum mounting height to bottom of display is 5', compared to 7' for the 1520 and 1820.

Both IDC models under evaluation are installed in very similar configurations to the two callboxes tested above. The installed weights are actually less, and unit centers of gravity (CG) are significantly higher. These two factors would likely result in even better test results. With less mass for the vehicle to accelerate off the slip base, the occupant impact velocities and change in vehicle velocities for both models would be less than in the tests described above. A higher CG would also keep the rotation of the post assembly at a higher center as the vehicle passes underneath. With this higher rotation and faster post-impact vehicle speed, the post assembly most probably would strike the vehicle further aft than in the above tests, with limited deformation to the occupant compartment, if any.

The IDC models are quite similar to the accepted SPEEDsentry products, but are lighter in weight and mounted higher. This would tend to give them even better crash performance.

All evaluation criteria for the VSC-1520 and VSC-1820 are assessed as having passed by comparisons with the above products, except for consideration of detached elements posing a hazard to occupants or nearby motorists or pedestrians. Since the speed display assemblies are attached to the posts facing the impacting vehicle and traffic, there is a possibility that they could undergo inertial forces directed upstream as the post is accelerated downstream from the impact. However, the post typically will rotate over and above the impacting vehicle with the top of the post rotating upstream and down. Inertial upstream forces on the display assembly relative to the post are not likely to be significant with this rotation opposing the downstream translation. It is probable that the display assembly would remain attached to the post throughout this rotation without experiencing enough stress on the connections to cause separation.

To ensure that the display assembly has no chance of separating from the post upon vehicular impact, and posing a flying hazard, the following structural dynamic analysis is presented.

DISPLAY ASSEMBLY CONNECTION ANALYSIS:

A structural dynamic analysis for the heavier 1820 product follows with these very conservative assumptions:

- vehicle impact velocity is 100 km/h (27.8 m/s), test 3-61
- the post assembly, including attached display assembly and power supply box, only translates downstream with no rotation
- the post is rigid
- the vehicle change in velocity is 1.0 m/s (3.28 fps), only about half that of the call box tests
- the vehicle decelerates from point of impact to its final velocity when the post and upper part of the support base completely slips free from the bottom, in approximately 6"
- the post assembly accelerates from rest to the final vehicle speed in 6"

The vehicle decelerates from 91.2 fps (27.8 m/s) to 87.9 fps (26.8 m/s). The post assembly translates from 0 fps to 87.9 fps in 0.5' with an average acceleration of 240 g:

$$a = (87.9^2 - 0^2) / (2 \times 0.5) = 7726 \text{ ft/s}^2 = 240 \text{ g}$$

The display assembly is attached to this accelerating post with 2 brackets bolted to its aluminum frame, and the brackets strapped to the post with U-bolts. (See figs. 2 and 3 below.) As the post accelerates, the inertial resistance of the display assembly creates an upstream force on these connections of 11.04 kips:

F = 240 g x 46 lbs = 11.04 k = 11,040 lbs

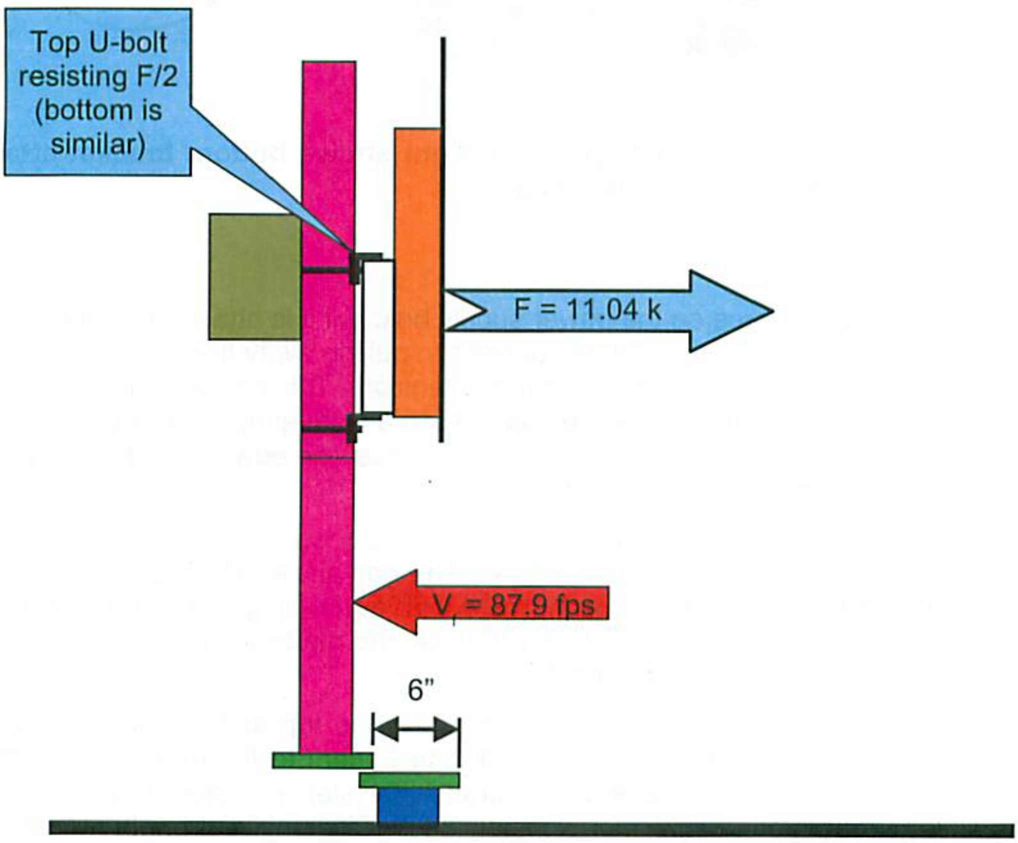


Figure 2: Inertial forces on display assembly connections

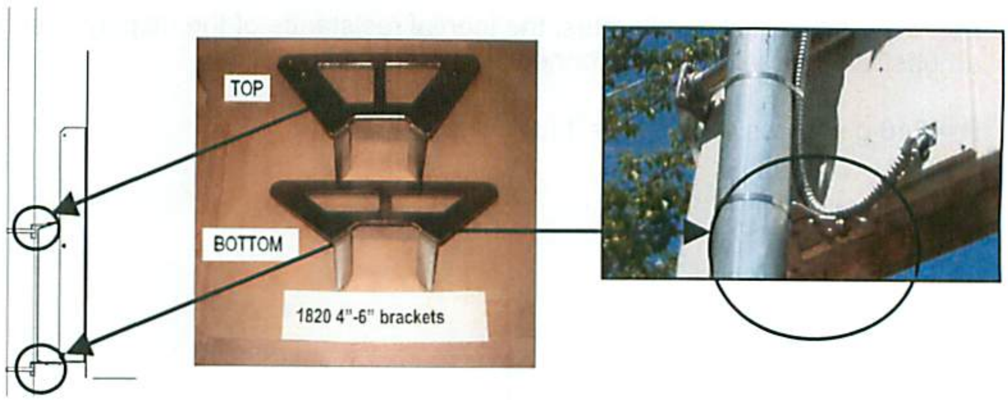


Figure 3: Bracket details. Photograph on right shows bottom bracket attached with steel strap. U-bolts will actually be used.

There is also an inertial force on the power supply box, but it is attached downstream of the post, so the post is pushed into it as opposed to pulling away from it. The connection hardware on it will not be stressed in tension. This hardware is however designed for wind loading and should be quite capable in keeping it attached and relatively stable under a vehicle impact situation. Hence, the power supply box will not be a potential flying hazard.

The brackets are stainless steel grade 304 and the bolts connecting them to the frame are 0.25" dia. 13/8 stainless steel grade 304. The galvanized U-bolts are a minimum 3/8" diameter, made of A307 steel (or of grade with equal or greater tensile strength). The U-bolt bar is a minimum 1.25" wide x 1/8" thick and made of grade A36 steel (or of grade with equal or greater tensile strength).

The inertial force of 11.04 k is distributed equally to the top and bottom connections. Four bolts connect the top bracket and two on the bottom to the frame of the display assembly. The ultimate tensile strength of grade 304 stainless steel is 75 ksi [6]. The ultimate shear strength of steel is approximately 80% of its tensile strength [7], or 60 ksi in this case. Maximum shear stress is in the bottom bolts and is below the estimated shear strength:

$$f_v = ((11.04 / 2) / 2) \text{ k} / 0.049 \text{ in}^2 = 56.3 \text{ ksi} \quad < \quad F_{uv} = (0.8 \times (F_{ut} = 75 \text{ ksi})) = 60 \text{ ksi}$$

Hence the bracket bolts will not fail.

The two bracket tabs that seat against the post are fastened to it by a U-bolt. (see figure 4 below). Each tab is 0.865" wide x 1/8" thick, and must resist the same shear force as a bracket bolt. The maximum shear stress at the top of each tab is below the estimated shear strength:

$f_v = 1.5 \times ((11.04 / 2) / 2)\ k / (0.865 \times 0.125)\ in^2 = 38.3\ ksi < F_{uv} = 60\ ksi$

Hence the brackets will not fail.

The tensile stress on each leg of the U-bolt is less than the 33 psi proof strength in tension of A307 steel [8] :

$f_t = 2.76\ k / 0.11\ in^2 = 25.1\ ksi < 33\ ksi$

The U-bolt legs are fastened against the bar with nuts, inducing shearing forces at each end of the bar.

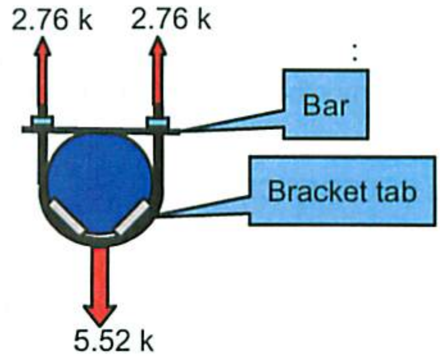


Figure 4: U-bolt forces.

The maximum shear stress through the net width of the bar at the bolt holes is less than the estimated shear strength:

$f_v = 1.5 \times 2.76\ k / ((1.25 - 0.5) \times 0.125)\ in^2 = 44.2\ ksi < F_{uv} = (0.8 \times 58\ ksi^{9}) = 46.4\ ksi$

As the brackets pull the U-bolt bar against the post, the bar will go into flexure and yield. It will tend to wrap around the post and essentially go into hoop tension. The maximum axial tensile stress of the bar at the net section through the bolt holes is less than the yield strength:

$f_t = 2.76\ k / (0.75 \times 0.125)\ in^2 = 29.4\ ksi < F_y = 36\ ksi$ (yield stress of A36 steel).

Hence, the U-bolts will not fail in tension nor shear.

In summary, this analysis investigates the load transfer from the accelerating display assembly to the post. Stresses in all critical components are below failure thresholds, and the connections will remain intact, keeping the display assembly from flying off the post.

CONCLUSION:

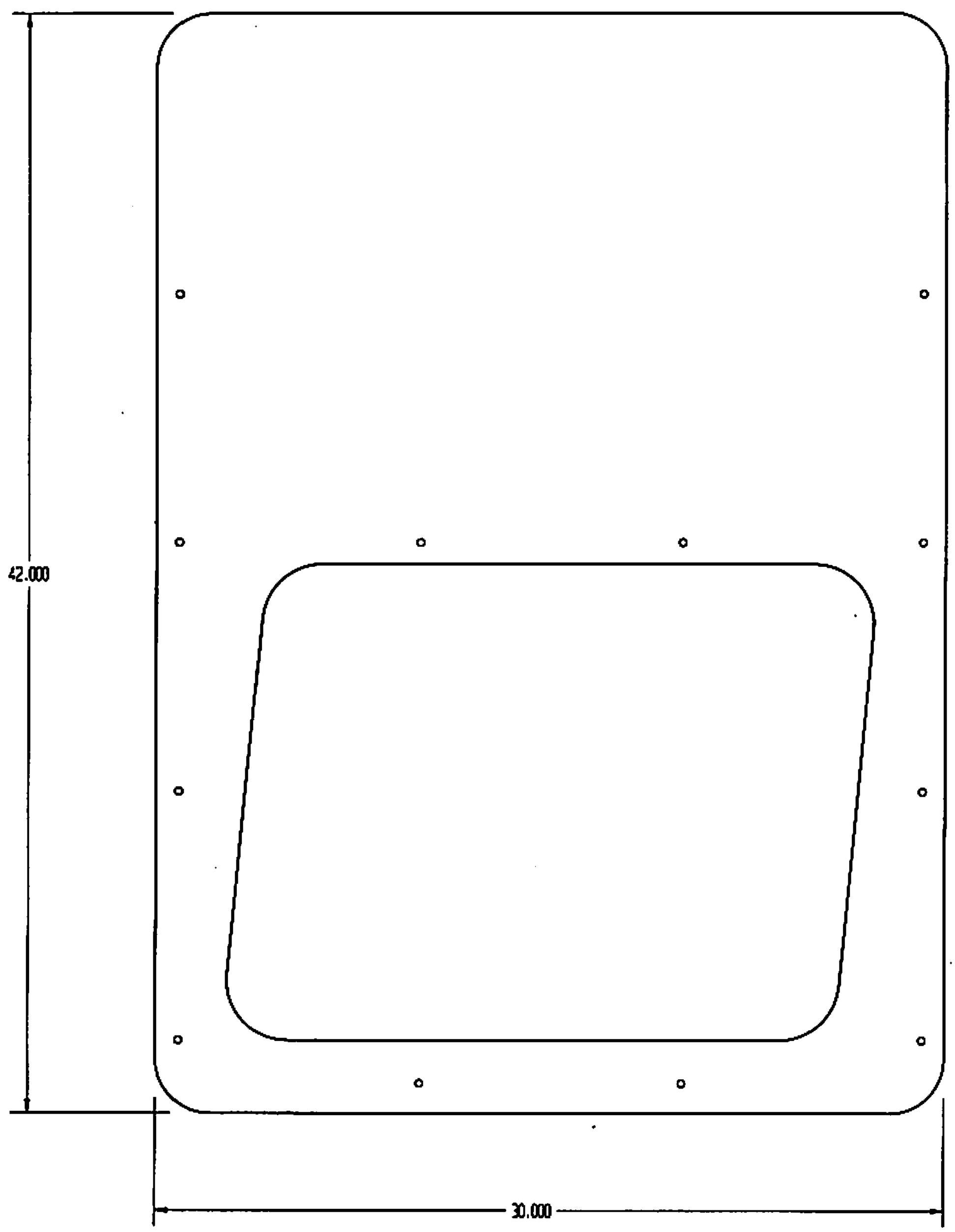
Both Speed Check™ models VSC-1520 and VSC-1820 satisfy the AASHTO and *Report 350* crashworthiness requirements by being comparable to products already meeting those requirements and accepted by the FHWA. A conservative analysis demonstrates the structural integrity of the device connections to the supporting posts during an impact, and completes the evaluation by satisfying the post-impact "flying hazard" criteria. Both products following the aforementioned configurations and specifications should be acceptable for installation in clear recovery zones by the FHWA or any other transportation agency.

REFERENCES:

1. 1520F.renderedviews[1].pdf, IDC
2. 1820F.rendered.views[1].pdf, IDC
3. FHWA acceptance letter, posted on FHWA website, http://safety.fhwa.dot.gov/roadway_dept/road_hardware/breakaway/pdf/ss84.pdf
4. FHWA acceptance letter, posted on FHWA website, http://safety.fhwa.dot.gov/roadway_dept/road_hardware/breakaway/pdf/ss121.pdf
5. FHWA acceptance letter, posted on FHWA website, http://safety.fhwa.dot.gov/roadway_dept/road_hardware/breakaway/pdf/ss135.pdf
6. *Mark's Standard Handbook for Mechanical Engineers*, 11th edition, table 6.2.12
7. *Machine Design: An Integrated Approach*, Norton, 3rd edition, equation 2.5b
8. *Machinery's Handbook*, 27th edition, page 1509.
9. *Mark's Handbook*, table 6.2.6, minimum tensile strength of A36 steel

REGISTERED PROFESSIONAL ENGINEER
GARY P. GAUTHIER
No. C 050889
Exp. 9/30/2009
CIVIL
STATE OF CALIFORNIA

Gary P. Gauthier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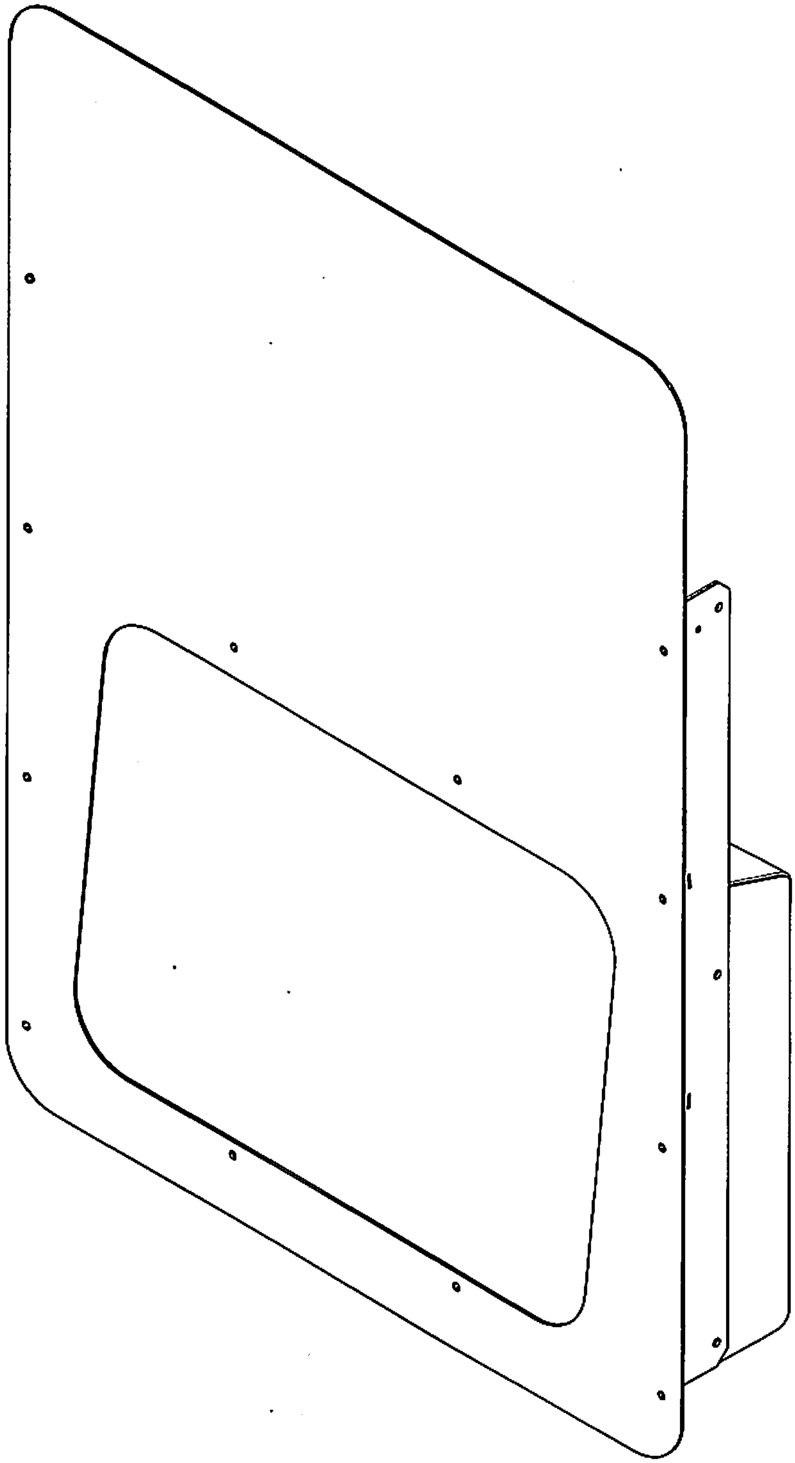

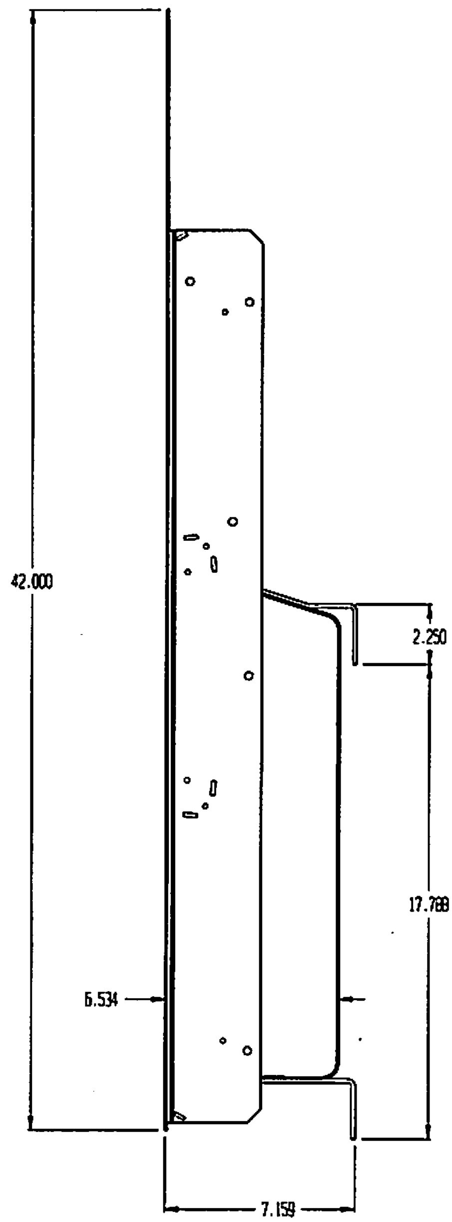
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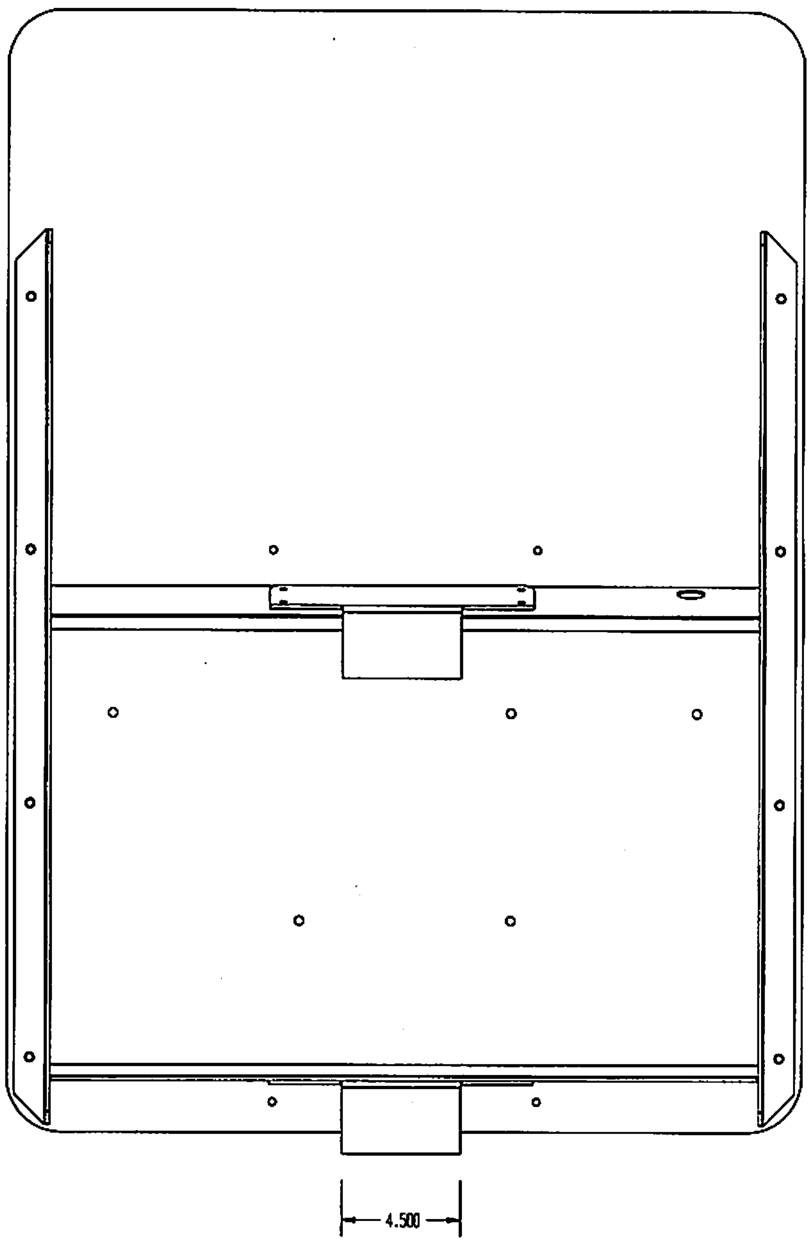
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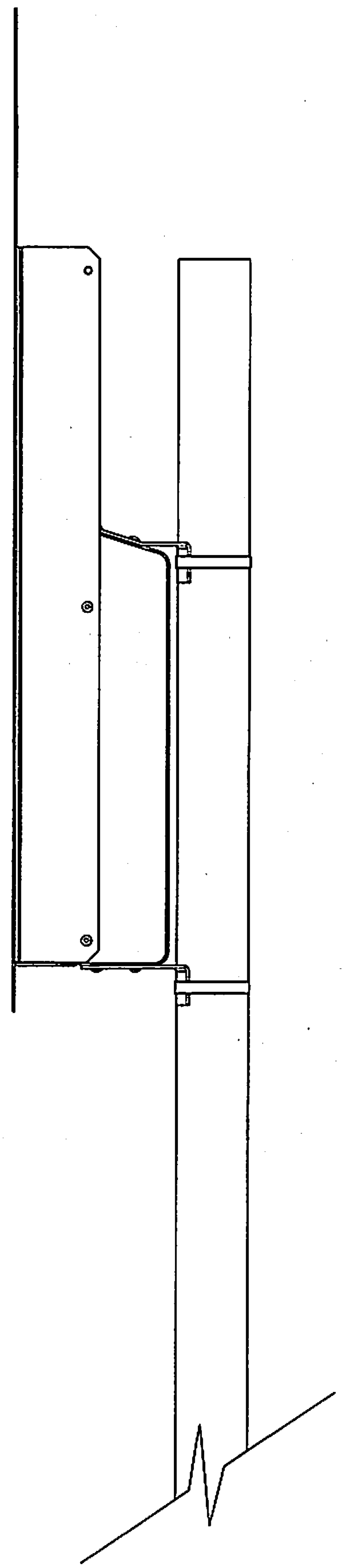
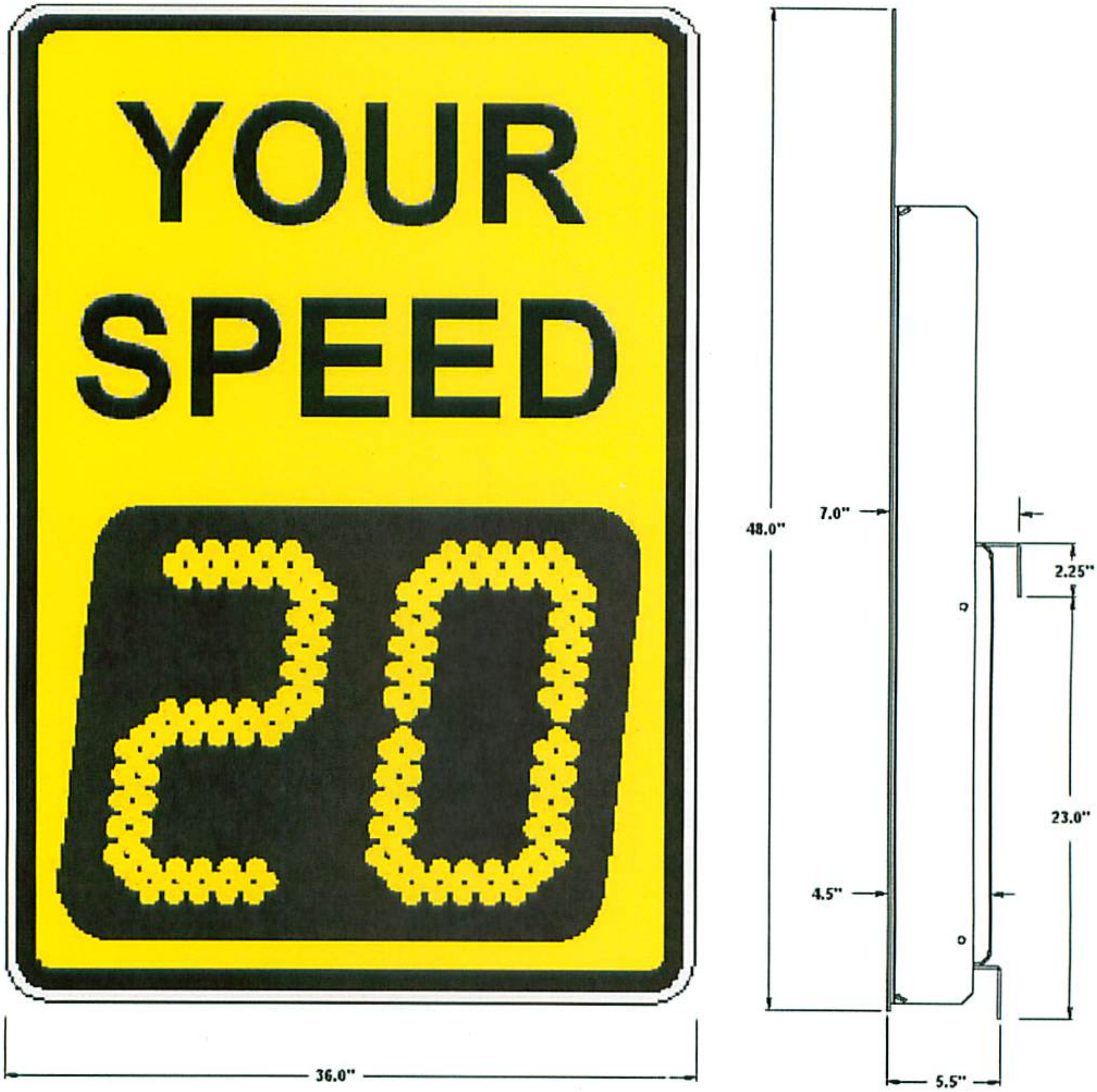
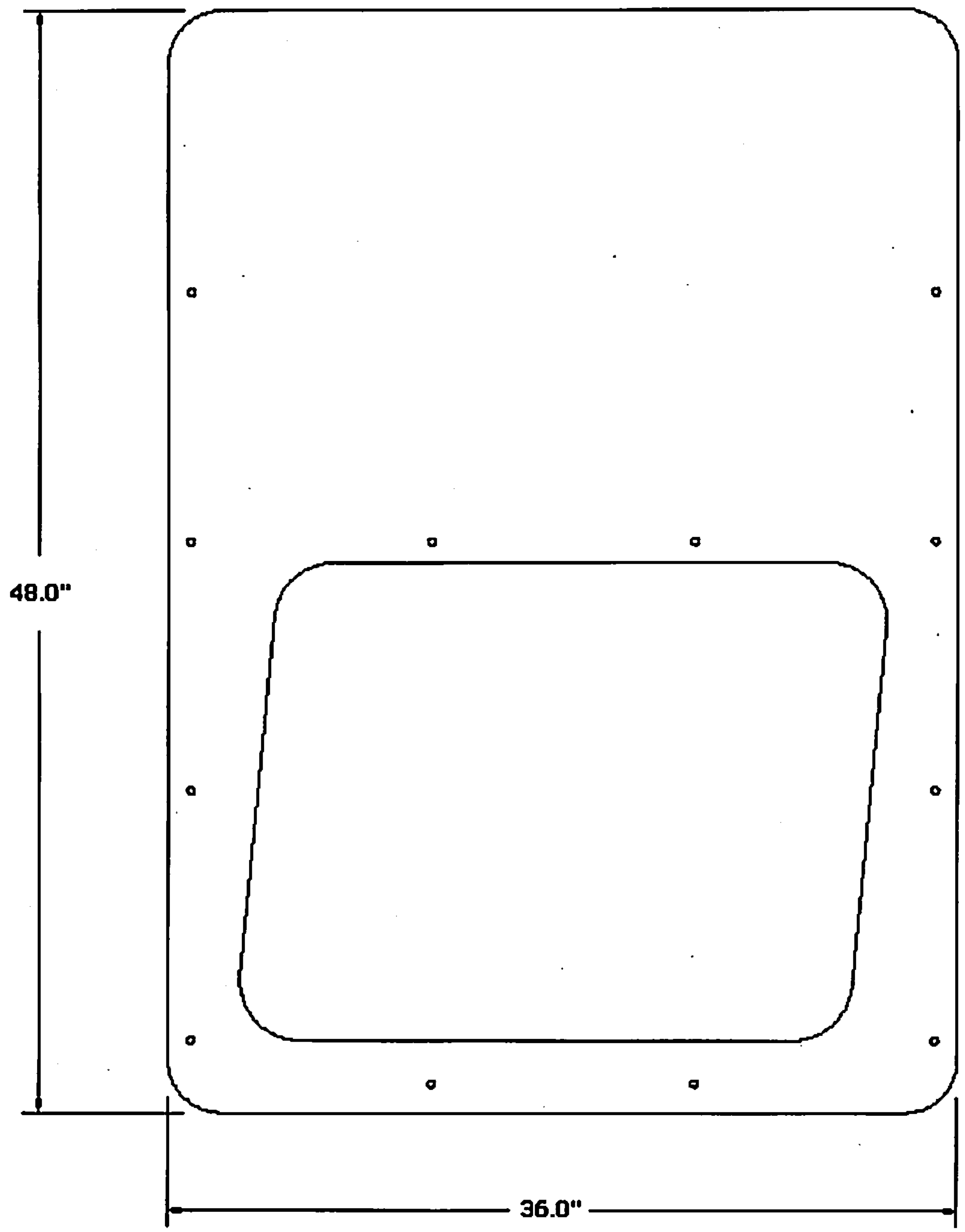


VSC-1820 Fixed-Mount Speed Display

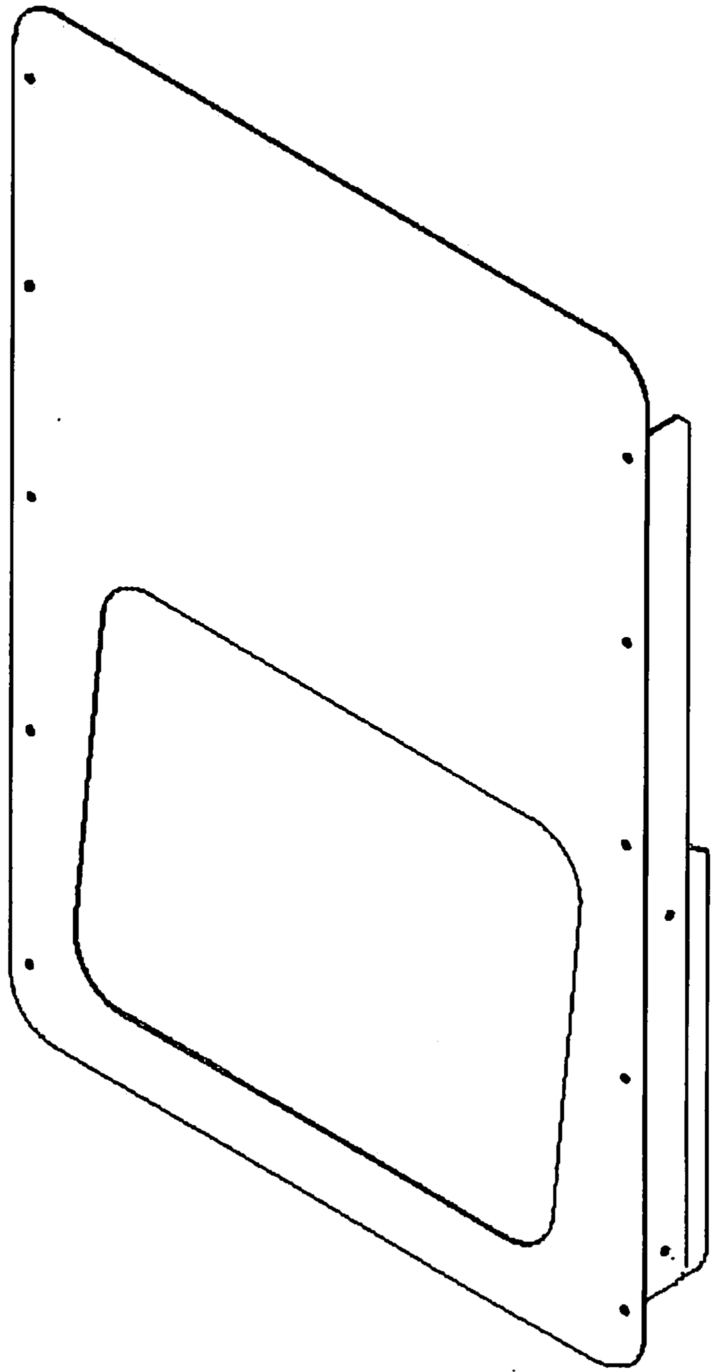


Diamond-grade sign sheeting
Amber LEDs per spec
Mounting detail included in this document
Brackets are 1/8" stainless steel
Stainless steel strapping or stainless steel U-bolts used for attachment to pole

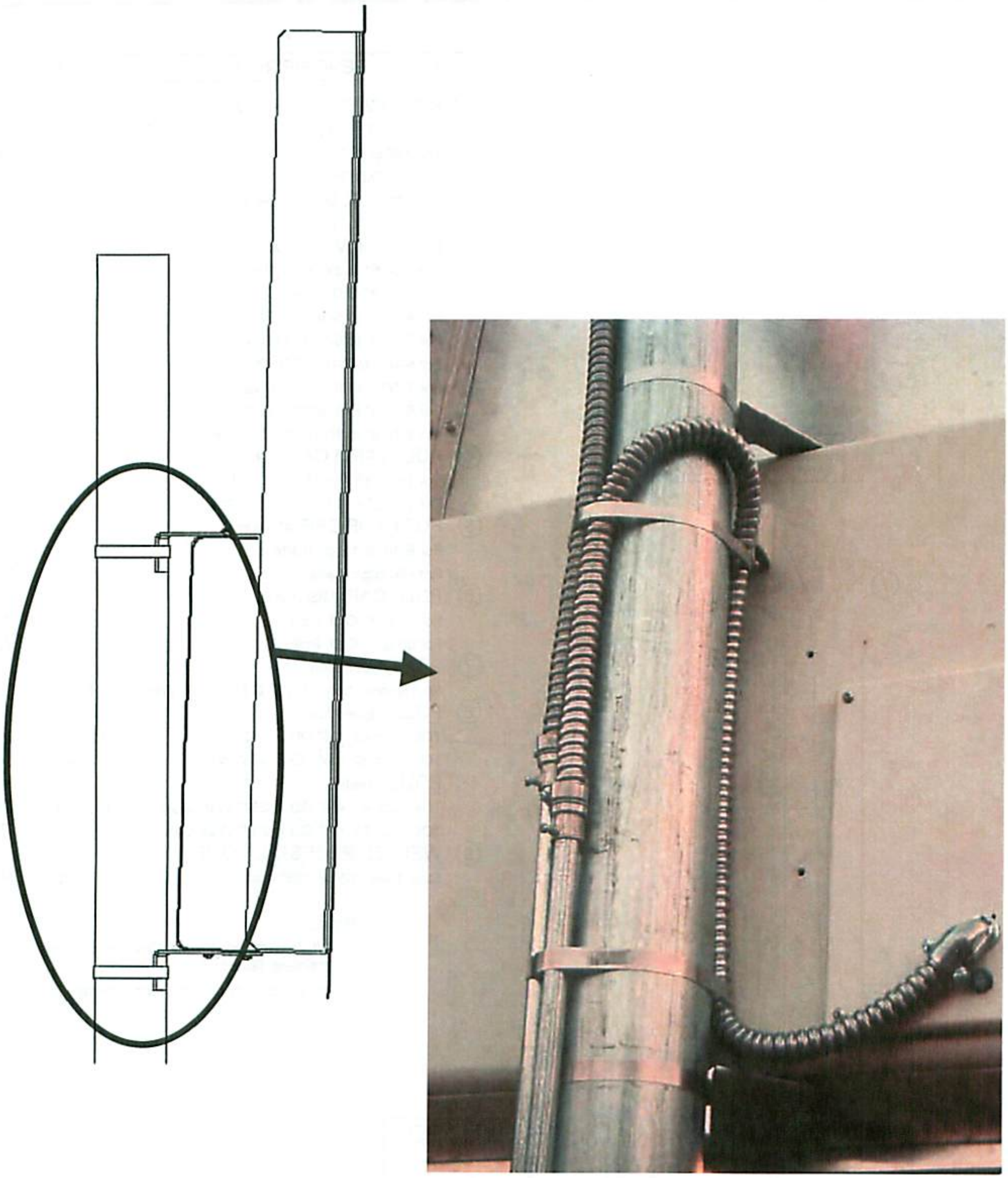
VSC-1820 Dimensions



VSC-1820 Overall View



VSC-1820 Pole Mounting View with Strapping; U-Bolts mounting is similar
Dimensions and material shown on Page 1



POLES AND BASES
Pedestal Poles & Caps

① ② ③

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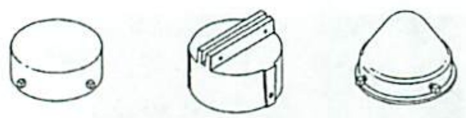
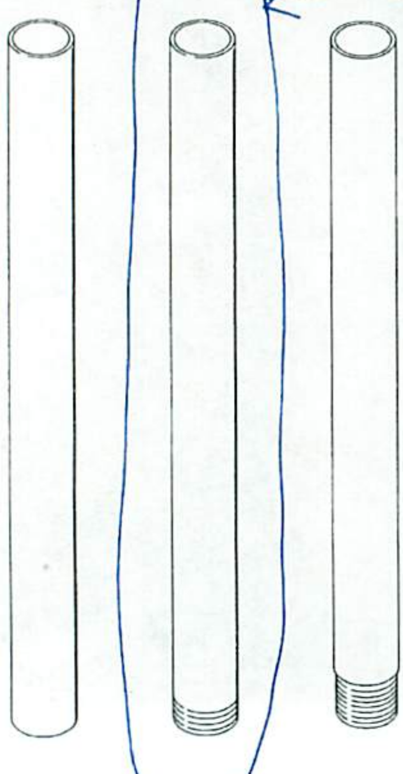


ITEM 1-5 OPTIONS
PAINT

⑦ ⑧ ⑨



ITEM	DESCRIPTION	WEIGHT	PART NO.
①	POLE CAP, Acorn Type, Alum:		
	For 3" O.D. Pole		PB-5403
	For 3½" O.D. Pole		PB-5407
	For 4½" O.D. Pole	1.4 lbs.	PB-5401
②	POLE CAP, Dome Type, Alum:		
	For 4½" O.D. Pole	1.3 lbs.	PB-5402
③	POLE / ARM CAP, Alum:		
	For 2-5/16" to 3½" O.D. Pole		AP-0101
	For 3" to 4" O.D. Pole		AP-0102
	For 4-3/16" to 5-3/16" O.D. Pole		AP-0103
	For 5-3/16" to 6-3/16" O.D. Pole		AP-0104
	For 6-1/8" to 7-1/8" O.D. Pole		AP-0105
	For 7-3/16" to 8¼" O.D. Pole		AP-0106
	For 8-3/16" to 9-3/16" O.D. Pole		AP-0107
	For 9-7/16" to 10-7/16" O.D. Pole		AP-0108
④	POLE / ARM CAP, Alum:		
	For 10-11/16"" to 11-11/16" O.D. Pole		AP-0109
	For 11-7/8" to 12-11/16" O.D. Pole		AP-0110
⑤	POST TOP CAP, 4", Alum:		
	For Extruded Sign Blade		SH-1608
	For Flat Sign Blade		SH-1615
⑥	POLE CAP, ABS Plastic:		
	For up to 4" O.D. Pole		AP-0805
	For up to 5" O.D. Pole		AP-0806
⑦	POLE, Spun Alum:		
	No Threads, Sch 40, 4½" O.D. x .237" Wall	3.8 lbs	PB-5101
⑧	POLE, Spun Alum:		
	TOE, Sch 40, 4½" OD x .237" Wall	3.8 lb/ft	PB-5100
	TOE, Sch 80, 4½" OD x .438" Wall	5.2 lb/ft	PB-5102
	POLE, Steel		
	TOE, Sch 40, 4½" OD x .237" Wall, Steel	11.5 lb/ft	PB-5201
	TOE, Sch 40, 4½" OD x .237" Wall, Galv	11.5 lb/ft	PB-5200
⑨	WELDED PEDESTAL POLE		
	Steel Tube, 4½" x .125" Wall	5.9 lb/ft	PB-5204

Notes:

1. All assemblies are supplied standard with stainless fasteners.
3. Please specify options when ordering.

ITEM 7-9 OPTIONS
LENGTH
PAINT

POLES AND BASES
Pedestal Bases

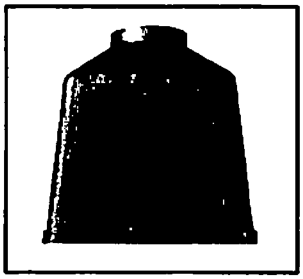
pelco PELCO PRODUCTS INC

ITEM	DESCRIPTION	WEIGHT	PART NO.
	SQUARE BASE ASSEMBLY:		
①	Aluminum	22.5 lbs.	PB-5335
	Aluminum, Heat Treated	22.5 lbs.	PB-5336
②	Alum w/ Steel Coupling	23.5 lbs.	PB-5341
③	Alum w/ Slip Fit	22.5 lbs.	PB-5339
④	Iron	76.0 lbs.	PB-5308
	OCTAGONAL BASE ASSEMBLY:		
⑤	Alum w/ Alum door	25.0 lbs.	PB-5349
⑥	Alum w/ Steel Coupling and Alum Door	27.0 lbs.	PB-5351
⑦	Alum w/ Slip Fit and Alum Door	25.0 lbs.	PB-5350
⑧	Iron w/ Iron door	78.0 lbs.	PB-5310

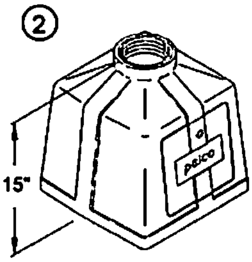
Notes:

1. AASHTO Certified Square Aluminum Base: All Aluminum square bases above are available with AASHTO Certifications and FHWA approval. Please specify by adding the Certification Part No. C-1001 in addition to the base part number.
2. All assemblies are supplied standard with stainless fasteners.
3. Please specify options when ordering.

①

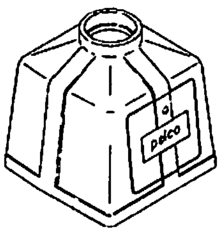


②



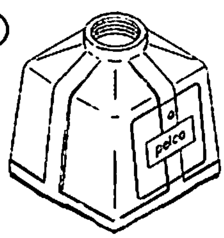
ITEM 1 & 2 OPTIONS
DOOR: Alum, Plastic, or Blank Plastic
SETSCREWS IN COLLAR: (1) 3/8" Hex Hd Bolt (3) 3/8" Soc Hd Setscrews
GROUNDING LUG
PAINT

③

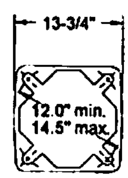


OPTIONS
DOOR: Alum, Plastic, or Blank Plastic
GROUNDING LUG
PAINT

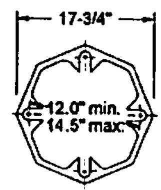
④



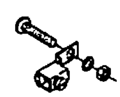
OPTIONS
SETSCREWS IN COLLAR: (1) 3/8" Hex Hd Bolt (3) 3/8" Soc Hd Setscrews
GROUNDING LUG
GALVANIZE
PAINT



Square Base

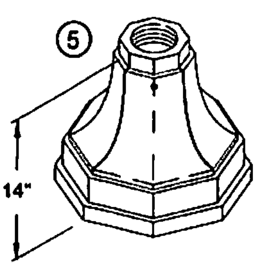


Octagonal Base

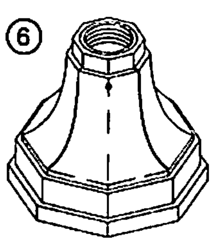


Grounding Lug

⑤

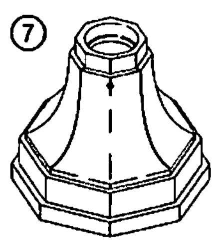


⑥



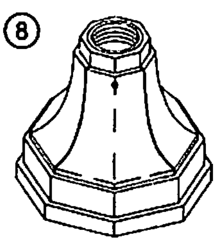
ITEM 5 & 6 OPTIONS
SETSCREWS IN COLLAR: (1) 3/8" Hex Hd Bolt (3) 3/8" Soc Hd Setscrews
GROUNDING LUG
PAINT

⑦



OPTIONS
GROUNDING LUG
PAINT

⑧



OPTIONS
SETSCREWS IN COLLAR: (1) 3/8" Hex Hd Bolt (3) 3/8" Soc Hd Setscrews
GROUNDING LUG
GALVANIZE
PAINT